United States Department of Agriculture

Natural Resources Conservation Service

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

Soil Survey of Ida County, Iowa

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How To Use This Soil Survey

General Soil Map

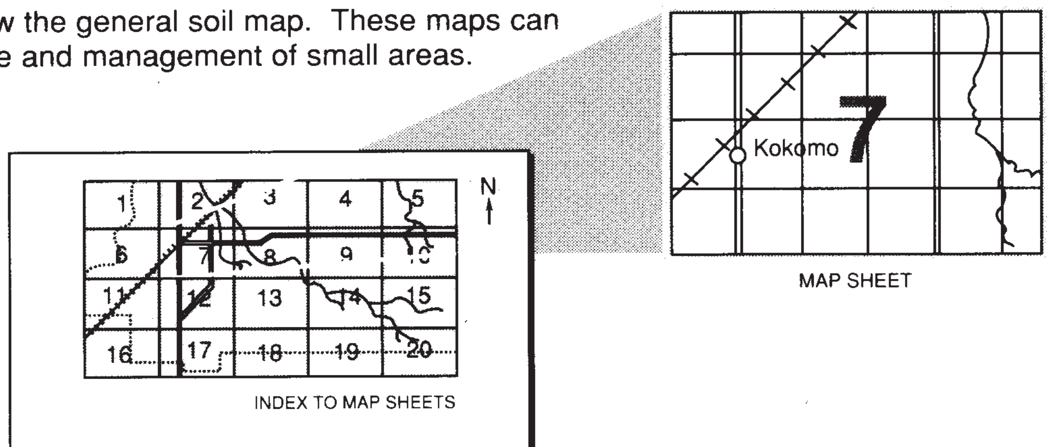
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

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

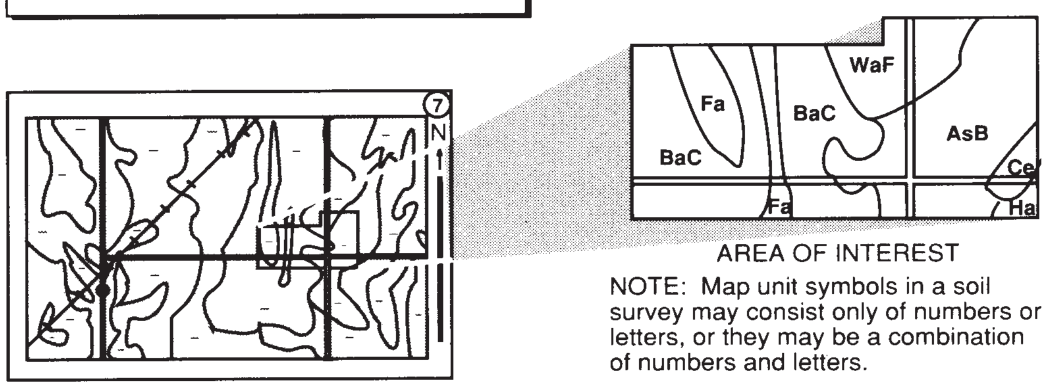
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

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

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

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

Major fieldwork for this soil survey was completed in the period 1984-1988. Soil names and descriptions were approved in 1989. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the Natural Resources Conservation Service; the Iowa Agriculture and Home Economics Experiment Station and the Cooperative Extension Service, Iowa State University; and the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship. It is part of the technical assistance furnished to the Ida County Soil Conservation District. Funds appropriated by Ida County were used to defray part of the cost of the survey.

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

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Cover: Row crops and hay in an area of Ida and Monona soils in the Crawford Creek watershed in Ida County.

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Issued January 1998

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Summary of Tables

Preface

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

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

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

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

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Soil Survey of
Ida County, Iowa

By Wayne N. Dankert, Natural Resources Conservation Service

Fieldwork by Craig R. Busskohl, Dale J. Ceolla, Wayne N. Dankert, David L. Reeves, and Jeff C. Talsky, Natural Resources Conservation Service, and Max Sherwood, private contractor

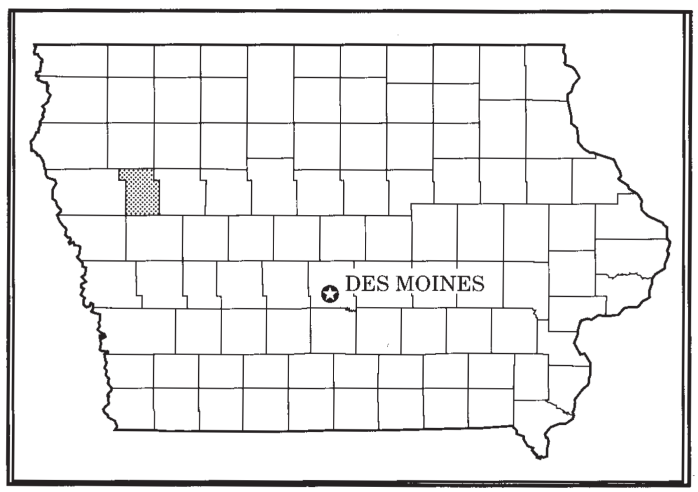
United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
the Iowa Agriculture and Home Economics Experiment Station and the Cooperative Extension Service, Iowa State University, and the Division of Soil Conservation, Iowa Department of Agriculture and Land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

IDA COUNTY is in northwestern Iowa (fig. 1). The county has a total land area of 276,400 acres, or about 431 square miles. Ida Grove, the county seat, is in the south-central part of the county.

In 1980, the population of Ida County was about 8,910 and that of Ida Grove was about 2,285. Other communities in the county include Holstein, which had a population of about 1,480 in 1980; Battle Creek, population 920; Galva, population 420; and Arthur, population 290.

The landscape in Ida County is predominantly uplands. The surface drainage pattern is well defined. Most of the upland areas are gently rolling to very steep, but a small area, mainly in the northern part of the county, is nearly level to undulating. The major valleys in the county include those of the Maple, Soldier, and Little Sioux Rivers. These valleys have distinct loess-covered benches and a few lower level alluvial terraces. The smaller valleys, in which the streams flow into the Maple River from the east, also have distinct loess-covered benches. The highest elevation in the county is about 1,530 feet above sea level. It occurs on a ridgetop in section 16, T. 86 N., R. 40 W. The lowest elevation is about 1,115 feet, at the point where the Little Sioux River leaves the county.

Farming and manufacturing are the main enterprises in the county. Corn and soybeans are the main crops. Manufacturing is mainly in the vicinity of Ida Grove and Holstein.



Ida Co-IA (locator map)

Figure 1.—Location of Ida County in Iowa.

This survey updates the soil survey of Ida County published in 1939 (Benton and Geib, 1939). It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section provides information on the history and development and the climate of Ida County. It also describes transportation facilities.

History and Development

Native Americans occupied the area that is now Ida County for thousands of years. The earliest people were hunters. The Late Woodland Culture gathered food and cultivated a few crops in addition to hunting. By A.D. 900 to 1300, the descendants of these people, the Great Oasis Culture, cultivated corn and sunflowers and gathered many other seeds. They also hunted. Their contemporaries, the Mill Creek Culture, also utilized many resources through farming, hunting, trapping, and fishing. By A.D. 1400, the Mill Creek and Great Oasis people had left the area. They were replaced by the Oneota Culture and later by the historic Ioway people (Anderson, 1975).

Ida County was one of 49 counties divided from Indian treaty lands by the Third Iowa General Assembly in 1851. The name Ida originated with the land surveyors. Indian campfires on the hills northwest of the present location of Ida Grove reminded the surveyors of Mt. Ida in Greece. Ida County was separated from Woodbury County by the State legislature on January 15, 1857 (Moorehead, 1906).

The first permanent residents of Ida County were the Ebenezer Comstock and John H. Moorehead families in 1856. The population of the area increased slowly until the Fort Dodge & Sioux City Railroad was built in 1877. In 1870, the population of Ida County was 226. It was 794 in 1875 and 4,382 in 1880. The early settlers were mainly from states east of Iowa, but later many foreign-born people settled in the county. Swedish-born settlers were dominant in the southwestern part of the county, Irish-born in the east-central part, and Danish people in Battle and Maple Townships. German-born people settled in various parts of the county (Benton and Geib, 1939; Moorehead, 1906).

The total acreage of farmland in Ida County has remained fairly constant since the early days of settlement. In recent years, the size of farms in the county has been increasing and the number of farms has been decreasing. In 1935, the county had 1,453 farms (Benton and Geib, 1939). There were 990 farms in 1976 and 820 farms in 1986. The average farm size was 188 acres in 1935, 278 acres in 1976, and 327 acres in 1986 (Skow, 1987).

About 44 percent of the land in Ida County has slopes of 5 percent or less. Most of the soils on these slopes are well suited to row crops and are commonly used for the production of corn and soybeans. On some of these soils, however, artificial drainage or flood control is difficult or costly. A few of the soils are droughty. Corn is the main crop in the county, but the acreage of soybeans has increased in recent years. In 1976, soybeans were grown on about 50,000 acres. By 1986, about 77,000 acres was used for soybeans. In 1986, corn was grown on about 119,000 acres, hay on 18,000 acres, and oats on 23,000 acres (Skow, 1987).

The majority of the corn and soybeans is sold to shippers, but some of these crops are used as livestock feed. In recent years, the number of grain-fed cattle has decreased significantly and the number of hogs farrowed, raised, and sold has slightly decreased. In 1986, 28,000 fed cattle and 174,000 fed hogs were sold. The number of beef cattle was 12,000, the number of milk cows was 1,300, and the total number of hogs and pigs was 95,000 (Skow, 1987).

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Ida Grove in the period 1961 to 1990. 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 20 degrees F and the average daily minimum temperature is 10 degrees. The lowest temperature on record, which occurred at Ida Grove on January 19, 1970, is -32 degrees. In summer, the average temperature is 72 degrees and the average daily maximum temperature is 84 degrees. The highest recorded temperature, which occurred at Ida Grove on June 8, 1985, is 105 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 31 inches. Of this, 23 inches, or about 74 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 11.01 inches at Ida Grove on August 31, 1962. Thunderstorms occur on about 44 days each year, and most occur in June.

The average seasonal snowfall is 34 inches. The greatest snow depth at any one time during the period of record was 23 inches. On the average, 56 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 59 percent. Humidity is higher at night, and the average at dawn is about 81 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13.2 miles per hour, in April.

Transportation Facilities

Ida County is served by two Federal highways, one State highway, and numerous all-weather surfaced county roads. Gravel-surfaced county roads follow most section lines. The county is served by one railroad company. Several trucking companies in the county provide local and long-distance freight transportation.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

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

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

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

General Soil Map Units

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

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

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

Soil Descriptions

1. Monona-Marshall Association

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

This association consists of gently sloping to strongly sloping soils on upland ridgetops and moderately sloping to steep soils on dissected upland side slopes. Slopes range from 2 to 30 percent.

This association makes up about 33 percent of the county. It is about 57 percent Monona soils, 21 percent Marshall and similar soils, and 22 percent soils of minor extent (fig. 2).

Monona soils are moderately sloping to steep and are on convex ridgetops and side slopes in the uplands. Marshall soils are gently sloping to strongly sloping and are on convex ridgetops in the uplands.

Typically, the surface layer of the Monona soils is very dark brown silty clay loam about 6 inches thick. The subsurface layer also is very dark brown silty clay loam. It is about 4 inches thick. The subsoil is about 40 inches thick. It is friable. In sequence downward, it is very dark grayish brown and dark brown silty clay loam; brown silty clay loam; brown silt loam; and yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam.

Typically, the surface layer of the Marshall soils is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is friable. In sequence downward, it is brown and dark brown silty clay loam; brown silty clay loam; yellowish brown silty clay loam; and yellowish brown, mottled silt loam.

Of minor extent in this association are Exira, Ida, Judson, and Kennebec soils. Exira, Ida, and Judson soils are well drained. Exira and Ida soils formed in loess. They are on upland side slopes and ridgetops. Ida soils are calcareous. Judson soils formed in local alluvium. They are on foot slopes and alluvial fans. Kennebec soils are moderately well drained and are on flood plains and in upland drainageways. They formed in alluvium.

Corn and soybeans are grown extensively on the soils in this association. Some areas of the moderately sloping and strongly sloping soils and many areas of the moderately steep and steep soils are used for pasture or hayland.

The gently sloping soils in this association are well suited to row crops. The moderately sloping and strongly sloping soils are suited to row crops in rotation with grasses and legumes. The moderately steep soils are moderately suited to row crops. Some of the moderately steep and steep soils are moderately eroded and severely eroded. The soils in these areas generally contain less organic matter than the less sloping soils. In some places the moderately sloping and strongly sloping soils are also severely eroded. Higher fertilizer application rates and more intensive management are needed in severely eroded areas than in the less eroded areas. The main management concerns are controlling runoff and erosion and maintaining tilth and fertility.

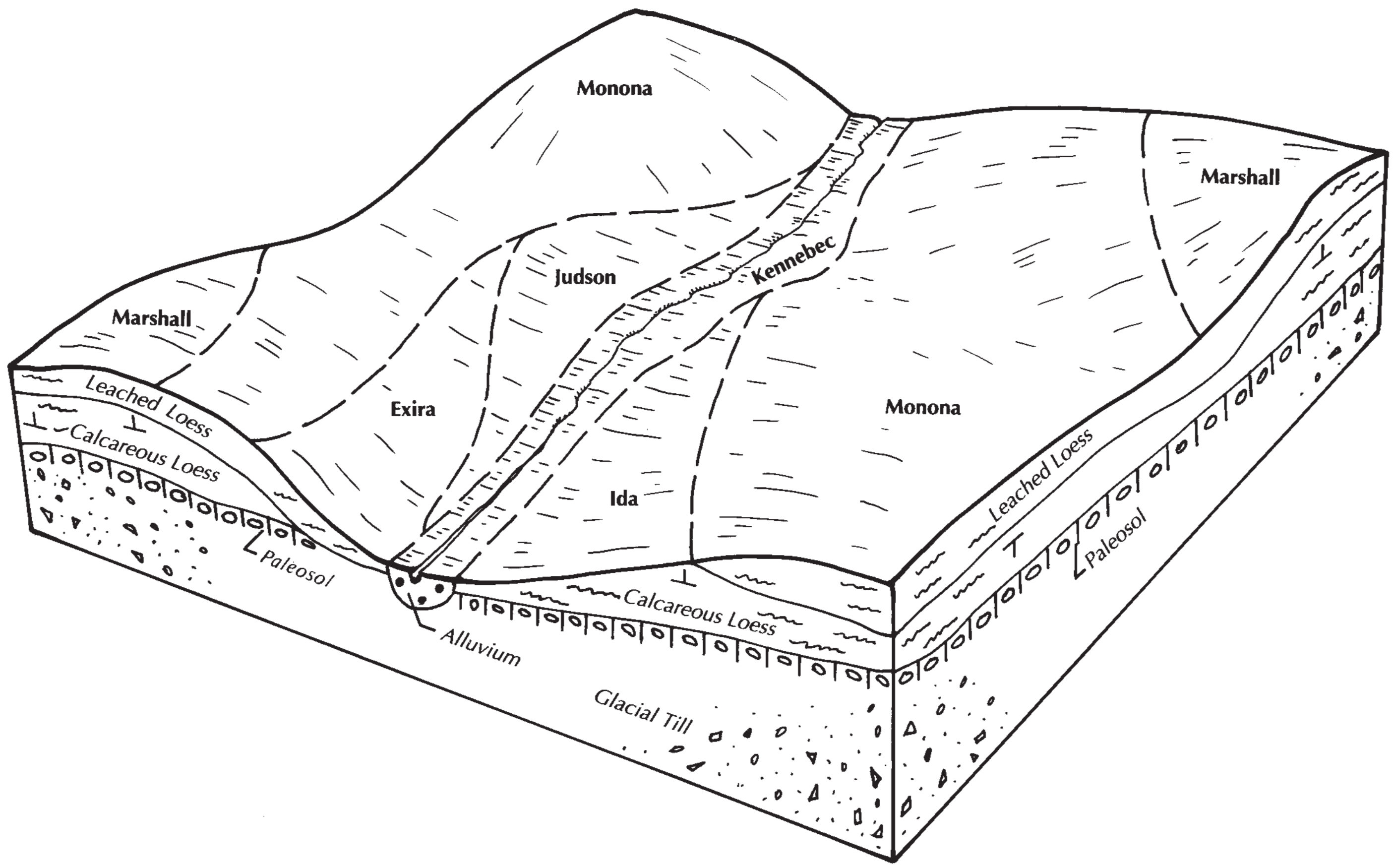


Figure 2.—Typical pattern of soils and parent material in the Monona-Marshall association.

2. Marshall-Exira Association

Gently sloping to moderately steep, well drained, silty soils that formed in loess; on uplands

This association consists of gently sloping to strongly sloping soils on upland ridgetops and moderately sloping to moderately steep soils on dissected side slopes. Slopes range from 2 to 20 percent.

This association makes up about 11 percent of the county. It is about 49 percent Marshall soils, 22 percent Exira soils, and 29 percent soils of minor extent (fig. 3).

Marshall soils are gently sloping to strongly sloping and are on convex ridgetops and side slopes in the uplands. Exira soils are moderately sloping to moderately steep and are on side slopes in the uplands.

Typically, the surface layer of the Marshall soils is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. It is friable. In sequence downward, it is brown and dark brown silty clay loam; brown silty clay loam; yellowish brown silty clay loam; and yellowish brown, mottled silt loam.

Typically, the surface layer of the Exira soils is very dark grayish brown silty clay loam about 7 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is about 31 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and grayish brown silt loam.

Of minor extent in this association are Ackmore, Colo, Judson, and Kennebec soils. The somewhat poorly drained Ackmore and poorly drained Colo soils and the moderately well drained Kennebec soils are on flood plains and in upland drainageways. They formed in alluvium. Judson soils are well drained and are on foot slopes and alluvial fans and in upland drainageways. They formed in local alluvium.

Corn and soybeans are grown extensively on the

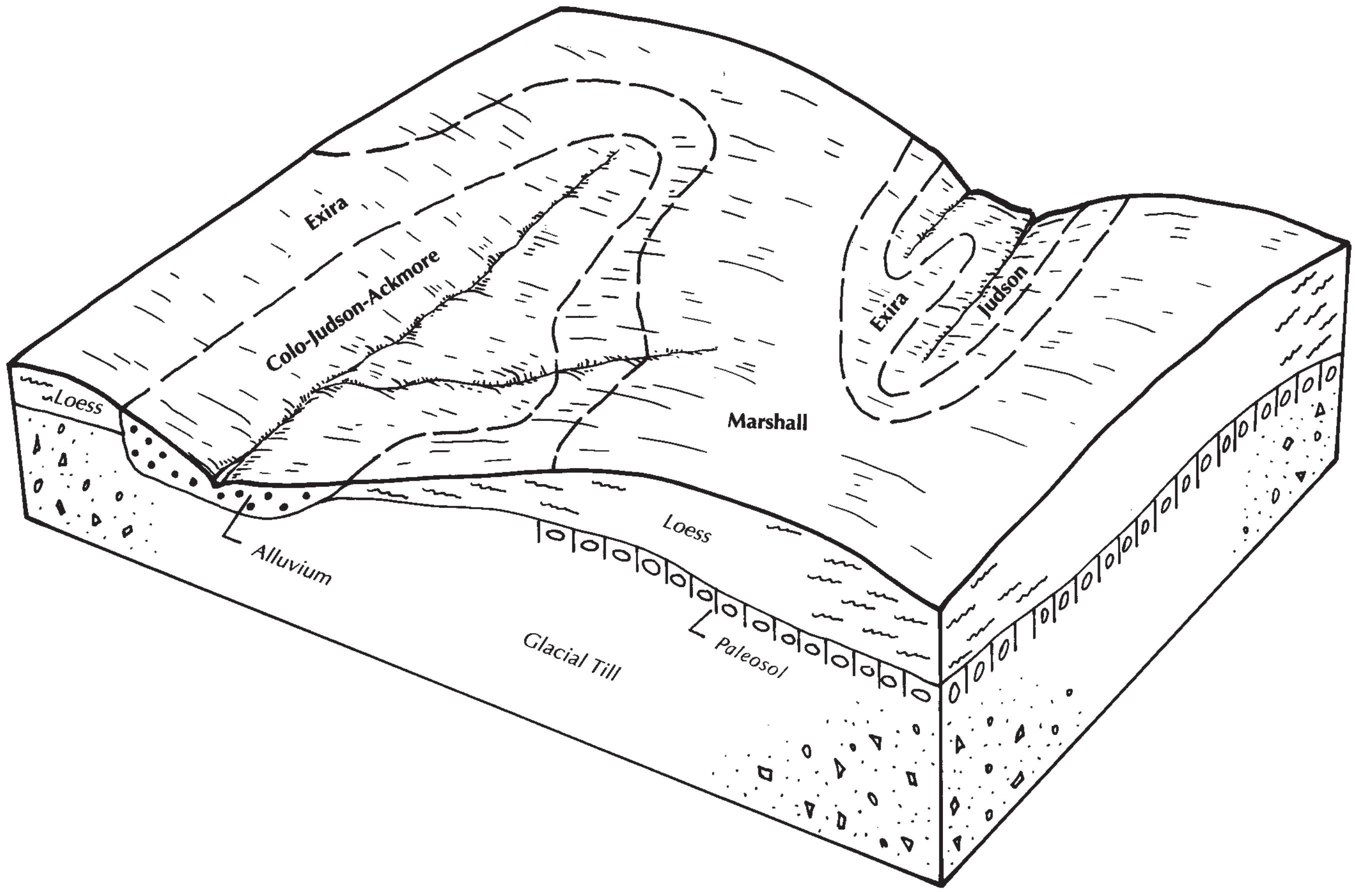


Figure 3.—Typical pattern of soils and parent material in the Marshall-Exira association.

soils in this association. Some areas of the moderately sloping and strongly sloping soils and many areas of the moderately steep soils are used for pasture or hayland. The gently sloping soils in this association are well suited to row crops. The moderately sloping and strongly sloping soils are suited to row crops in rotation with grasses and legumes. The moderately steep soils are moderately suited to row crops in rotation with grasses and legumes. In most places the strongly sloping and moderately steep soils are more eroded and contain less organic matter than the less sloping soils. The main management concerns are controlling runoff and erosion and maintaining tilth and fertility.

3. Kennebec-Colo-Galva Association

Nearly level to strongly sloping, moderately well drained, poorly drained, and well drained, silty soils that formed in alluvium on flood plains and in loess on high benches

This association consists of nearly level to gently sloping soils on intermediate and low flood plains and nearly level to strongly sloping soils on high benches. The intermediate flood plains are subject to rare flooding, and the low flood plains are subject to occasional flooding. Runoff from the adjacent uplands crosses the high benches in places. Slopes range from 0 to 14 percent.

This association makes up about 8 percent of the county. It is about 39 percent Kennebec soils, 28 percent Colo soils, 18 percent Galva soils, and 15 percent soils of minor extent (fig. 4).

Kennebec and Colo soils are nearly level to gently sloping. Kennebec soils are moderately well drained and are on flood plains, low stream terraces, alluvial fans, and foot slopes. Colo soils are poorly drained and are on flood plains. Galva soils are nearly level to strongly sloping. They are well drained and are on stream benches.

Typically, the surface layer of the Kennebec soils is very dark gray silty clay loam about 7 inches thick. The subsurface layer is friable silty clay loam about 43 inches thick. The upper part is very dark gray, and the

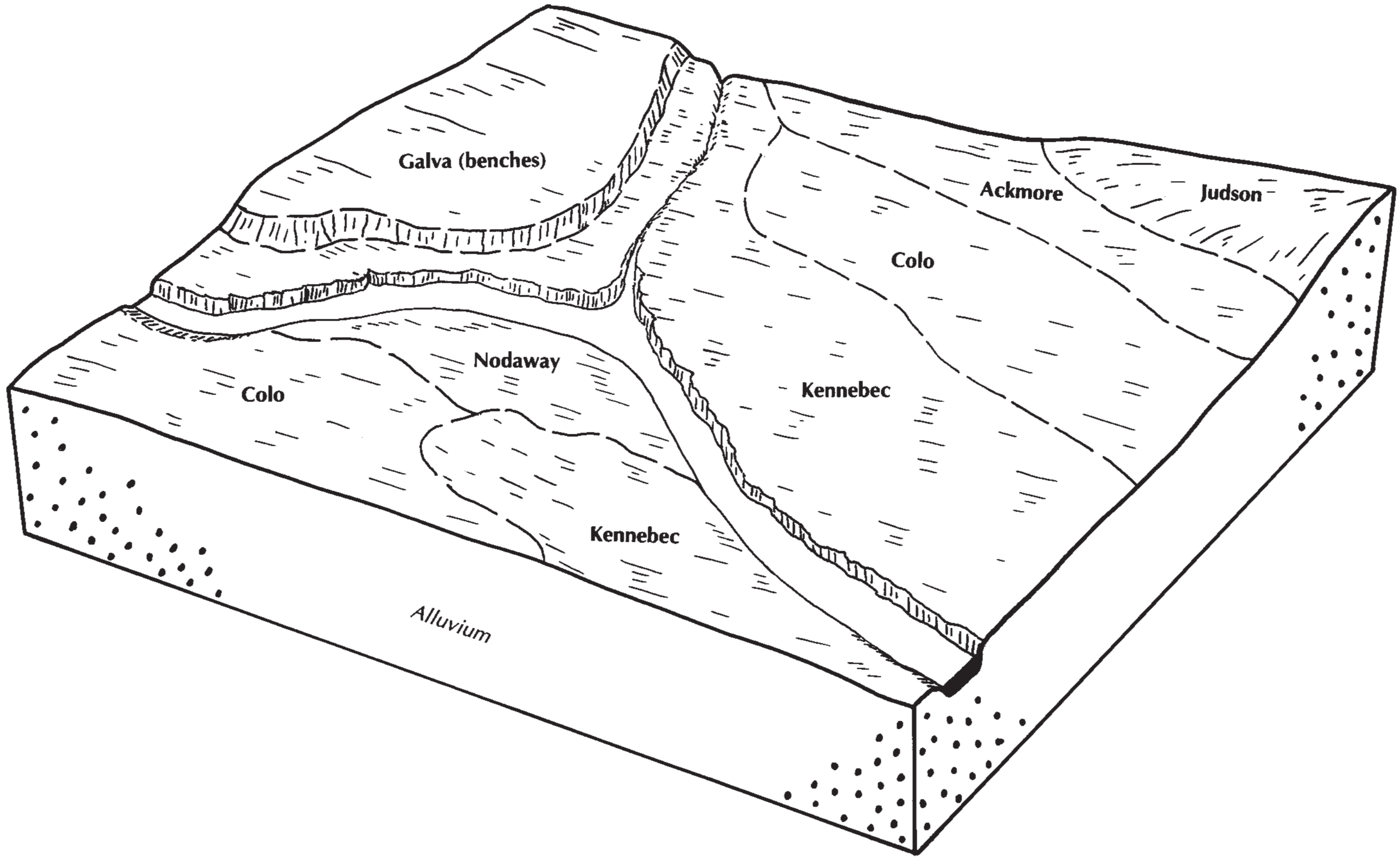


Figure 4.—Typical pattern of soils and parent material in the Kennebec-Colo-Galva association.

lower part is very dark grayish brown. The substratum to a depth of 60 inches or more is very dark grayish brown and dark grayish brown, mottled silty clay loam.

Typically, the surface layer of the Colo soils is black silty clay loam about 8 inches thick. The subsurface layer also is black silty clay loam. It is about 28 inches thick. The subsoil extends to a depth of 60 inches or more. It is friable silty clay loam. The upper part is black and very dark gray, the next part is very dark gray, and the lower part is very dark gray and dark gray and is mottled.

Typically, the surface layer of the Galva soils is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 49 inches thick. It is friable. The upper part is dark brown and brown silty clay loam, the next part is brown silty clay loam, and the lower part is yellowish brown silt loam and is mottled. The substratum to a depth of 60 inches or more is mottled yellowish brown and gray silt loam.

Of minor extent in this association are Ackmore, Judson, and Nodaway soils. Ackmore and Judson soils formed in alluvium. Ackmore soils are somewhat poorly drained and are on flood plains. Judson soils are well drained and are on foot slopes and alluvial fans. Nodaway soils are moderately well drained and are on flood plains. They formed in recent stratified alluvium.

Corn and soybeans are grown extensively on the soils in this association. Some of the soils adjacent to stream channels are used for pasture. The well drained and moderately well drained, nearly level to gently sloping soils are suited to row crops in rotation with grasses and legumes. The poorly drained soils are well suited to row crops if they are adequately drained. The main management concerns are maintaining drainage and flood control measures on the flood plains, controlling runoff and erosion on the gently sloping and moderately sloping soils on benches, and maintaining tilth and fertility.

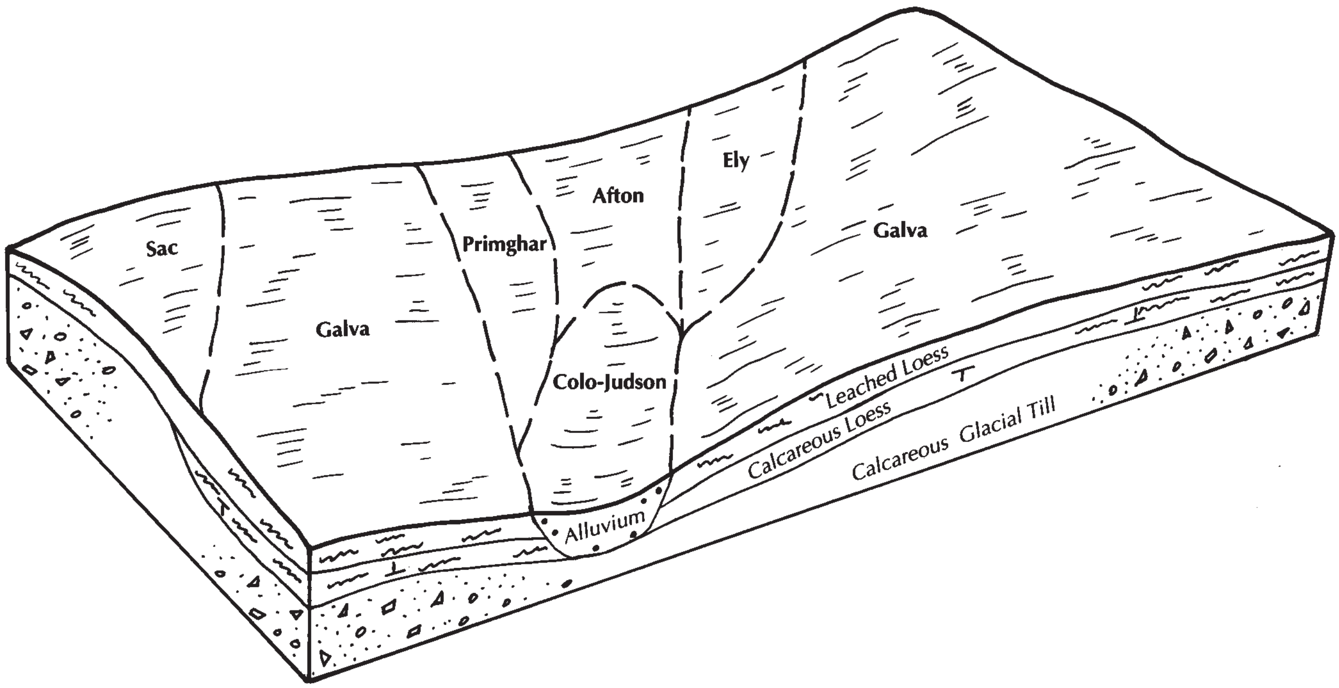


Figure 5.—Typical pattern of soils and parent material in the Galva association.

4. Galva Association

Nearly level to strongly sloping, well drained, silty soils that formed in loess; on uplands

This association consists of nearly level to gently sloping soils on broad upland ridgetops, gently sloping and moderately sloping soils on the narrower upland ridgetops, and gently sloping to strongly sloping soils on long upland side slopes. Slopes range from 0 to 14 percent.

This association makes up about 47 percent of the county. It is about 68 percent Galva and similar soils and 32 percent soils of minor extent (fig. 5).

Galva soils are on convex ridgetops and side slopes in the uplands. Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay loam about 44 inches thick. It is friable. The upper part is dark brown and brown, the next part is brown, and the lower part is yellowish brown and is mottled. The substratum to a depth of 60 inches or more is mottled yellowish brown and gray silt loam.

Of minor extent in this association are Afton, Colo, Ely, Judson, Primghar, and Sac soils. The poorly drained Afton and Colo soils formed in alluvium. Afton soils are in upland drainageways. Colo soils are in upland drainageways and on narrow flood plains. Judson and Sac soils are well drained, and Ely soils are somewhat poorly drained. Ely and Judson soils formed in local alluvium. They are on foot slopes and alluvial fans and in drainageways. Sac soils formed in loess and in the underlying glacial till. They are on upland ridgetops and side slopes. Primghar soils are somewhat poorly drained and are in upland drainageways and on the lower side slopes. They formed in loess.

Corn and soybeans are grown extensively on the soils in this association. In a few places grasses and legumes for hay or pasture are grown, mainly on the strongly sloping soils. The nearly level to gently sloping soils are well suited to row crops. The moderately sloping and strongly sloping soils are suited to row crops in rotation with grasses and legumes. In most places the moderately sloping and strongly sloping soils are more eroded and contain less organic matter than the less sloping soils. The main management concerns are controlling runoff and erosion and maintaining tilth and fertility.

5. Galva-Steinauer-Burchard Association

Gently sloping to very steep, well drained, silty soils that formed in loess and loamy soils that formed in glacial till; on uplands

This association consists of gently sloping and moderately sloping soils on ridgetops and moderately sloping to very steep soils on side slopes. Slopes range from 2 to 40 percent.

This association makes up about 1 percent of the county. It is about 50 percent Galva soils, 30 percent Steinauer soils, 15 percent Burchard soils, and 5 percent soils of minor extent.

Galva soils are gently sloping to strongly sloping and are on convex ridgetops and side slopes in the uplands. Steinauer soils are moderately steep to very steep and are on convex side slopes in the uplands. Burchard soils are moderately sloping to very steep and are on convex side slopes.

Typically, the surface layer of the Galva soils is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay loam about 44 inches thick. It is friable. The upper part is dark brown and brown, the next part is brown, and the lower part is yellowish brown and is mottled. The substratum to a depth of 60 inches or more is mottled yellowish brown and gray silt loam.

Typically, the surface layer of the Steinauer soils is very dark grayish brown, calcareous clay loam about 5 inches thick. Below this is a transitional layer of dark grayish brown and light olive brown, firm, calcareous clay loam about 7 inches thick. The substratum to a depth of 60 inches or more is light olive brown, mottled, calcareous clay loam. It contains pebbles throughout.

Typically, the surface layer of the Burchard soils is black clay loam about 5 inches thick. The subsurface layer is very dark gray and very dark grayish brown clay loam about 6 inches thick. The subsoil is about 25 inches thick. It is firm. The upper part is brown clay loam, and the lower part is brown, mottled, calcareous loam. The substratum to a depth of 60 inches or more is brown, mottled, calcareous loam. It contains pebbles throughout.

Of minor extent in this association are Colo, Hawick, Judson, Kennebec, and Nodaway soils. The poorly drained Colo soils and the moderately well drained Kennebec and Nodaway soils formed in alluvium. They are on flood plains and in upland drainageways. Hawick soils are excessively drained and are on side slopes of stream terraces. They formed in loamy, sandy, and gravelly glacial deposits. Judson soils are well drained and are on foot slopes and alluvial fans. They formed in alluvium.

Corn and soybeans are grown on the gently sloping and moderately sloping soils on ridgetops. Some of the strongly sloping soils also are used for corn and soybeans. Most of the moderately steep to very steep soils are used for pasture. The gently sloping soils in this association are well suited to row crops. The moderately sloping and strongly sloping soils are suited to row crops in rotation with grasses and legumes. The moderately steep soils are moderately suited to row crops, but the steep and very steep soils are unsuited to row crops. In most places the moderately steep to very steep soils have never been cultivated. The main management concern is controlling runoff. Controlling water erosion is also a concern in cultivated areas. Maintaining tilth and fertility and maintaining pasture conditions are also important considerations.

Detailed Soil Map Units

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

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

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

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

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

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Steinauer-Burchard complex, 18 to 40 percent slopes, is an example.

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

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. The map unit Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

Soil Descriptions

1B—Ida silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on narrow, rounded ridgetops and nose slopes in the uplands. Individual areas range from 2 to 15 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 6 inches thick. Plowing has mixed some of the brown substratum material into the surface layer. The substratum to a depth of 60 inches or more is brown, friable, calcareous silt loam. It is mottled in the lower part. In some places the surface layer is mainly brown substratum material. In other places the surface layer is not calcareous.

Included with this soil in mapping are small areas of soils that formed in glacial till and soils that have a sandy surface layer. These soils are in landscape positions similar to those of the Ida soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Ida soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.5 to 3.5 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain good tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

1C—Ida silt loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow, rounded ridgetops, nose slopes, and the upper parts of side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 6 inches thick. Plowing has mixed some of the brown substratum material into the surface layer. The substratum to a depth of 60 inches or more is brown, dark yellowish brown, and yellowish brown, very friable, calcareous silt loam. It is mottled in the lower part. In some places the surface layer is not calcareous. In other places calcium carbonate concretions are on the surface.

Included with this soil in mapping are small areas of soils that formed in glacial till and soils that have a sandy surface layer. These soils are in landscape positions similar to those of the Ida soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Ida soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.0 to 3.5 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops (fig. 6). Conservation tillage and crop rotations also maintain good tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

1C3—Ida silt loam, 5 to 9 percent slopes, severely eroded. This moderately sloping, well drained soil is on narrow, rounded ridgetops, nose slopes, and the upper parts of side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are narrow and irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 8 inches thick. It is mainly substratum material but contains a few dark brown streaks and pockets of surface soil material. The substratum to a depth of 60 inches or more is brown and grayish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are in the surface layer and in most parts of the substratum. In some areas the surface layer is mixed very dark grayish brown and brown.

Included with this soil in mapping are small areas of soils that have a sandy surface layer and soils that formed in glacial till. These soils are in landscape positions similar to those of the Ida soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Ida soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 0.7 to 1.7 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Ida soils.

A cover of pasture plants or hay is effective in

Figure 6.—Baled hay in an area of Ida silt loam, 5 to 9 percent slopes. Hay and pasture plants help to control erosion in areas of this soil.

controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

1D—Ida silt loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on upland ridges and side slopes. Individual areas range from 2 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 6 inches thick. Plowing has mixed some of the brown substratum material into the surface layer. The substratum to a depth of 60 inches or more is brown and yellowish brown, very friable, calcareous silt loam. It is mottled in the lower part. In some places the surface layer is not calcareous. In other places the substratum is light brownish gray and grayish brown.

Included with this soil in mapping are small areas of soils that have a sandy surface layer and soils that formed in glacial till. These soils are in landscape positions similar to those of the Ida soil. They make up less than 5 percent of the unit.

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

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain good tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

1D3—Ida silt loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on upland ridges and side slopes. Individual areas range from 2 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 7 inches thick. It is mainly substratum material but has a few dark brown streaks and pockets of surface soil material. The substratum to a depth of 60 inches or more is brown and grayish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are on the surface and in most or all parts of the substratum. In some areas the substratum is light brownish gray and grayish brown throughout. In other areas the surface layer is mixed very dark grayish brown and brown.

Included with this soil in mapping are small areas of soils that have a sandy surface layer and soils that formed in glacial till. These soils are in landscape positions similar to those of the Ida soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Ida soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 0.7 to 1.7 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Ida soils.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

1E—Ida silt loam, 14 to 20 percent slopes. This moderately steep, well drained soil is on upland side slopes. Individual areas range from 2 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown, calcareous silt loam about 6 inches thick. Plowing has mixed some brown substratum material into the surface layer. The substratum to a depth of 60 inches or more is brown and yellowish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are on the surface. In some areas the substratum is light brownish gray or grayish brown.

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

Most areas are used for pasture. Some areas are cultivated. This soil is suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain good tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

1E3—Ida silt loam, 14 to 20 percent slopes, severely eroded. This moderately steep, well drained soil is on upland side slopes. Individual areas range from 2 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 6 inches thick. It is mainly substratum material but has a few dark brown streaks and pockets of surface soil material. The substratum to a depth of 60 inches or more is brown, yellowish brown, and grayish brown, mottled, very friable, calcareous silt loam. In many places calcium carbonate concretions are on the surface. In some areas the substratum is light brownish gray or grayish brown.

Included with this soil in mapping are small areas of soils that formed in glacial till and soils that have a sandy surface layer. These soils are in landscape positions similar to those of the Ida soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Ida soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 0.7 to 1.7 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for pasture. Some areas are cultivated. This soil is moderately suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. It is best suited to hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain good tilth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Ida soils.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

1F3—Ida silt loam, 20 to 30 percent slopes, severely eroded. This steep, well drained soil is on upland side slopes. Individual areas range from 5 to 60 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown, calcareous silt loam about 5 inches thick. It is mainly substratum material but has a few dark brown streaks and pockets of surface soil material. The substratum to a depth of 60 inches or more is brown, yellowish brown, and grayish brown, mottled, very friable, calcareous silt loam. In many places the surface layer is very dark grayish brown. In many areas calcium carbonate concretions are on the surface. In places the substratum is light brownish gray or grayish brown.

Permeability is moderate, and runoff is very rapid. Available water capacity is high. The content of organic matter is about 0.7 to 1.7 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are used for pasture. This soil is unsuited to cultivated crops because of the slope and a severe hazard of erosion. It is moderately suited to pasture. More nitrogen and more intensive management are needed on this soil than on the less eroded and less sloping Ida soils.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

8B—Judson silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on foot slopes and in upland drainageways. Individual areas range from 2 to 30 acres in size and are long and narrow.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 24 inches thick. The upper part is very dark brown, and the lower part is very dark brown and very dark grayish brown. The subsoil to a depth of 60 inches or more is friable silty clay loam. The upper part is dark brown and very dark grayish brown, the next part is dark brown and brown, and the lower part is brown and yellowish brown and is mottled. In some places the surface layer and subsurface layer are more than 40 inches thick. In other places the subsoil is dark grayish brown or grayish brown.

Included with this soil in mapping are some small areas of the poorly drained Colo soils. These soils remain wet for long periods unless they are artificially drained. They are on the lowest part of drainageways. They make up less than 10 percent of the unit.

Permeability is moderate in the Judson soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope help to prevent siltation and gullying in areas of this soil. Grassed waterways help to remove excess water and prevent gullying. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling gullying and erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

8C—Judson silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on foot slopes and alluvial fans and in upland drainageways. Most areas range from 2 to 15 acres in size and are long and narrow.

Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsurface layer is about 17 inches thick. The upper part is very dark brown silty clay loam, and the lower part is very dark grayish brown silt loam. The subsoil to a depth of 60 inches or more is friable silty clay loam. The upper part is dark brown and very dark grayish brown, the next part is dark brown and brown, and the lower part is yellowish brown and is mottled. In some places the subsurface layer extends to a depth of about 36 inches.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used for pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. In some areas runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope help to prevent siltation and gullying on this soil. Grassed waterways help to remove excess water and prevent gullying. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and runoff. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling gullying and erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9B—Marshall silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad upland ridgetops. Individual areas range from 5 to 100 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 3 inches thick. The subsoil is about 50 inches thick. It is friable. In sequence downward, it is brown and dark brown silty clay loam; brown silty clay loam; yellowish brown silty clay loam; and yellowish brown, mottled silt loam. In places, the soil does not have a subsurface layer and streaks and pockets of brown subsoil material are mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

9B2—Marshall silty clay loam, 2 to 5 percent slopes, moderately eroded. This gently sloping, well drained soil is on convex upland ridgetops. Individual areas range from 5 to more than 40 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown and yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and grayish brown silt loam. In some places the upper part of the subsoil has mottles. In other places the soil has a dark subsurface layer.

Included with this soil in mapping are a few small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Marshall soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

9C—Marshall silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on upland side slopes and ridgetops. Individual areas range from 2 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer also is very dark brown silty clay loam. It is about 5 inches thick. The subsoil is about 40 inches thick. It is friable. In sequence downward, it is very dark grayish brown silty clay loam; brown silty clay loam; yellowish brown, mottled silty clay loam; and yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and light brownish gray silt loam. In places grayish brown mottles are within a depth of 24 inches. In some areas, the soil does not have a substratum and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9C2—Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on upland side slopes and ridgetops. Individual areas range from 2 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 44 inches thick. It is friable. The upper part is brown and yellowish brown silty clay loam, and the lower part is mottled yellowish brown and grayish brown silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and light brownish gray silt loam. In some places grayish brown or light brownish gray mottles are within a depth of 24 inches. In other places the soil has a very dark grayish brown subsurface layer. In some areas the surface layer is mostly dark brown and brown.

Included with this soil in mapping are a few small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Marshall soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces (fig. 7), a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9D—Marshall silty clay loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on

Figure 7.—Terraces that have a grassed back slope help to control erosion in this area of Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded, and Monona silty clay loam, 9 to 14 percent slopes, moderately eroded. The crop is soybeans.

upland side slopes. Individual areas range from 2 to 20 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is very dark gray and very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 35 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is brown, mottled silt loam. The substratum to a depth of 60 inches or more is mottled brown and light brownish gray silt loam. In places light brownish gray or grayish brown mottles are within a depth of 24 inches. In some areas, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil has a low supply of available phosphorus and potassium.

Most areas are used for pasture or are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

9D2—Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes. Individual areas range from 2 to 30 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 42 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled, calcareous silt loam. In some places grayish brown or light brownish gray mottles are within a depth of 24 inches. In other places the soil has a very dark grayish brown subsurface layer. In some areas the surface layer is mostly dark brown and brown subsoil material.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

11B—Colo-Judson silty clay loams, 0 to 5 percent slopes. These nearly level to gently sloping soils are along narrow upland drainageways and the adjacent foot slopes. The poorly drained Colo soil is near the drainageways. It is occasionally flooded for brief periods. The well drained Judson soil occurs as narrow bands between areas of the Colo soil and the higher lying soils on the adjacent hillsides. The Judson soil also is on the upper part of drainageways above the Colo soil. Individual areas of these soils range from 5 to 50 acres in size and are long and narrow. They are about 65 percent Colo soil, 20 percent Judson soil, and 15 percent soils of minor extent. In some areas the Judson soil makes up less than 5 percent. The Colo and Judson soils occur as areas so intricately mixed or so narrow that mapping them separately is impractical.

Typically, the surface layer of the Colo soil is black silty clay loam about 7 inches thick. The subsurface layer also is black silty clay loam. It is about 25 inches thick. The subsoil extends to a depth of 60 inches or more. It is friable silty clay loam. The upper part is black and very dark gray, the next part is very dark gray and is mottled, and the lower part is dark gray and very dark gray and is mottled.

Typically, the surface layer of the Judson soil is very dark brown silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 24 inches thick. The upper part is very dark brown, and the lower part is very dark brown and very dark grayish brown. The subsoil is friable silty clay loam about 26 inches thick. The upper part is dark brown and very dark grayish brown, the next part is dark brown and brown, and the lower part is brown and yellowish brown. The substratum to a depth of 60 inches or more is yellowish brown, mottled silty clay loam.

Permeability is moderate in the Colo and Judson soils. Runoff is slow or medium on the Colo soil and medium on the Judson soil. Available water capacity is high in both soils. The Colo soil has a seasonal high water table. The content of organic matter is about 5 to 7 percent in the surface layer of the Colo soil and about 3 to 4 percent in the surface layer of the Judson soil. The subsoil of the Colo soil generally has a medium supply of available phosphorus and a very low supply of available potassium. The subsoil of the Judson soil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated, but some areas are used for grasses and legumes. These soils are well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Most of the flooding on the Colo soil occurs before row crops are planted. Tile drains improve soil aeration and permit more timely tillage of the Colo soil. In some areas runoff from soils upslope results in sedimentation and gullying. Measures that control the runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. If cultivated crops are grown, water erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage during wet periods help to maintain tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during wet periods, help to keep the pasture in good condition.

The land capability classification is IIw.

22D3—Dow silt loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on upland side slopes. Individual areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is brown, calcareous silt loam about 5 inches thick. It is mainly substratum material but has a few dark grayish brown and dark brown streaks and pockets of surface soil material. The substratum to a depth of 60 inches or more is very friable, calcareous silt loam. It is mottled light brownish gray in the upper part and mottled brown in the lower part. In many areas calcium carbonate concretions are on the surface. In places the substratum is mainly brown and yellowish brown.

Included with this soil in mapping are a few small areas of soils that formed in glacial till. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Dow soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 0.7 to 1.7 percent. The substratum generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a severe hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Conservation tillage and crop rotations also maintain tilth. Returning crop residue to the soil or regularly adding other organic material improves tilth and fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

26—Kennebec silty clay loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on flood plains. It is subject to occasional flooding for brief periods. Individual areas range from 5 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silty clay loam about 7 inches thick. The subsurface layer is friable silty clay loam about 43 inches thick. The upper part is very dark gray, and the lower part is very dark grayish brown. The substratum to a depth of 60 inches or more is very dark grayish brown and dark grayish brown, mottled silty clay loam. In places a brown subsoil is within a depth of 36 inches. In some areas the soil is silt loam throughout. In other areas the soil is overlain by stratified, recently deposited material.

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

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Most of the periods of flooding are very brief or brief and occur before row crops are planted. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is properly managed.

The land capability classification is IIw.

26B—Kennebec silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is in narrow drainageways in the uplands, on alluvial fans, and on foot slopes. It is subject to occasional flooding for brief periods unless it is protected. Individual areas range from 5 to 100 acres in size and are elongated.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray, friable silty clay loam about 29 inches thick. Below this to a depth of 60 inches or more is a transitional layer of very dark grayish brown, friable silty clay loam. In places about 12 inches of recently deposited silt loam overlies the surface layer.

Included with this soil in mapping are some small areas of the poorly drained Colo soils. These soils are slightly lower on the landscape than the Kennebec soil. Also, they dry out more slowly after rains. They make up less than 10 percent of the unit.

Permeability is moderate in the Kennebec soil, and runoff is medium. Available water capacity is high. The soil has a seasonal high water table. The content of organic matter is about 4 to 6 percent in the surface layer. The substratum generally has a low supply of available phosphorus and a medium supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas flooding or runoff from soils upslope results in siltation and gullying. Measures that control the runoff on the soils upslope help to prevent siltation and gullying in areas of this soil. Grassed waterways help to remove excess water and prevent gullying. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling gullying and erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is properly managed.

The land capability classification is IIe.

27B—Terril loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on foot slopes, on alluvial fans, and in upland drainageways. Individual areas range from 2 to 15 acres in size and are long and narrow.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is loam about 30 inches thick. The upper part is very dark brown, and the lower part is very dark brown and very dark grayish brown. The subsoil to a depth of 60 inches or more is friable loam. The upper part is very dark grayish brown and dark brown, and the lower part is brown. In some places the surface layer and subsurface layer are more than 40 inches thick. In other places the subsoil is dark grayish brown or grayish brown.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used for pasture. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Measures that control runoff on the soils upslope help to prevent siltation and gullying in areas of this soil. Grassed waterways help to remove excess water and prevent gullying. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling gullying and erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

27C—Terril loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on slightly concave foot slopes and in upland drainageways. Individual areas range from 5 to 10 acres in size and are long and narrow.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is loam about 28 inches thick. The upper part is very dark brown, and the lower part is very dark brown and very dark grayish brown. The subsoil to a depth of 60 inches or more is friable loam. The upper part is very dark grayish brown and dark brown, and the lower part is brown. In places the surface layer and subsurface layer are more than 40 inches thick. In some areas the slope is 9 to 14 percent.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used for pasture. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. In some areas runoff from soils upslope results in siltation and gullying. Measures that control runoff on the soils upslope are needed. Grassed waterways help to remove excess water and prevent gullying. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and runoff. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective is controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

28C2—Dickman sandy loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on side slopes and ridgetops. Individual areas range from 3 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown sandy loam about 6 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is brown, very friable loamy fine sand about 34 inches thick. The substratum to a depth of 60 inches or more is yellowish brown, loose fine sand and sand. In places, the surface layer is very dark grayish brown and the soil has a dark brown subsurface layer. In some areas the surface layer and the upper part of the subsoil are loamy sand.

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

Most areas are used for pasture. Some areas are cropped along with larger areas of adjacent soils that are suited to crops. This soil generally is poorly suited to cultivated crops because of droughtiness and soil blowing. It is suited to small grain and to grasses and legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated row crops are grown, soil blowing is a severe hazard.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too dry hinders forage production and reduces the protective plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IVe.

28D2—Dickman sandy loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on side slopes adjacent to drainageways and in isolated areas on uplands. Individual areas range from 3 to 10 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 30 inches thick. It is very friable. The upper part is brown and yellowish brown sandy loam, and the lower part is brown and yellowish brown loamy fine sand. The substratum to a depth of 60 inches or more is yellowish brown, loose fine sand and sand. In places the surface layer and subsurface layer are loamy sand. In some areas the soil has a very dark grayish brown or dark brown subsurface layer. In a few places the slope is as much as 18 percent.

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

Most areas are used for pasture. A few areas are cropped along with larger areas of adjacent soils that are suited to crops. This soil generally is poorly suited to cultivated crops because of droughtiness and soil blowing. It is suited to small grain and to grasses and legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated crops are grown, soil blowing is a severe hazard.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too dry hinders forage production and reduces the protective plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IVe.

31—Afton silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in concave drainageways on uplands. It is subject to occasional flooding for very brief periods. Individual areas range from 3 to 30 acres in size and generally are long and narrow.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer also is black silty clay loam. It is about 16 inches thick. The subsoil is mottled, friable silty clay loam about 19 inches thick. The upper part is very dark gray, the next part is dark gray, and the lower part is olive gray. The substratum to a depth of 60 inches or more is gray, mottled silt loam. In places the surface soil is more than 30 inches thick. In some areas the slope is more than 2 percent.

Permeability is moderately slow, and runoff is slow. This soil has a seasonal high water table. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 6 to 7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated, but some areas in grassed waterways are used for hay. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Most of the flooding occurs before row crops are planted. Tile drains improve soil aeration and permit more timely tillage. A system of conservation tillage that leaves crop residue on the surface and grassed waterways help to prevent gullying and maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility and prevent surface crusting.

A cover of pasture plants or hay is effective in preventing gullying and maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIw.

35E2—Steinauer-Burchard complex, 14 to 18 percent slopes, moderately eroded. These moderately steep, well drained soils are on convex side slopes in the uplands. In most places, the Steinauer soil is on south- and west-facing side slopes and nose slopes and the Burchard soil is on north- and east-facing side slopes. Individual areas of these soils range from 3 to 15 acres in size and are long and irregularly shaped. They are about 55 percent Steinauer soil, 40 percent Burchard soil, and 5 percent soils of minor extent. The Steinauer and Burchard soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the surface layer of the Steinauer soil is very dark gray, calcareous clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of dark grayish brown and light olive brown material from the underlying layer into the surface layer. The next layer is a transitional layer of dark grayish brown and light olive brown, firm, calcareous clay loam. It is about 5 inches thick. The substratum to a depth of 60 inches or more is light olive brown, mottled, calcareous clay loam. It contains pebbles throughout. In places the surface layer is more than 6 inches thick and does not have streaks and pockets of material from the underlying layer.

Typically, the surface layer of the Burchard soil is very dark grayish brown clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is firm clay loam about 23 inches thick. The upper part is brown, the next part is yellowish brown, and the lower part is yellowish brown and is mottled. The substratum to a depth of 60 inches or more is mottled yellowish brown and grayish brown clay loam. Pebbles are in the surface layer, subsoil, and substratum. In places the soil has a very dark grayish brown subsurface layer. In some areas the surface layer is mostly subsoil material. In places the depth to lime is more than 30 inches.

Permeability is moderately slow in the Steinauer and Burchard soils, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 2.7 percent in the surface layer. The substratum generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture. These soils generally are unsuited to corn, soybeans, and small grain because of the hazard of erosion. Also, the slope restricts the use of farm machinery. The soils are better suited to grasses and legumes for hay and pasture.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

35G—Steinauer-Burchard complex, 18 to 40 percent slopes. These steep and very steep, well drained soils are on convex side slopes in the uplands. The Steinauer soil is on the south- and west-facing side slopes, and the Burchard soil is on the north- and east-facing side slopes. Individual areas of these soils range from 3 to 40 acres in size and are long and irregularly shaped. They are about 50 percent Steinauer soil, 40 percent Burchard soil, and 10 percent soils of minor extent. The Steinauer and Burchard soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the surface layer of the Steinauer soil is very dark grayish brown, calcareous clay loam about 5 inches thick. Below this is a transitional layer of dark grayish brown and light olive brown, firm, calcareous clay loam about 7 inches thick. The substratum to a depth of 60 inches or more is light olive brown, mottled, calcareous clay loam. It contains pebbles throughout.

Typically, the surface layer of the Burchard soil is black clay loam about 5 inches thick. The subsurface layer is very dark gray and very dark grayish brown clay loam about 6 inches thick. The subsoil is about 25 inches thick. The upper part is brown, firm clay loam, and the lower part is brown, mottled, calcareous, firm loam. The substratum to a depth of 60 inches or more is brown, mottled, calcareous loam. It contains pebbles throughout.

Included with these soils in mapping are small areas of soils that are silty clay and clay. These included soils are on the lower part of some side slopes. They make up about 5 percent of the unit.

Permeability is moderately slow in the Steinauer and Burchard soils, and runoff is very rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The substratum of the Steinauer soil and the subsoil of the Burchard soil generally have a very low supply of available phosphorus and potassium.

Most areas are used for pasture. These soils are unsuited to corn, soybeans, and small grain because of the hazard of erosion. Also, the slope restricts the use of farm machinery. The soils are better suited to grasses and legumes for hay and pasture.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIIe.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is at the lower elevations on flood plains. It is occasionally flooded for brief or long periods unless it is protected. Individual areas range from 5 to 50 acres in size and are wide and irregularly shaped.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer also is black silty clay loam. It is about 31 inches thick. The subsoil to a depth of 60 inches or more is black, friable silty clay loam. In some places the surface layer is overlain by as much as 12 inches of recently deposited silt loam. In other places the subsurface layer and the subsoil are silty clay.

Permeability and runoff are slow. Available water capacity is high. This soil has a seasonal high water table. The shrink-swell potential is high. The content of organic matter is about 5 to 7 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Tile drains improve soil aeration and permit more timely tillage. Tile drains work satisfactorily only if they are more closely spaced than they are in most other soils. Surface drains are needed to remove surface water in some areas. Most of the flooding occurs before row crops are planted. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility and help to prevent surface crusting.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIw.

59D2—Burchard clay loam, 5 to 14 percent slopes, moderately eroded. This moderately sloping and strongly sloping, well drained soil is on convex side slopes in the uplands. Individual areas range from 3 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is firm clay loam about 23 inches thick. The upper part is brown; the next part is yellowish brown; and the lower part is yellowish brown, mottled, and calcareous. The substratum to a depth of 60 inches or more is calcareous clay loam. It is mottled yellowish brown and grayish brown in the upper part and mottled gray and yellowish brown in the lower part. Pebbles are in the surface layer, subsoil, and substratum. In some places the soil has a dark subsurface layer. In other places the surface layer is mostly subsoil material. In places the depth to lime is more than 30 inches.

Included with this soil in mapping are small areas of the calcareous Steinauer soils. These soils are in landscape positions similar to those of the Burchard soil. They make up about 15 percent of the unit.

Permeability is moderately slow in the Burchard soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated, but a few areas are used for pasture. In most places this soil is managed along with adjacent soils. It is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. The stones on the surface in some areas can result in damage to farm equipment unless they are removed. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

78B—Sac silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on narrow ridgetops and convex side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 3 inches thick. The subsoil is about 26 inches thick. The upper part is brown, friable silty clay loam, and the lower part is yellowish brown, firm, mottled clay loam. The substratum to a depth of 60 inches or more is yellowish brown, calcareous, mottled clay loam. In some places the depth to firm clay loam or friable loam glacial till is more than 40 inches. In other places the depth to glacial till is less than 20 inches. In some areas, the soil does not have a subsurface layer and brown subsoil material has been mixed with the surface layer by tillage.

Included with this soil in mapping are small areas of soils that formed in glacial till. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Sac soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

78B2—Sac silty clay loam, 2 to 5 percent slopes, moderately eroded. This gently sloping, well drained soil is on narrow ridgetops and convex side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 33 inches thick. The upper part is brown, friable silty clay loam; the next part is yellowish brown, friable silty clay loam; and the lower part is yellowish brown, firm, mottled clay loam. The substratum to a depth of 60 inches or more is yellowish brown, calcareous, mottled clay loam. In some places the depth to firm clay loam or friable loam glacial till is more than 40 inches. In other places the depth to glacial till is less than 20 inches. In some areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of soils that formed in glacial till. These soils are generally in the more convex landscape positions. They make up less than 10 percent of the unit.

Permeability is moderate in the Sac soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

78C—Sac silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridgetops and convex side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 28 inches thick. The upper part is very dark grayish brown and brown, friable silty clay loam; the next part is yellowish brown, friable silty clay loam; and the lower part is yellowish brown, firm, mottled clay loam. The substratum to a depth of 60 inches or more is yellowish brown, calcareous, mottled clay loam. In some places the depth to clay loam or loam glacial till is more than 40 inches. In other places the depth to glacial till is less than 20 inches. In some areas, the soil does not have a subsurface layer and brown subsoil material has been mixed with the surface layer by tillage.

Included with this soil in mapping are small areas of soils that formed in glacial till. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Sac soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

78C2—Sac silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow ridgetops and convex side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown and very dark brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 33 inches thick. The upper part is brown, friable silty clay loam, and the lower part is yellowish brown, firm, mottled clay loam. The substratum to a depth of 60 inches or more is yellowish brown, calcareous, mottled clay loam. In some places the depth to clay loam or loam glacial till is more than 40 inches. In other places the depth to glacial till is less than 20 inches. In some areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of gravelly or sandy soils and soils that formed in glacial till. These soils are generally in the more convex landscape positions. They make up less than 10 percent of the unit.

Permeability is moderate in the Sac soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

78D2—Sac silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown and very dark brown silty clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 29 inches thick. The upper part is brown, friable silty clay loam; the next part is yellowish brown, friable silt loam; and the lower part is yellowish brown, firm clay loam. The substratum to a depth of 60 inches or more is yellowish brown, calcareous, mottled clay loam. In some places the depth to clay loam or loam glacial till is more than 40 inches. In other places the depth to glacial till is less than 20 inches. In some areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of gravelly or sandy soils and soils that formed in glacial till. These soils are generally in the more convex landscape positions. They make up less than 15 percent of the unit.

Permeability is moderate in the Sac soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

91B—Primghar silty clay loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is in upland drainageways and on the lower side slopes. Most areas range from about 2 to 30 acres in size and are longer than they are wide.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 11 inches thick. The upper part is black, and the lower part is black and very dark grayish brown. The subsoil is friable silty clay loam about 27 inches thick. The upper part is dark grayish brown and is mottled; the next part is grayish brown and dark grayish brown and is mottled; and the lower part is grayish brown, mottled, and calcareous. The substratum to a depth of 60 inches or more is grayish brown, mottled, calcareous silt loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. This soil has a seasonal high water table. The shrink-swell potential is high. The content of organic matter is about 5 to 6 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used for grasses and legumes. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Water erosion and gullying are hazards because of runoff from soils in areas upslope. These hazards can be controlled by grassed waterways, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Establishing grassed waterways in areas where runoff concentrates helps to prevent gullying and water erosion. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration. In the wetter years, tile drainage improves the timeliness of tillage and soil aeration in some cultivated areas. The tile line commonly is installed near the center of drainageways, where the soil tends to be the wettest.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIe.

92—Marcus silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in upland drainageways. Individual areas range from about 3 to 30 acres in size and occur as narrow bands.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 13 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is friable silty clay loam about 15 inches thick. The upper part is mottled olive gray and dark gray, and the lower part is mottled gray and olive gray. The substratum to a depth of 60 inches or more is mottled gray and olive gray, calcareous silt loam. In some places the slope is more than 2 percent.

Permeability is moderately slow, and runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The shrink-swell potential is high. The content of organic matter is about 6 to 7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used for grasses and legumes. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Tile drains reduce wetness and provide good aeration and a deep root zone for plants. Establishing tiled grassed waterways in areas where runoff concentrates helps to prevent crop damage from overflow and siltation. Installing terraces on the higher adjacent soils and farming on the contour also help to prevent this damage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth and fertility and helps to prevent surface crusting.

A cover of pasture plants or hay is effective in

maintaining tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition.

The land capability classification is IIw.

99C2—Exira silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on upland side slopes and narrow ridgetops. Individual areas range from 2 to 25 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 33 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and light brownish gray silt loam. In some places the soil does not have grayish mottles within a depth of 24 inches. In other places the surface layer is mostly dark brown and brown. In some areas the soil has a very dark grayish brown subsurface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

99D2—Exira silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes. Individual areas range from 3 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 31 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and grayish brown silt loam. In some places the soil does not have grayish brown or light brownish gray mottles within a depth of 24 inches. In other places the surface layer is mostly dark brown and brown. In some areas the soil has a very dark grayish brown subsurface layer.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

99D3—Exira silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on side slopes in the uplands. Individual areas range from 3 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is brown and dark brown silty clay loam about 7 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is about 31 inches thick. It is friable. In sequence downward, it is brown silty clay loam; brown, mottled silty clay loam; brown, mottled silt loam; and mottled yellowish brown and grayish brown silt loam. The substratum to a depth of 60 inches or more is mottled yellowish brown and grayish brown silt loam. In places the soil does not have grayish brown or light brownish gray mottles within a depth of 24 inches. In some areas the surface layer is very dark grayish brown. In other areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Exira soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 1.2 to 2.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Exira soils.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

99E2—Exira silty clay loam, 14 to 20 percent slopes, moderately eroded. This moderately steep, well drained soil is on upland side slopes in the uplands. Individual areas range from 3 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 29 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown, mottled silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In some places the soil does not have grayish brown or light brownish gray mottles within a depth of 24 inches. In other places the surface layer is mostly dark brown and brown. In some areas the soil has a very dark grayish brown subsurface layer.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Because of the slope, meadow crops provide more practical erosion control than cultivated crops in areas where contour farming, terraces, and a system of conservation tillage are used. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

100C—Monona silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on narrow ridgetops and long side slopes in the uplands. Individual areas range from 2 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsurface layer also is very dark brown silty clay loam. It is about 4 inches thick. The subsoil is about 40 inches thick. It is friable. In sequence downward, it is very dark grayish brown and dark brown silty clay loam; brown silty clay loam; brown silt loam; and yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In a few places the surface soil and subsoil are silt loam throughout. In a few areas, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

100C2—Monona silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on narrow ridgetops and long side slopes in the uplands. Individual areas range from 2 to 60 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 46 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In some places the soil has a very dark brown or very dark grayish brown subsurface layer. In other places the surface layer is mostly dark brown and brown. In some areas the surface layer and subsoil are silt loam throughout.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

100C3—Monona silty clay loam, 5 to 9 percent slopes, severely eroded. This moderately sloping, well drained soil is on narrow ridgetops and on side slopes in the uplands. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is dark brown and brown silty clay loam about 8 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is about 30 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled, calcareous silt loam. In some areas the surface layer is mostly very dark grayish brown. In a few areas the soil has a very dark grayish brown subsurface layer. In places the surface layer and subsoil are silt loam throughout.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 1.2 to 2.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Monona soils.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

100D—Monona silty clay loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on upland side slopes. Individual areas range from 2 to 40 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown silty clay loam about 3 inches thick. The subsoil is about 40 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is yellowish brown silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer. In a few areas the soil is silt loam throughout.

Permeability is moderate, and runoff is rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture or are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

100D2—Monona silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes (fig. 8). Individual areas range from 3 to 40 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled, calcareous silt loam. In some places the soil has a very dark grayish brown subsurface layer. In other places the surface layer is mostly dark brown and brown.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

100D3—Monona silty clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, well drained soil is on upland side slopes. Individual areas range from 2 to 30 acres in size and are long and irregularly shaped.

Typically, the surface layer is dark brown and brown silty clay loam about 7 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is about 25 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. It is calcareous in the lower part. In some places the surface layer is very dark grayish brown. In a few areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 1.2 to 2.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain

Figure 8.—An area of Monona silty clay loam, 9 to 14 percent slopes, moderately eroded. The farm pond provides water for livestock and opportunities for recreation.

tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Monona soils.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

100E—Monona silty clay loam, 14 to 20 percent slopes. This moderately steep, well drained soil is on upland side slopes. Individual areas range from 3 to 30 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 4 inches thick. The subsurface layer also is very dark brown silty clay loam. It is about 6 inches thick. The subsoil is about 38 inches thick. It is friable. The upper part is brown and dark brown silty clay loam; the next part is brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are used for pasture, but a few areas are cultivated. This soil is moderately suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

100E2—Monona silty clay loam, 14 to 20 percent slopes, moderately eroded. This moderately steep, well drained soil is on upland side slopes. Individual areas range from 3 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 30 inches thick. It is friable. In sequence downward, it is brown silty clay loam; brown silt loam; yellowish brown silt loam; and yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In some places the soil has a very dark grayish brown subsurface layer. In other places the surface layer is mostly brown and dark brown.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

100E3—Monona silty clay loam, 14 to 20 percent slopes, severely eroded. This moderately steep, well drained soil is on upland side slopes. Individual areas range from 3 to 30 acres in size and are long and narrow or irregularly shaped.

Typically, the surface layer is dark brown and brown silty clay loam about 6 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is about 37 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In places the surface layer is very dark grayish brown. In a few areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of the calcareous Ida soils. These soils are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Monona soil, and runoff is rapid. Available water capacity is high. The content of organic matter is 1.2 to 2.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to some row crops in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a serious hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration. More nitrogen and more intensive management are needed on this soil than on the less eroded Monona soils.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IVe.

100F—Monona silty clay loam, 20 to 30 percent slopes. This steep, well drained soil is on upland side slopes. Individual areas range from 3 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 9 inches thick. The subsurface layer is dark brown silty clay loam about 4 inches thick. The subsoil is about 35 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is very rapid. Available water capacity is high. The content of organic matter is 3 to 4 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are used for pasture. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. It is moderately suited to grasses and legumes for hay and pasture.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

100F2—Monona silty clay loam, 20 to 30 percent slopes, moderately eroded. This steep, well drained soil is on upland side slopes. Individual areas range from 3 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 34 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In places the soil has a very dark grayish brown subsurface layer. In some areas the surface layer is mostly brown and dark brown.

Permeability is moderate, and runoff is very rapid. Available water capacity is high. The content of organic matter is 2.2 to 3.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are used for pasture. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. It is moderately suited to grasses and legumes for hay and pasture.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIe.

100F3—Monona silty clay loam, 20 to 30 percent slopes, severely eroded. This steep, well drained soil is on upland side slopes. Individual areas range from 3 to 50 acres in size and are long and irregularly shaped.

Typically, the surface layer is dark brown and brown silty clay loam about 6 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is about 32 inches thick. It is friable. The upper part is brown silty clay loam; the next part is brown silt loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. It is calcareous in the lower part. In places the surface layer is very dark grayish brown.

Permeability is moderate, and runoff is very rapid. Available water capacity is high. The content of organic matter is 1.2 to 2.2 percent in the surface layer. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are used for pasture. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. It is moderately suited to grasses and legumes for hay and pasture. More nitrogen and more intensive management are needed on this soil than on the less eroded Monona soils.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is VIIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains. It is occasionally flooded for very brief to long periods unless it is protected. Individual areas range mainly from 5 to 100 acres in size, but some are as large as 300 acres. The areas are irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer also is black silty clay loam. It is about 28 inches thick. The subsoil to a depth of 60 inches or more is friable silty clay loam. The upper part is black and very dark gray, the next part is very dark gray, and the lower part is very dark gray and dark gray and has olive gray mottles. In places about 12 inches of recently deposited silt loam overlies the surface.

Included with this soil in mapping are small areas of the moderately well drained Kennebec soils and small areas of poorly drained soils that are loam and clay loam. Kennebec soils are slightly higher on the landscape than the Colo soil. Also, they dry out more rapidly after rains. They make up less than 10 percent of the unit. The loam and clay loam soils are in landscape positions similar to those of the Colo soil. They make up less than 10 percent of the unit.

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

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Flooding is a hazard. Most of the flooding occurs before row crops are planted. Tile drains improve soil aeration and permit more timely tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility and prevent surface crusting.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIw.

133+—Colo silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on flood plains. It is occasionally flooded for very brief to long periods unless it is protected. Individual areas range mainly from 5 to 50 acres in size, but some are larger. The areas are irregularly shaped.

Typically, the surface layer is recently deposited alluvium about 12 inches thick. It is very dark grayish brown silt loam. The subsurface layer is black silty clay loam about 35 inches thick. The subsoil to a depth of 60 inches or more is very dark gray and black, friable silty clay loam. In some places the subsurface layer and subsoil are silt loam.

Included with this soil in mapping are some small areas of the moderately well drained Kennebec soils. These soils are slightly higher on the landscape than the Colo soil. Also, they dry out more rapidly after rains. They make up less than 10 percent of the unit.

Permeability is moderate in the Colo soil, and runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The content of organic matter is about 3 to 5 percent in the surface layer. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Flooding is a hazard. Most of the flooding occurs before row crops are planted. Tile drains improve soil aeration and permit more timely tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, and help to prevent surface crusting.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIw.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in areas of recent deposition on flood plains. It is occasionally flooded for very brief or brief periods unless it is protected. Individual areas range mainly from 5 to 50 acres in size, but some are larger. The areas are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 10 inches thick. The substratum, to a depth of about 57 inches, is dark grayish brown and very dark grayish brown, stratified silt loam. Below this is a buried soil of black silt loam. In places the dark buried soil is within a depth of 36 inches.

Included with this soil in mapping are some small areas of Kennebec soils. These soils are at the slightly higher elevations. They are not stratified and contain more organic matter in the surface layer than the Nodaway soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Nodaway soil, and runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Measures that control flooding improve the timeliness of fieldwork. Most of the flooding occurs before row crops are planted. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, and helps to prevent surface crusting.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

A few small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is properly managed.

The land capability classification is IIw.

309—Allendorf silty clay loam, 0 to 3 percent slopes. This very gently sloping, well drained soil is on stream terraces. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 25 inches thick. The upper part is brown, friable silty clay loam; the next part is brown, friable loam; and the lower part is brown, friable very gravelly sandy loam. The substratum to a depth of 60 inches or more is brown very gravelly loamy sand. In some places the surface layer is loam. In other places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer. In some areas the depth to the gravelly substratum is less than 24 inches or more than 40 inches.

Included with this soil in mapping are small areas of gravelly soils. These soils are in landscape positions similar to those of the Allendorf soil. They make up less than 10 percent of the unit.

Permeability is moderate in the upper part of the Allendorf soil and very rapid in the substratum. Runoff is slow. Available water capacity is moderate. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is seasonally droughty because of the sandy and gravelly substratum. If cultivated crops are grown, erosion is a hazard. It can be controlled by contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIs.

310—Galva silty clay loam, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, slightly convex ridgetops in the uplands. Individual areas range from 3 to 20 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown and very dark brown silty clay loam about 9 inches thick. The subsoil is about 39 inches thick. It is friable. In sequence downward, it is dark brown and brown silty clay loam; brown silty clay loam; yellowish brown silty clay loam; and yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled silt loam. In some places the soil does not have a subsurface layer.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter is about 4 to 5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is I.

310B—Galva silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Individual areas range from 3 to 200 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 49 inches thick. The upper part is dark brown and brown, the next part is brown, and the lower part is yellowish brown and is mottled. The substratum to a depth of 60 inches or more is mottled yellowish brown and gray silt loam. In some places the depth to firm clay loam or friable loam glacial till is less than 40 inches. In other places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

310B2—Galva silty clay loam, 2 to 5 percent slopes, moderately eroded. This gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Individual areas range from 3 to 50 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 39 inches thick. It is friable. The upper part is brown and very dark grayish brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The upper part of the substratum, to a depth of about 56 inches, is yellowish brown, mottled silt loam. The lower part to a depth of 60 inches or more is mottled yellowish brown and gray, calcareous clay loam. In places the depth to firm clay loam or friable loam glacial till is less than 40 inches. In some areas the soil has a dark subsurface layer.

Included with this soil in mapping are small areas of Burchard and Steinauer soils. These soils formed in glacial till. They are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Galva soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

310C—Galva silty clay loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex upland side slopes. Individual areas range from 3 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark brown and dark brown silty clay loam about 4 inches thick. The subsoil is about 45 inches thick. It is friable. In sequence downward, it is dark brown and brown silty clay loam; brown silty clay loam; brown, mottled silty clay loam; and yellowish brown, mottled clay loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled clay loam. In some places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer. In other places the depth to firm clay loam or friable loam glacial till is less than 40 inches.

Included with this soil in mapping are small areas of Burchard and Steinauer soils. These soils formed in glacial till. They are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Galva soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

310C2—Galva silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on convex upland side slopes. Individual areas range from 3 to 100 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 38 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown and is mottled. The upper part is silt loam, and the lower part is calcareous clay loam. In some places the depth to firm clay loam or friable loam glacial till is less than 40 inches. In other places the soil has a very dark brown or very dark grayish brown subsurface layer. In some areas the surface layer is mostly dark brown and brown.

Included with this soil in mapping are small areas of Burchard and Steinauer soils. These soils formed in clay loam glacial till. They are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Galva soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces (fig. 9), a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

310D—Galva silty clay loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on convex upland side slopes. Individual areas range from 3 to 20 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown, friable silty clay loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown silty clay loam about 4 inches thick. The subsoil is about 37 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled, calcareous silt loam. In places gray mottles are within a depth of 24 inches.

Included with this soil in mapping are small areas of Burchard and Steinauer soils. These soils formed in clay loam glacial till. They are generally in the more convex landscape positions. They make up about 5 percent of the unit.

Permeability is moderate in the Galva soil, and runoff is rapid. Available water capacity is high. The content of organic matter in the surface layer is about 3.5 to 4.5 percent. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

Figure 9.—Terraces in an area of Galva silty clay loam, 5 to 9 percent slopes, moderately eroded.

The land capability classification is IIIe.

310D2—Galva silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex upland side slopes. Individual areas range from 3 to 40 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 36 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown and is mottled. The upper part is silt loam, and the lower part is calcareous clay loam. In some places the depth to firm clay loam or friable loam glacial till is less than 40 inches. In other places the soil has a very dark brown or very dark grayish brown subsurface layer. In some areas the surface layer is mostly dark brown and brown.

Included with this soil in mapping are small areas of Burchard and Steinauer soils. These soils formed in clay loam glacial till. They are generally in the more convex landscape positions. They make up less than 5 percent of the unit.

Permeability is moderate in the Galva soil, and runoff is rapid. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by a combination of contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

428B—Ely silty clay loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is on slightly concave foot slopes and alluvial fans. Individual areas range from 3 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer also is very dark gray silty clay loam. It is about 16 inches thick. The subsoil is friable silty clay loam about 22 inches thick. The upper part is very dark grayish brown, the next part is dark grayish brown and is mottled, and the lower part is grayish brown and is mottled. The substratum to a depth of 60 inches or more is mottled grayish brown and yellowish brown silty clay loam. In some places the subsoil is dark brown and brown.

Permeability is moderate, and runoff is medium. This soil has a seasonal high water table. Available water capacity is high. The content of organic matter is about 5 to 6 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. In some areas runoff from soils upslope results in siltation and gullying. Grassed waterways help to remove excess water and prevent gullying. If cultivated crops are grown, water erosion is a hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface and crop rotations that include meadow crops. A tile drainage system reduces wetness and improves the timeliness of fieldwork in a few places. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

430—Ackmore silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on flood plains. It is occasionally flooded for very brief or brief periods unless it is protected. Individual areas range mainly from 5 to 50 acres in size, but some are as large as 100 acres. The areas are irregularly shaped.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum is very dark grayish brown and dark gray, stratified silt loam about 22 inches thick. Below this to a depth of 60 inches or more is a buried soil of silty clay loam. The upper part is black, and the lower part is black and very dark gray. In some places the soil is silt loam or silty clay loam throughout.

Included with this soil in mapping are some small areas of the moderately well drained Kennebec soils. These soils are generally higher on the landscape than the Ackmore soil. They dry out more quickly after rains and have a higher content of organic matter than the Ackmore soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Ackmore soil, and runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The content of organic matter is about 1 to 3 percent in the surface layer. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Flooding is a hazard. Most of the flooding occurs before crops are planted. Tile drains improve soil aeration and permit more timely tillage. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

A few small areas support native hardwoods. This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is properly managed.

The land capability classification is IIw.

430B—Ackmore silt loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is in narrow drainageways on uplands. It is subject to occasional, very brief periods of flooding. Individual areas range mainly from 5 to 50 acres in size, but some are as large as 100 acres. The areas are elongated.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The substratum is very dark grayish brown and very dark brown, stratified silt loam about 27 inches thick. Below this to a depth of 60 inches or more is a buried soil of black silty clay loam. In some places the soil is silt loam or silty clay loam throughout.

Included with this soil in mapping are some small areas of the moderately well drained Kennebec soils. These soils are generally higher on the landscape than the Ackmore soil. They dry out more quickly after rains and have a higher content of organic matter than the Ackmore soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Ackmore soil, and runoff is medium. Available water capacity is high. This soil has a seasonal high water table. The content of organic matter is about 1 to 3 percent in the surface layer. The substratum generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture if it is adequately drained. Flooding is a hazard. Most of the flooding occurs before row crops are planted. Tile drains improve soil aeration and permit more timely tillage. In places diversion terraces help to control runoff from the adjacent soils. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material helps to maintain tilth, improves fertility, and helps to prevent surface crusting.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

A few small areas support native hardwoods. This soil is moderately well suited to trees. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is properly managed.

The land capability classification is IIw.

474C—Bolan loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on convex upland side slopes and ridgetops. Most areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 4 inches thick. The subsoil is about 37 inches thick. The upper part is brown, friable loam; the next part is brown, very friable sandy loam; and the lower part is brown, very friable loamy sand. The substratum to a depth of 60 inches or more is yellowish brown sand. In places the soil is silt loam below a depth of 40 inches. In some areas, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer. In many places the slope is 2 to 5 percent.

Included with this soil in mapping are small areas of soils that have a sand or loamy sand surface layer, subsurface layer, and subsoil. These soils are in the more convex landscape positions. They are more droughty than the Bolan soil. They make up about 5 percent of the unit.

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

Most areas are cultivated. A few areas are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. It is well suited to grasses and legumes for hay and pasture. Erosion is a hazard, especially on the longer slopes. Also, corn and soybeans are damaged by drought in years when the distribution of rainfall is poor. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and soil blowing and conserves moisture. Contour farming also helps to control erosion. If terraces are constructed on this soil, the cuts could expose the more droughty fine sandy loam or loamy fine sand underlying the loam. Exposing this more droughty material reduces the available water capacity and hinders plant growth. Returning crop residue to the soil or regularly adding other organic material helps to maintain good tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay reduces the runoff rate and helps to control erosion. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

474D2—Bolan loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on convex upland side slopes. Most areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. Plowing has mixed streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 28 inches thick. The upper part is brown, friable loam; the next part is yellowish brown, very friable fine sandy loam; and the lower part is yellowish brown loamy sand. The substratum to a depth of 60 inches or more is yellowish brown loamy sand and sand. In places the soil is silt loam below a depth of 40 inches. In some areas the soil has a very dark grayish brown subsurface layer.

Included with this soil in mapping are small areas of soils that have a sand or loamy sand surface layer, subsurface layer, and subsoil. These soils are in the more convex landscape positions. They are more droughty than the Bolan soil. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Bolan soil and rapid in the substratum. Runoff is rapid. Available water capacity is moderate. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. A few areas are used for hay or pasture. This soil is suited to corn, soybeans, and small grain. It is well suited to grasses and legumes for hay and pasture. Erosion is a serious hazard. Also, corn and soybeans are damaged by drought in years when the distribution of rainfall is poor. A system of conservation tillage that leaves crop residue on the surface helps to control erosion and soil blowing and conserves moisture. Contour farming also helps to control erosion. If terraces are constructed on this soil, the cuts could expose the more droughty fine sandy loam or loamy fine sand underlying the loam. Exposing this more droughty material reduces the available water capacity and hinders plant growth. Returning crop residue to the soil or regularly adding other organic material helps to maintain good tilth, improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay reduces the runoff rate and helps to control erosion. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition.

The land capability classification is IIIe.

475B—Arthur silty clay loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on upland side slopes and narrow ridgetops. Individual areas range from 2 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown silty clay loam about 4 inches thick. The subsoil is about 29 inches thick. The upper part is brown, friable silty clay loam; the next part is yellowish brown, friable silty clay loam; and the lower part is yellowish brown, very friable, stratified loamy sand, sand, and sandy loam. The substratum to a depth of 60 inches or more is stratified yellowish brown loamy sand and sand. In some places the surface layer is loam. In other places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer. In some areas the depth to the sandy substratum is less than 24 inches or more than 40 inches.

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

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is seasonally droughty because of the sandy substratum. If cultivated crops are grown, erosion is a hazard. It can be controlled by contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. If terraces are constructed on this soil, the cut areas are more droughty and less productive, especially where the sandy substratum is exposed. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

475C2—Arthur silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on upland side slopes and narrow ridgetops. Individual areas range from 2 to 30 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 23 inches thick. The upper part is very dark grayish brown and brown, friable silty clay loam; the next part is brown, friable silty clay loam; and the lower part is yellowish brown, very friable sandy loam. The substratum to a depth of 60 inches or more is light yellowish brown and yellowish brown sand. In some places the surface layer is loam. In other places the soil has a very dark grayish brown subsurface layer. In some areas a high proportion of brown subsoil material is mixed with the very dark grayish brown material in the surface layer. In places the depth to the sandy substratum is less than 24 inches or more than 40 inches.

Included with this soil in mapping are small areas of soils that have a gravelly substratum. These soils are on stream terraces. They make up about 5 percent of the unit.

Permeability is moderate in the upper part of the Arthur soil and rapid in the substratum. Runoff is medium. Available water capacity is moderate. The content of organic matter is about 2 to 3 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is seasonally droughty because of the sandy substratum. If cultivated crops are grown, further erosion is a hazard. It can be controlled by contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. If terraces are constructed on this soil, the cut areas are more droughty and less productive, especially where the sandy substratum is exposed. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

475D2—Arthur silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained soil is on upland side slopes. Individual areas range from 2 to 15 acres in size and are irregularly shaped.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 27 inches thick. The upper part is brown, friable silty clay loam; the next part is brown, friable silt loam; and the lower part is yellowish brown, friable loam. The substratum to a depth of 60 inches or more is light yellowish brown and yellowish brown sand. In some places the surface layer is loam. In other places the soil has a very dark grayish brown subsurface layer. In some areas the depth to the sandy substratum is less than 24 inches or more than 40 inches.

Permeability is moderate in the upper part of the Arthur soil and rapid in the substratum. Runoff is rapid. Available water capacity is moderate. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. It is seasonally droughty because of the sandy substratum. If cultivated crops are grown, further erosion is a hazard. It can be controlled by a combination of contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. If terraces are constructed on this soil, the cut areas are more droughty and less productive, especially where the sandy substratum is exposed. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth, improve fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

509—Marshall silty clay loam, benches, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, loess-covered stream benches. Individual areas range from 5 to 100 acres in size and are long or broad and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown, friable silty clay loam about 12 inches thick. The subsoil to a depth of 60 inches or more is friable silty clay loam. The upper part is brown, and the lower part is yellowish brown.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in

maintaining good tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is I.

509B—Marshall silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream benches. Individual areas range from 3 to 200 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 11 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The subsoil extends to a depth of 60 inches or more. It is friable. In sequence downward, it is dark brown and brown silty clay loam, brown silty clay loam, yellowish brown silty clay loam, and yellowish brown silt loam. In a few places the depth to sand and gravel is less than 40 inches. In some areas, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

509C—Marshall silty clay loam, benches, 5 to 9 percent slopes. This moderately sloping, well drained soil is on side slopes of stream benches. Individual areas range from 3 to 20 acres in size and are long and narrow.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is silty clay loam about 11 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown and dark brown. The subsoil extends to a depth of 60 inches or more. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. In a few places the depth to sand and gravel is less than 40 inches. In some areas, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain good tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

509C2—Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on side slopes of stream benches. Individual areas range from 3 to 20 acres in size and are long and narrow.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil extends to a depth of 60 inches or more. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. In a few places the depth to sand and gravel is less than 40 inches. In some areas the soil has a very dark brown and very dark grayish brown subsurface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.2 to 3.2 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain good tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

740C—Hawick gravelly sandy loam, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is on side slopes of stream terraces. Individual areas range from 2 to 10 acres in size and are long or irregularly shaped.

Typically, the surface layer is very dark brown, calcareous gravelly sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown, calcareous sandy loam about 5 inches thick. The subsoil is brown, very friable, calcareous gravelly loamy sand about 6 inches thick. The substratum to a depth of 60 inches or more is stratified brown, yellowish brown, and pale brown, calcareous gravelly sand and gravelly coarse sand. In places the slope is 2 to 5 percent.

Included with this soil in mapping are small areas of soils that formed in clayey material. These soils are in landscape positions similar to those of the Hawick soil. They make up about 5 percent of the unit.

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

Some areas are cultivated. Some areas are used for hay and pasture. This soil is poorly suited to corn, soybeans, and small grain. It is better suited to grasses and legumes for hay and pasture. If cultivated crops are grown, droughtiness and erosion limit crop production. Erosion can be controlled by contour farming, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material help to maintain tilth, improve fertility, and conserve moisture.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous, droughty soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture in good condition.

The land capability classification is IVs.

740E—Hawick gravelly sandy loam, 9 to 18 percent slopes. This strongly sloping to moderately steep, excessively drained soil is on side slopes of stream terraces. Individual areas range from 2 to 10 acres in size and are long or irregularly shaped.

Typically, the surface layer is very dark brown gravelly sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown, calcareous sandy loam about 5 inches thick. The subsoil is brown, loose, calcareous gravelly loamy sand about 6 inches thick. The substratum to a depth of 60 inches or more is stratified yellowish brown, light yellowish brown, and pale brown, calcareous gravelly sand and gravelly coarse sand.

Included with this soil in mapping are small areas of soils that formed in clayey material. These soils are in landscape positions similar to those of the Hawick soil. They make up about 5 percent of the unit.

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

Most areas are used for pasture. This soil is unsuited to corn, soybeans, and small grain. It is better suited to grasses and legumes for hay and pasture. Some areas support forage grasses for wildlife habitat or for grazing after harvest. Droughtiness and a hazard of erosion limit crop production.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous, droughty soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture in good condition.

The land capability classification is VIs.

740G—Hawick gravelly sandy loam, 18 to 40 percent slopes. This steep or very steep, excessively drained soil is on side slopes of stream terraces. Individual areas range from 2 to 20 acres in size and are long or irregularly shaped.

Typically, the surface layer is very dark brown and very dark grayish brown, calcareous gravelly sandy loam about 9 inches thick. The subsurface layer is very dark grayish brown, calcareous sandy loam about 4 inches thick. The subsoil is brown, very friable, calcareous, stratified gravelly loamy sand and gravelly sand about 7 inches thick. The substratum to a depth of 60 inches or more is brown and pale brown, calcareous, stratified gravelly sand and gravelly coarse sand.

Included with this soil in mapping are small areas of soils that formed in clayey, silty, and loamy material. These soils are on the lower part of the side slopes. They make up about 10 percent of the unit.

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

Most areas are used for pasture. This soil is unsuited to corn, soybeans, and small grain and to legumes for hay, mainly because of droughtiness, the slope, and the hazard of erosion. It is better suited to grasses and legumes for pasture.

A cover of pasture plants or hay is effective in controlling erosion. Species that can grow well in a calcareous, droughty soil should be selected for planting. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during dry periods, help to keep the pasture in good condition.

The land capability classification is VIIs.

810—Galva silty clay loam, benches, 0 to 2 percent slopes. This nearly level, well drained soil is on broad, loess-covered stream benches. Individual areas range from 10 to 200 acres in size and are long and irregularly shaped or broad and irregularly shaped.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 12 inches thick. The upper part is black, and the lower part is very dark grayish brown. The subsoil to a depth of 60 inches or more is brown, friable silty clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. The content of organic matter is about 4 to 5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in maintaining tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is I.

810B—Galva silty clay loam, benches, 2 to 5 percent slopes. This gently sloping, well drained soil is on stream benches. Individual areas range from 3 to 200 acres in size and are long and irregularly shaped.

Typically, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsurface layer is very dark grayish brown and very dark brown silty clay loam about 6 inches thick. The subsoil extends to a depth of 60 inches or more. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The upper part of the substratum, to a depth of about 100 inches, is yellowish brown, mottled silt loam. The lower part to a depth of more than 100 inches is yellowish brown sand and loamy sand. In some places the depth to sand and gravel is less than 40 inches. In some places, the soil does not have a subsurface layer and brown subsoil material is mixed with the surface layer.

Permeability is moderate, and runoff is medium. Available water capacity is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIe.

810C2—Galva silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, well drained soil is on side slopes of stream benches. Individual areas range from 3 to 20 acres in size and are long and narrow.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. Plowing has mixed some streaks and pockets of brown subsoil material into the surface layer. The subsoil is about 43 inches thick. It is friable. The upper part is brown silty clay loam; the next part is yellowish brown silty clay loam; and the lower part is yellowish brown, mottled silt loam. The substratum to a depth of 60 inches or more is yellowish brown, stratified silt loam, loam, and sandy loam. In some places the depth to sand and gravel is less than 40 inches.

Included with this soil in mapping are small areas of soils that formed in gravelly material. These soils are in landscape positions similar to those of the Galva soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Galva soil, and runoff is medium. Available water capacity is high. The content of organic matter is about 2.7 to 3.7 percent in the surface layer. The subsoil generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is suited to corn and soybeans in rotation with small grain and grasses and legumes for hay and pasture. If cultivated crops are grown, further water erosion is a hazard. It can be controlled by contour farming, terraces, a system of conservation tillage that leaves crop residue on the surface, and crop rotations that include meadow crops. Returning crop residue to the soil or regularly adding other organic material and deferring tillage when the soil is wet help to maintain good tilth and fertility, help to prevent surface crusting, and increase the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

The land capability classification is IIIe.

1220—Nodaway silt loam, channeled, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in areas of recent deposition on low flood plains. It is frequently flooded for very brief or brief periods unless it is protected. Individual areas range mainly from 5 to 100 acres in size, but some are as large as 300 acres. The areas are irregularly shaped.

Typically, the surface layer is very dark brown silt loam about 10 inches thick. The substratum to a depth of 60 inches or more is stratified dark grayish brown, grayish brown, and very dark gray silt loam. In places black or very dark gray silty clay loam is within a depth of 36 inches.

Included with this soil in mapping are small areas of gravelly soils. These soils are at elevations similar to those of the Nodaway soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Nodaway soil, and runoff is slow. Available water capacity is high. This soil has a seasonal high water table. The content of organic matter is about 1.5 to 2.5 percent in the surface layer. The substratum generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture, woodland, or wildlife habitat. A few areas are cultivated. This soil is generally unsuited to corn, soybeans, and small grain because of the frequent flooding, siltation, and stream channels. The soil is lower than the other soils on the flood plains and may be flooded in any season. It is suited to grasses and legumes for hay and pasture. A system of conservation tillage that leaves crop residue on the surface helps to maintain good tilth.

A cover of pasture plants or hay is effective in controlling channeling or soil washing by floodwater. Proper stocking rates, pasture rotation, and timely deferment of grazing, especially during wet periods, help to keep the pasture in good condition.

Many small areas support native hardwoods. This soil is suited to trees if flooding is controlled. No major hazards or limitations affect planting or harvesting if suitable species are selected for planting and the stand is properly managed.

The land capability classification is Vw.

5010—Pits, sand and gravel. This map unit is mainly on stream terraces. Individual areas range from 4 to 20 acres in size and are rectangular or irregularly shaped.

A few pits contain ground water, but most do not. Some pits that have been abandoned for a number of years support trees, shrubs, and herbaceous vegetation. The density of the vegetation varies, depending on the gravel content of the remaining material. Most pits are suitable as wildlife habitat.

No land capability classification is assigned.

5040—Orthents, loamy. These nearly level to moderately steep soils are in areas of uplands, benches, terraces, and flood plains where part or all of the original soil has been excavated or buried by fill. Individual areas range from 2 to 45 acres in size and are roughly square or rectangular or long and narrow.

Typically, the surface layer is silty clay loam about 12 inches thick. It is mixed material from the topsoil, subsoil, or substratum of the original soil. In uplands the underlying material is brown or grayish brown silt loam or silty clay loam in most places. On stream terraces and flood plains, the underlying material is mixed loamy material underlain by sandy or gravelly material in most places.

Included with these soils in mapping are areas that are covered by roads or structures, areas that are used for solid waste disposal, and areas that have a coarse textured surface layer. Areas that are used for solid waste disposal vary greatly, depending on the kind and amount of fill covering the solid waste. Areas that have coarse textures are droughty and have a relatively low available water capacity. These areas make up about 15 percent of the unit.

The properties of the Orthents vary greatly from place to place. The most common Orthents in the uplands are moderately permeable. Surface runoff is medium. Available water capacity is moderate or high.

Most areas support grasses and legumes for hay and pasture. Some areas are cultivated. Cultivated crops are more productive in areas where grasses and legumes are grown for several years after the borrow areas have been reclaimed. Growing grasses and legumes increases the content of organic matter in the surface layer and the upper part of the underlying material. Erosion and soil blowing are hazards in cultivated areas. A conservation tillage system that leaves crop residue on the surface and contour farming help to control erosion and soil blowing.

A cover of pasture plants and hay helps to minimize soil loss. Proper stocking rates, pasture rotation, and timely deferment of grazing help to keep the pasture in good condition.

No land capability classification is assigned.

Prime Farmland

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

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

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

About 113,000 acres in the survey area, or nearly 41 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the northern and central parts, mainly in associations 2, 3, and 4, which are described under the heading "General Soil Map Units." About 100,000 acres of this prime farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated one-half of the county's total agricultural income each year.

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

Not all of the prime farmland soils in Ida County are equally suited to all of the commonly grown crops. For example, some crops require a sustained moisture supply throughout the season. These crops tend to grow better on soils that have a high available water capacity, such as Marshall silty clay loam, 2 to 5 percent slopes, than on soils that have only a moderate available water capacity, such as Arthur silty clay loam, 2 to 5 percent slopes.

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

Use and Management of the Soils

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

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

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

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

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

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

Crops and Pasture

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

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

In 1986, about 218,600 acres in Ida County was used for crops and about 49,000 acres was used for pasture or other noncrop uses. About 119,000 acres was used for corn, 76,900 acres for soybeans, 22,800 acres for oats, and 18,300 acres for alfalfa and other hay (Skow, 1987). The acreage used for corn and soybeans has increased in recent years, but that used for hay and pasture has decreased.

The soils in Ida County have good potential for sustained, efficient crop production if proper management is applied. This soil survey provides soil information that can facilitate the application of such management. The paragraphs that follow describe the most important management concerns in the county and the crop production technology that is related to those concerns.

Water erosion is the major soil management concern on about 79 percent of the land in Ida County if this land is used for crops. Water erosion is a hazard where slopes are more than about 3 percent. The hazard of erosion becomes progressively more severe as the slope gradient increases. The most common types of water erosion in the county are sheet and rill erosion. Gully erosion also occurs in part of the county.

Water erosion reduces crop production efficiency. Yields are reduced by topsoil losses, and additional fertilizers can only partially compensate for lost topsoil (Mielke and Schepers, 1986). Fertilizers and other soil-applied chemicals are lost along with topsoil as a result of erosion.

Soil losses are sometimes underestimated because tillage generally maintains the thickness of the surface layer by incorporating material from the subsurface layer or subsoil into the surface layer. As a result of tillage, the fertility and the content of organic matter in the surface layer may be reduced. Also, the content of clay in the surface layer may increase in some of the soils in Ida County. Some soils, such as the slightly eroded Marshall and Monona soils, have slightly more clay in the upper part of the subsoil than in the surface layer. In areas that are moderately or severely eroded, these soils have more clay in the surface layer than in the subsoil. The loss of organic matter from the surface layer also makes these soils more erodible. Monona soils, for example, are much less erodible than soils that have comparable textures but that have less organic matter (Meyer and Harman, 1984).

Soils in certain landscape positions are also more erodible than other soils (Johnson, 1988). For example, Monona soils on the upper side slopes and on some convex ridgetops are more erodible than the same soils on the lower side slopes. Most erosion on convex ridgetops and side slopes occurs as sheet and rill erosion.

Another kind of water erosion, gully erosion, is less common in the county than sheet and rill erosion, but it is a serious problem where it occurs. Most gully erosion is in the more sloping areas of the Monona-Marshall association, which is described under the heading "General Soil Map Units." Accelerated runoff from the adjacent, less sloping cultivated soils increases the rate of gully erosion on the more sloping soils.

Erosion can be controlled by cultural practices, structures, or both. Cultural practices include farming on the contour and using conservation tillage systems that maintain a protective cover of crop residue on at least 30 percent of the surface. Structures, such as terraces and sediment-control basins, control erosion by reducing the effective length of slopes.

Conservation tillage systems have both short-term and long-term benefits. By increasing the amount of crop residue on the soil surface, they reduce the runoff rate and help to control erosion on sloping soils. Most conservation tillage systems also result in less total tillage. Research has indicated that soils receiving relatively less tillage over a long period have a higher content of organic matter and higher levels of nitrogen, even where there is no erosion difference (Lamb and others, 1985). Other changes in physical and chemical properties of the soils are associated with conservation tillage. Most of these changes improve soil productivity or reduce production costs. On some soils under some conditions, more soil nitrogen is lost through leaching and as gaseous nitrous oxide under no-till farming than under conventional tillage methods (Evangelou and Blevins, 1985; Groffman, 1985; Rice and Smith, 1982). In general, the most effective conservation tillage systems are those that leave the largest amount of crop residue on the soil surface.

Some examples of conservation tillage systems are no-till or slot-plant, ridge-till, till-plant, and certain pre-planting tillage operations. In no-till or slot-plant, ridge-till, and till-plant systems, the seedbed is prepared and the seed planted in one operation and much of the protective crop residue is left on the surface. In no-till or slot-plant systems, a fluted coulter prepares a narrow seedbed. In a ridge-till system, a sweep prepares a seedbed by clearing residue from the top of the row-crop ridge from the previous year. In a till-plant system, a tillage implement prepares a seedbed strip no wider than one-third of the row width. A protective cover of residue is left on two-thirds of the row width. These conservation tillage systems also help to control soil blowing, which is a serious hazard on some soils, such as those of the Dickman series.

Ridge-till planting has been increasing in Ida County in recent years. In addition to controlling erosion, ridge-till planting has reduced soil moisture losses and the time and expense required for planting.

Chisel plowing and discing are common tillage practices in Ida County. These practices can be incorporated into a conservation tillage system. Many soils, however, do not have enough residue on the surface after chisel plowing or discing to control water erosion or soil blowing. On some farms, the cover of residue is reduced by changes in chisel size or shape, spacing, or tillage depth. On other farms, the amount of residue needed to protect the soil is reduced by contour farming and terraces. Any fall tillage that covers residue increases the erodibility of sloping soils. Unless a protective cover of crop residue is provided, the soils tend to freeze and thaw more often through the winter. With each freezing and thawing cycle, the soil aggregates become finer and less strongly bonded; therefore, the soil is more erodible (Comis, 1989). Leaving crop residue on the surface after planting is necessary to control water erosion effectively on sloping soils, such as Galva, Marshall, and Monona soils, and to control soil blowing on sandy soils, such as Dickman soils. Crop residue or vegetative cover is also important on field borders of contoured and terraced fields.

Contour farming and stripcropping help to control erosion on many soils in the county. These practices are most effective in areas where slopes are smooth and uniform. For example, many areas of Galva soils and some areas of Marshall and Monona soils are well suited to contour farming and stripcropping (fig. 10).

Farmers and researchers have observed that sloping soils are more erodible when they are used for soybean

Figure 10.—Contour stripcropping helps to control erosion in this area of Monona soils.

production than for corn production. Soil aggregate size and stability are not maintained as well when soybeans are grown (Bathke and Blake, 1984). A conservation tillage system, especially no-till, helps to compensate for the increased erodibility resulting from the production of soybeans.

Terraces and sediment-control basins can be used alone or in combination with a conservation tillage system to control water erosion on many soils in Ida County. These structures are most effective and practical in areas where slopes are relatively long, where the soils do not have sandy, unproductive material that will be exposed, or where the soils are not so shallow that productivity is reduced after construction. Some of the newer terrace designs that include steeper, unfarmable slopes require much less fill material than conventional broad-base terraces. These designs can be used on the more sloping Monona and Ida soils that are less suited to broad-base terraces than the less sloping soils.

Minimizing the area of cut is beneficial on all of the soils in the county that are suited to terraces. Terraces and sediment-control basins are not practical on some soils. Terrace cuts can expose sandy, unproductive material in some soils, such as Bolan and Dickman soils. Information and assistance in designing erosion-control practices are available at the local office of the Natural Resources Conservation Service.

Irrigation is beneficial in most years on soils that tend to be droughty, such as Allendorf, Arthur, Bolan, and Dickman soils. Irrigation is also beneficial on most of the soils in Ida County during years in which rainfall distribution is poor. Aquifers in the major stream valleys and in the Nishnabotna member of the Dakota Formation (Munter and others, 1983) have a sufficient quantity of water for irrigation.

Crop production technology also includes selecting appropriate crops and crop varieties and using agricultural chemicals and fertilizers. Crops that use most of the growing season to mature, such as full-season corn or soybeans, grow poorly on droughty soils, such as Dickman soils, in years during which the distribution of rainfall is poor. In most years, crops that mature earlier in the season, such as wheat and oats, are more productive than full-season corn or soybeans on Allendorf, Bolan, and Dickman soils. Deep-rooted perennial crops, such as alfalfa, also grow well on these soils in most years because they can utilize soil moisture from a much greater depth than annual crops. Where soil pH has been reduced by corn production, applications of lime improve the growth of alfalfa and other legumes.

Many soil-applied herbicides are sensitive to levels of organic matter, soil pH, and clay content. Many fields in Ida County that are managed as a unit contain areas of soils that have widely varying amounts of organic matter and clay and varying pH levels in the surface layer. For example, the slightly eroded Monona soils are associated in many fields with the severely eroded Ida soils. In fields that include these soils, the content of organic matter in the surface layer ranges from about 0.5 to 4.0 percent. The pH in the surface layer may vary from about 5.6 to 8.0, and the content of clay in the surface layer ranges from about 20 to 30 percent. Some soil-applied herbicides perform poorly in soils whose properties have these ranges.

Tile drainage is needed for the production of cultivated crops on most poorly drained soils, which make up about 14 percent of the acreage in Ida County. Some poorly drained soils on flood plains, such as Colo soils, are adequately drained with open ditches. Some areas are drained with a combination of tile and open ditches. On some farms, tile drainage is also beneficial on somewhat poorly drained soils, such as Ely and Primghar soils, because it improves the timeliness of tillage. Some areas of poorly drained and somewhat poorly drained soils that are used only for pasture need little or no artificial drainage. Information and assistance in designing artificial drainage systems are available at the local office of the Natural Resources Conservation Service.

Soil sampling for fertility tests is an important part of crop production technology. Soil test data is most useful when the combined sample that is analyzed is from areas of soils that have similar properties, such as Galva and Sac soils. If the past fertility management of part of a field is known to have been different, however, that part of the field generally should be sampled separately, even when the soils have similar properties. Soils that have different properties, such as Dickman, Ida, and Monona soils, should be sampled separately, even if the same management is planned. For example, a Dickman soil generally would be sampled separately from a Monona soil for lime requirement analysis. More specific information on soil sampling for fertility tests is available at the local office of the Cooperative Extension Service.

In 1986, about 25,000 acres in Ida County was used for pasture. Some areas are used for pasture in rotation with row crops, but permanent pasture is in most areas of soils that are too sloping, too wet, or too frequently flooded to be used for cultivated crops in most years. A cover of pasture plants is effective in controlling water erosion and soil blowing. The most common pasture plants are bromegrass and bluegrass. On most of the soils in Ida County, seeding pastures to tall warm-season native grasses, such as big bluestem, indiangrass, and switchgrass, provides good summer grazing (Hitchcock, 1950). Other seeded pasture plants, such as reed canarygrass, orchardgrass, birdsfoot trefoil, ladino clover, and red clover, provide forage in spring and fall when the tall warm-season grasses are more susceptible to damage by grazing.

Forage production can be enhanced by good management practices. On established stands these practices include fertilizer applications, weed and brush control, rotation and deferred grazing in a full-season grazing system, proper stocking rates, and adequate livestock watering facilities. More specific information on pasture plant selection, seeding methods, and pasture management is available at the local offices of the Cooperative Extension Service and the Natural Resources Conservation Service.

Yields per Acre

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

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

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

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

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

Land Capability Classification

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

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

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

Corn Suitability Rating (CSR)

The corn suitability rating for each soil is given in table 6. Corn suitability ratings provide a relative ranking of all soils mapped in the state of Iowa based on their potential to be utilized for the intensive production of row crops. The CSR is an index that can be used to rate the potential production of one soil compared with another over a period of time. The CSR considers average weather conditions and frequency of use of the soil for row crops. Ratings range from 5 for soils that have severe limitations affecting the production of row crops to 100 for soils that have no physical limitations, have minimal slopes, and can be continuously row cropped. The ratings listed in table 6 assume adequate management, natural weather conditions (no irrigation), artificial drainage where required, and no land leveling or terracing. They also assume that soils lower on the landscape are not affected by frequent, damaging floods. The weighted CSR for a given field can be modified by the occurrence of sandy spots, local deposits, rock and gravel outcrops, field boundaries, and noncrossable drainageways. Even though predicted average yields will change with time, the CSR's are expected to remain relatively constant in relation to one another.

The CSR's in Ida County range from 82 for Marshall silty clay loam, benches, 0 to 2 percent slopes, to 5 for several soils, including Hawick gravelly sandy loam, 5 to 9 percent slopes. No ratings are provided for miscellaneous areas because of the variability of properties and use of these areas.

Woodland Management and Productivity

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

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

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

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

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

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

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

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

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

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

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

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

Windbreaks and Environmental Plantings

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

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

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

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

Recreation

Ida County provides many opportunities for outdoor recreation. Two parks maintained by the County Conservation Board are the main water-based recreational facilities. They also offer picnicking, camping, and winter sports. The Maple River is also used for boating and fishing. Numerous farm ponds provide fishing opportunities (fig. 11).

All communities in the county maintain municipal parks. The American Legion maintains a park at the western edge of Ida Grove. The county has two golf courses. Also, a privately sponsored scale model air show is an annual event. The potential for the development of additional public recreational facilities is good.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

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

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

Figure 11.—A farm pond provides recreational opportunities. Erosion control on the surrounding Monona soils maintains the quality of water and the depth of the pond.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

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

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

Wildlife Habitat

The soils, water, and vegetation in Ida County provide habitat for a variety of fish and wildlife. The streams and shallow water areas provide habitat for furbearing animals and resting and feeding areas for migratory waterfowl and shore birds. Small populations of Canada geese, ducks, and mute swans inhabit the Ida Grove area year-round.

Cottontail rabbits, coyotes, white-tailed jackrabbits, Hungarian partridge, pheasant, quail, red fox, eastern fox squirrels, black squirrels, whitetail deer, woodchucks, and numerous predatory birds and songbirds inhabit many areas of the county. Wild turkeys have been observed in areas of the Galva-Steinauer-Burchard association, which is described under the heading "General Soil Map Units."

The rivers, streams, and impoundments in the county are the habitat for bluegill, bullhead, channel catfish, crappie, largemouth bass, green sunfish, perch, and northern pike. Soil areas adjacent to rivers, streams, and impoundments have the best potential for wildlife habitat. All of the soil associations in Ida County contain some water areas, but these areas are most common in the Galva-Steinauer-Burchard and Kennebec-Colo-Galva associations.

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

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

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

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

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

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

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage.

Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

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

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

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

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

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

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

Engineering

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

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

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

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

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

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

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

The soils in Ida County were not sampled for engineering analysis, but some of the same soils in nearby counties have been sampled and analyzed. The engineering test data for these soils (Miller, 1978) and an explanation of the analytical procedures (Hallberg, 1978) can also be used to make additional interpretations.

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

Building Site Development

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

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

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

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

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

Sanitary Facilities

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

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

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

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

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

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

Construction Materials

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

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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 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 or stones, 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 or stones, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and

Figure 12.—Erosion on grassed back slope terraces in an area of Monona soils. The small, lighter colored areas are Ida soils.

special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

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

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment.

Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. 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 or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance (fig. 12).

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

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Soil Properties

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

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

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

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

Engineering Index Properties

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

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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

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

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

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

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

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

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

Physical and Chemical Properties

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil and Water Features

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

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

The four hydrologic soil groups are:

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

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

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

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

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

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

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

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

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

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. Only saturated zones within a depth of about 6 feet are indicated.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu,* meaning water, plus *oll,* from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl,* meaning minimal horizonation, plus *aquoll,* the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Ackmore Series

The Ackmore series consists of somewhat poorly drained, moderately permeable soils on flood plains and in the lower part of upland drainageways. These soils formed in recent stratified alluvium over an older buried soil. The native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Ackmore silt loam, 0 to 2 percent slopes, in a cultivated field; 460 feet south and 125 feet east of the northwest corner of sec. 28, T. 86 N., R. 39 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few very fine distinct grayish brown (10YR 5/2) and brown (7.5YR 4/4) mottles; weak very fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

C1—8 to 18 inches; very dark grayish brown (10YR 3/2) silt loam that has a few dark grayish brown (10YR 4/2) lenses, grayish brown (10YR 5/2) dry; massive with horizontal parting; friable; few very fine roots; neutral; gradual smooth boundary.

C2—18 to 30 inches; stratified very dark grayish brown (10YR 3/2) and dark gray (10YR 4/1) silt loam; massive with horizontal parting; friable; very few very fine roots; neutral; clear smooth boundary.

2Ab1—30 to 40 inches; black (10YR 2/1) silt loam; weak fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

2Ab2—40 to 52 inches; black (10YR 2/1) silty clay loam; weak fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

2ABb—52 to 60 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silty clay loam; few fine distinct dark gray (10YR 4/1) mottles; moderate medium and fine subangular blocky structure; friable; neutral.

The thickness of the A and C horizons ranges from 20 to 36 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam. The strata in the C horizon have value of 2 to 5 and chroma of 1 or 2. Colors on each end of the color range are mainly in thin strata. The 2Ab horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1 to a depth of 48 inches or more.

Afton Series

The Afton series consists of poorly drained, moderately slowly permeable soils in upland drainageways. These soils formed in loess and alluvium. The native vegetation was prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Afton silty clay loam, 0 to 2 percent slopes, in a cultivated field; 470 feet north and 150 feet east of the southwest corner of sec. 3, T. 89 N., R. 40 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; few very fine distinct dark brown (7.5YR 3/4) mottles; weak fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

A1—7 to 14 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky and granular structure; friable; few very fine roots; neutral; gradual smooth boundary.

A2—14 to 23 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; very few fine distinct dark grayish brown (10YR 4/2) mottles; moderate very fine subangular blocky and granular structure; friable; few very fine roots; neutral; clear smooth boundary.

Bg1—23 to 27 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; few fine and medium distinct olive gray (5Y 4/2) and few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine and very fine prismatic and subangular blocky structure; friable; few very fine roots; mildly alkaline; gradual smooth boundary.

Bg2—27 to 33 inches; dark gray (5Y 4/1) silty clay loam; black (5Y 2.5/1) on faces of peds; common fine and medium faint olive gray (5Y 5/2) and few fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine prismatic and subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

Bg3—33 to 42 inches; olive gray (5Y 5/2) and dark gray (5Y 4/1) silty clay loam; few fine distinct brown (7.5YR 4/4) mottles; weak fine prismatic structure; friable; mildly alkaline; clear smooth boundary.

Cg—42 to 60 inches; gray (5Y 5/1) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) mottles; massive; friable; common fine and medium concretions and segregations of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. Free carbonates are in the lower part of the solum or immediately below it. The mollic epipedon is 24 to 32 inches thick.

The A horizon is 20 to 30 inches thick. It has value of 2 or 3 and chroma of 0 or 1. Some pedons have an AB horizon. The Bg horizon has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 2 or less. In most pedons it has mottles with higher value or higher chroma. The Cg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 or less.

Allendorf Series

The Allendorf series consists of well drained soils on stream terraces. These soils formed in loess or silty and loamy alluvium overlying sandy sediments. Permeability is moderate in the solum and very rapid in the sandy sediments. The native vegetation was tall prairie grasses. Slopes range from 0 to 3 percent.

The Allendorf soils in Ida County are taxadjuncts because the silty material is slightly thinner than is defined as the range for the series. Also, the loam transitional layer is slightly thicker than is typical. These soils are classified as fine-silty over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls.

Typical pedon of Allendorf silty clay loam, 0 to 3 percent slopes, in a cultivated field; 2,280 feet north and 330 feet east of the southwest corner of sec. 6, T. 89 N., R. 41 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; very few very fine roots; slightly acid; abrupt smooth boundary.

A—7 to 14 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak fine and very fine subangular blocky and granular structure; friable; very few very fine roots; slightly acid; clear smooth boundary.

Bw1—14 to 20 inches; brown (10YR 4/3) silty clay loam; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) on faces of peds; weak fine and very fine subangular blocky structure; friable; very few very fine roots; common very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) pore fillings; neutral; clear smooth boundary.

Bw2—20 to 28 inches; brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) on few faces of peds; weak medium and fine subangular blocky structure; friable; very few very fine roots; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) pore fillings; neutral; clear smooth boundary.

2Bw3—28 to 34 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; very few very fine roots; about 14 percent coarse fragments; neutral; clear smooth boundary.

2BC—34 to 39 inches; brown (10YR 4/3) very gravelly sandy loam; dark brown (10YR 3/3) on faces of peds; weak medium prismatic and subangular blocky structure; friable; about 40 percent coarse fragments; slight effervescence in the lower part; mildly alkaline; clear smooth boundary.

2C—39 to 60 inches; brown (10YR 4/3) very gravelly loamy sand; single grained; loose; about 47 percent coarse fragments; lime-cemented sand on undersides of coarse fragments; slight effervescence to a depth of 54 inches, strong effervescence at a depth of 54 to 60 inches; mildly alkaline.

The thickness of the solum and the depth to carbonates range from about 30 to 40 inches. The thickness of the silty and loamy material ranges from about 30 to 40 inches. The mollic epipedon is 10 to 18 inches thick.

The A horizon is 10 to 18 inches thick. It has value and chroma of 2 or 3. It is silty clay loam or silt loam. Some pedons have an AB or a BA horizon. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or silt loam and is 24 to 32 percent clay. The 2B horizon is loam or sandy loam. It contains coarse fragments in most pedons. The 2C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 to 6. It is gravelly or very gravelly loamy sand or sand. The content of coarse fragments varies with depth and location.

Arthur Series

The Arthur series consists of well drained soils on upland ridgetops and side slopes. These soils formed in loess and in the underlying sandy sediments. Permeability is moderate in the solum and very rapid in the sandy sediments. The native vegetation was tall prairie grasses. Slopes range from 2 to 14 percent.

Typical pedon of Arthur silty clay loam, 2 to 5 percent slopes, in a cultivated field; 2,400 feet west and 150 feet north of the southeast corner of sec. 25, T. 87 N., R. 39 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; slightly acid; abrupt smooth boundary.

BA—7 to 11 inches; 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; weak fine and very fine subangular blocky structure; friable; few very fine roots; common very dark brown (10YR 2/2) worm casts and pore fillings; few brown (10YR 4/3) worm casts; neutral; clear smooth boundary.

Bw1—11 to 17 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; neutral; clear smooth boundary.

Bw2—17 to 24 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) on few faces of peds; weak medium and fine subangular blocky structure; friable; few very fine roots; neutral; clear wavy boundary.

Bw3—24 to 32 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) on faces of peds; weak medium subangular blocky structure; friable; few very fine roots; neutral; clear wavy boundary.

2BC—32 to 40 inches; yellowish brown (10YR 5/4), stratified loamy sand, sand, and sandy loam; weak medium subangular blocky structure; very friable; very few very fine roots; neutral; clear wavy boundary.

2C1—40 to 72 inches; light yellowish brown (10YR 6/4), stratified sand and loamy sand; single grained; loose; very few very fine roots to a depth of 60 inches; neutral; clear wavy boundary.

2C2—72 to 78 inches; light yellowish brown (10YR 6/4), stratified sand and loamy sand; single grained; loose; mildly alkaline.

The thickness of the solum ranges from 30 to 48 inches. The depth to carbonates ranges from 40 to more than 60 inches. The mollic epipedon is 10 to 18 inches thick.

The A horizon is 6 to 14 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Most pedons have an AB or a BA horizon. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or silt loam and is 24 to 34 percent clay. The 2BC and 2C horizons are stratified sand and loamy sand with strata of sandy loam and silt loam. They have value of 5 or 6 and chroma of 3 or 4.

The Arthur soils in map units 475C2 and 475D2 do not have a mollic epipedon, which is defined for the series.

Bolan Series

The Bolan series consists of well drained soils on upland ridgetops and side slopes. These soils formed in loamy eolian sediments and in the upper part of the sandy substratum. Permeability is moderate in the solum and rapid in the sandy sediments. The native vegetation was tall prairie grasses. Slopes range from 5 to 14 percent.

Typical pedon of Bolan loam, 5 to 9 percent slopes, in a rotation pasture; 2,080 feet south and 100 feet west of the northeast corner of sec. 1, T. 86 N., R. 39 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

AB—7 to 11 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak very fine subangular blocky and granular structure; friable; few very fine roots; few brown (10YR 4/3) worm casts; medium acid; clear smooth boundary.

Bw1—11 to 17 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; common very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; medium acid; clear smooth boundary.

Bw2—17 to 24 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; few very fine roots; medium acid; gradual smooth boundary.

Bw3—24 to 32 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

Bw4—32 to 40 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; very few very fine roots; slightly acid; gradual smooth boundary.

BC—40 to 48 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; very friable; very few very fine roots; slightly acid; gradual smooth boundary.

C—48 to 60 inches; yellowish brown (10YR 5/4) sand; single grained; loose; very few very fine roots; slightly acid.

The thickness of the solum ranges from 30 to 48 inches. The mollic epipedon is 10 to 15 inches thick.

The A horizon is 10 to 15 inches thick. It has value of 2 or 3. Some pedons do not have an AB or a BA horizon. The Bw horizon has value of 4 to 6 and chroma of 3 to 6. It is 12 to 20 percent clay and 40 to 60 percent sand. The C horizon has value of 4 to 6 and chroma of 3 to 6. It is loamy sand or sand.

The Bolan soil in map unit 474D2 does not have a mollic epipedon, which is defined for the series. This soil is classified as coarse-loamy, mixed, mesic Dystric Eutrochrepts.

Burchard Series

The Burchard series consists of well drained, moderately slowly permeable soils on upland side slopes and ridgetops. These soils formed in glacial till. The native vegetation was tall and intermediate native grasses. Slopes range from 5 to 40 percent.

Typical pedon of Burchard clay loam, in an area of

Steinauer-Burchard complex, 18 to 40 percent slopes, in a pasture; 1,870 feet south and 140 feet west of the northeast corner of sec. 6, T. 89 N., R. 41 W.

A—0 to 5 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few fine and very fine roots; few coarse fragments; neutral; clear smooth boundary.

AB—5 to 11 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) clay loam, gray (10YR 5/1) and grayish brown (10YR 5/2) dry; weak fine subangular blocky and granular structure; friable; few fine and very fine roots; common black (10YR 2/1) pore fillings and worm casts; few brown (10YR 4/3) worm casts; few coarse fragments; neutral; clear smooth boundary.

Bt1—11 to 18 inches; brown (10YR 4/3) clay loam; weak fine and very fine subangular blocky structure; firm; few thin clay films on faces of peds; few fine and very fine roots; common very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; few coarse fragments; neutral; clear smooth boundary.

Bt2—18 to 24 inches; brown (10YR 5/3) clay loam; weak medium and fine subangular blocky structure; firm; few thin clay films on faces of peds; few fine and very fine roots; few very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; few coarse fragments; mildly alkaline; clear smooth boundary.

BC—24 to 36 inches; brown (10YR 5/3) clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm; few fine and very fine roots; few very dark grayish brown (10YR 3/2) pore fillings; few coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C—36 to 60 inches; brown (10YR 5/3) clay loam; common fine distinct grayish brown (2.5Y 5/2) and few fine prominent yellowish red (5YR 4/6) mottles; weak medium angular blocky structure; friable; very few very fine roots; few coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from about 24 to 50 inches. The depth to carbonates ranges from about 13 to 30 inches. The mollic epipedon is about 8 to 18 inches thick.

The A horizon is 8 to 16 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is clay loam or loam. The B horizon has value of 3 to 5 and chroma of 3 to 6. It has grayish mottles in some pedons. The C horizon has hue of 2.5Y or 10YR and chroma of 2 or 3. It is clay loam or loam.

The Burchard soils in map units 35E2 and 59D2 do not have a mollic epipedon, which is defined for the series. These soils are classified as fine-loamy, mixed, mesic Mollic Hapludalfs.

Colo Series

The Colo series consists of poorly drained, moderately permeable soils on flood plains and on the lower part of upland drainageways. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, in a cultivated field; 1,620 feet west and 390 feet south of the northeast corner of sec. 35, T. 86 N., R. 39 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

A1—8 to 18 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky and granular structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

A2—18 to 28 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

A3—28 to 36 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine and very fine subangular blocky structure; friable; very few very fine roots; neutral; gradual smooth boundary.

BA—36 to 42 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silty clay loam, very dark gray (10YR 3/1) and dark gray (10YR 4/1) dry; very few fine prominent olive gray (5Y 5/2) mottles; moderate fine prismatic and subangular blocky structure; friable; very few very fine roots; neutral; gradual smooth boundary.

Bg—42 to 52 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine prominent olive gray (5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak fine prismatic and subangular blocky structure; friable; neutral; clear smooth boundary.

BCg—52 to 60 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay loam; common fine prominent olive gray (5Y 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure; friable; common very fine black (10YR 2/1) concretions of iron and manganese oxides; neutral.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon is more than 36 inches thick.

The A horizon is 30 to 40 inches thick. The upper part is silt loam or silty clay loam overwash in some pedons. The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 0 or 1. The overwash, if it occurs, has chroma of 2. The Bg horizon has value of 2 or 3. It has mottles with higher value or with higher value and higher chroma in some pedons. The BCg and Cg horizons have hue of 10YR to 5Y, value of 3 to 5, and chroma of 2 or less.

Dickman Series

The Dickman series consists of well drained soils on upland ridgetops and side slopes and on stream terraces. These soils formed in loamy and sandy eolian deposits. Permeability is moderately rapid in the upper part of the solum, which formed in sandy loam, and rapid in the lower part of the solum and the substratum. The native vegetation was tall and intermediate prairie grasses. Slopes range from 5 to 14 percent.

The Dickman soils in Ida County do not have a mollic epipedon, which is defined for the series. Also, the lower part of the B horizon has higher value than is defined as the range. These soils are classified as sandy, mixed, mesic Dystric Eutrochrepts.

Typical pedon of Dickman sandy loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 2,100 feet east and 840 feet south of the northwest corner of sec. 35, T. 87 N., R. 41 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; about 10 percent streaks and pockets of brown (10YR 4/3) subsoil material; weak fine granular structure; very friable; very few very fine roots; slightly acid; abrupt smooth boundary.

Bw1—7 to 13 inches; brown (10YR 4/3) sandy loam; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) on a few faces of peds; weak fine and very fine subangular blocky structure; very friable; very few very fine roots; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) pore fillings; neutral; clear smooth boundary.

Bw2—13 to 20 inches; brown (10YR 4/3) loamy fine sand; weak fine subangular blocky structure; very friable; very few very fine roots; neutral; clear smooth boundary.

Bw3—20 to 27 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine subangular blocky structure; very friable; very few very fine roots; neutral; clear smooth boundary.

BC—27 to 37 inches; yellowish brown (10YR 5/4) loamy fine sand; weak medium subangular blocky structure; very friable; very few very fine roots; neutral; clear smooth boundary.

C1—37 to 54 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; very few very fine roots; neutral; clear smooth boundary.

C2—54 to 60 inches; yellowish brown (10YR 5/4) sand; single grained; loose; very few very fine roots; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 48 inches. Free carbonates are at a depth of 32 to more than 60 inches. The upper, loamy part of the solum is 12 to 20 inches thick.

The Ap horizon is 6 to 10 inches thick. It has value of 3 or 4 and chroma of 2 or 3. Where it has value of 3 and chroma of 2, it has streaks and pockets with value of 4. The A horizon is sandy loam or fine sandy loam. The Bw horizon has value and chroma of 3 to 6. It is sandy loam, fine sandy loam, loamy sand, or loamy fine sand. The BC and C horizons have value of 4 to 6 and chroma of 3 to 6. They are loamy fine sand, fine sand, or sand.

Dow Series

The Dow series consists of well drained, moderately permeable soils on upland side slopes, head slopes, and nose slopes. These soils formed in loess. The native vegetation was prairie grasses. Slopes range from 9 to 14 percent.

Typical pedon of Dow silt loam, 9 to 14 percent slopes, severely eroded, in a cultivated field; 720 feet south and 115 feet west of the northeast corner of sec. 3, T. 87 N., R. 41 N.

Ap—0 to 5 inches; mixed brown (10YR 4/3 and 5/3) silt loam; about 10 percent very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) streaks and pockets; weak fine and very fine granular structure; friable; few very fine roots; few fine and medium rounded concretions of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—5 to 11 inches; light brownish gray (2.5Y 6/2) silt loam; many fine distinct brown (10YR 5/3) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots; very few fine rounded and irregular concretions of lime; strong effervescence; moderately alkaline; clear smooth boundary.

C2—11 to 19 inches; light brownish gray (2.5Y 6/2) silt loam; common fine distinct brown (10YR 5/3) and strong brown (7.5YR 5/6) mottles; massive; friable; very few very fine roots; very few fine rounded and irregular concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—19 to 50 inches; light brownish gray (2.5Y 6/2) silt loam; common fine and medium prominent strong brown (7.5YR 5/6) and few fine distinct brown (10YR 5/3) mottles; massive; friable; very few very fine roots; very few fine rounded and irregular concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C4—50 to 60 inches; brown (10YR 5/3) silt loam; common fine distinct light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) mottles; massive; friable; very few fine rounded and irregular concretions of lime; strong effervescence; moderately alkaline.

The thickness of the solum is 10 inches or less and corresponds to the thickness of the A or Ap horizon.

The A or Ap horizon is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or brown (10YR 4/3 or 5/3). It is mixed with these colors and with colors from the substratum in many pedons. The C horizon has hue of 2.5Y, 10YR, or 5Y and value of 5 or 6. It contains mottles and mottled colors with chroma of 2 to 6. The mottles and light brownish gray colors are the result of relict weathering zones in the loess and not of drainage.

Ely Series

The Ely series consists of somewhat poorly drained, moderately permeable soils on foot slopes along drainageways and on alluvial fans. These soils formed in silty local alluvium derived from loess. The native vegetation was tall prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Ely silty clay loam, 1 to 4 percent slopes, in a cultivated field; 2,100 feet east and 155 feet north of the southwest corner of sec. 13, T. 87 N., R. 39 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

A1—8 to 16 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine and very fine granular structure; friable; few very fine roots; slightly acid; clear smooth boundary.

A2—16 to 24 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky and granular structure; friable; few very fine roots; neutral; clear smooth boundary.

BA—24 to 30 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) on faces of peds; few fine distinct olive brown (2.5Y 4/4) mottles; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

Bw1—30 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay loam; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) on faces of peds; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine and very fine subangular blocky structure; friable; very few very fine roots; few fine black (10YR 2/1) segregations of iron and manganese oxides; neutral; gradual smooth boundary.

Bw2—36 to 46 inches; grayish brown (2.5Y 5/2) silty clay loam; very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) on faces of peds; many fine distinct yellowish brown (10YR 5/4) mottles; weak medium and fine subangular blocky structure; friable; very few very fine roots; few very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) pore fillings; few black (10YR 2/1) segregations of iron and manganese oxides; neutral; clear smooth boundary.

C1—46 to 54 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct yellowish brown (10YR 5/4) mottles; weak fine prismatic structure; friable; very few very fine roots; few very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) pore fillings; few fine black (10YR 2/1) segregations of iron and manganese oxides; few fine concretions and segregations of lime; slight effervescence; moderately alkaline; gradual smooth boundary.

C2—54 to 60 inches; mottled grayish brown (2.5YR 5/2) and yellowish brown (10YR 5/4) silt loam; massive; friable; very few very fine roots to a depth of 62 inches; few fine black (10YR 2/1) segregations of iron and manganese oxides; common fine and medium concretions and segregations of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. Free carbonates are at a depth of about 4 feet to more than 5 feet. The mollic epipedon is 24 to 36 inches thick.

The A horizon is 20 to 30 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Most pedons have an AB or a BA horizon. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2, or it has chroma of 3 or 4 and has mottles with chroma of 2. The BC and C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. They are mottled. A 2C horizon of loam or clay loam glacial till or consisting of strata of loamy sand and sand is below a depth of 48 inches in some pedons.

Exira Series

The Exira series consists of well drained, moderately permeable soils on upland ridgetops and side slopes. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 5 to 20 percent.

The Exira soils in Ida County do not have a mollic epipedon, which is defined for the series. These soils are classified as fine-silty, mesic Dystric Eutrochrepts.

Typical pedon of Exira silty clay loam, 9 to 14 percent slopes, moderately eroded, in a cultivated field; 500 feet north and 125 feet west of the southeast corner of sec. 4, T. 86 N., R. 39 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; about 10 percent streaks and pockets of brown (10YR 4/3) subsoil material; weak fine and very fine granular structure; friable; few very fine roots; slightly acid; abrupt smooth boundary.

Bw1—7 to 12 inches; brown (10YR 4/3) silty clay loam; weak fine and very fine subangular blocky structure; friable; few very fine roots; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts; neutral; clear smooth boundary.

Bw2—12 to 21 inches; brown (10YR 4/3) silty clay loam; common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

Bw3—21 to 29 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few very fine roots; few fine and medium black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual smooth boundary.

BC—29 to 37 inches; yellowish brown (10YR 5/4) silt loam; common fine and medium distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; few fine and medium black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual smooth boundary.

C1—37 to 60 inches; mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; massive with horizontal parting; friable; very few very fine roots; few fine and medium black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual smooth boundary.

2C2—60 to 78 inches; mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) silty clay loam that has a moderate sand content; massive; friable; mildly alkaline.

The thickness of the solum ranges from 30 to 50 inches. Carbonates are below a depth of 40 inches.

The A horizon is 5 to 9 inches thick. It has chroma of 2 or 3. It is a mixture of dark brown (10YR 3/3) and brown (10YR 4/3) material in some pedons. The B horizon has value of 4 or 5 and chroma of 3 or 4. The BC and C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The mottles and grayish colors in the Bw, BC, and C horizons are the result of relict weathering zones in the loess and not of drainage.

Galva Series

The Galva series consists of well drained, moderately permeable soils on upland ridgetops and side slopes and on stream benches. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 0 to 14 percent.

Typical pedon of Galva silty clay loam, 2 to 5 percent slopes, in a cultivated field; 830 feet west and 195 feet south of the northeast corner of sec. 13, T. 89 N., R. 40 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

A—7 to 12 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) on faces of peds; moderate fine and very fine subangular blocky structure; friable; few very fine roots; few dark brown (10YR 3/3) worm casts; neutral; clear smooth boundary.

BA—12 to 17 inches; dark brown (10YR 3/3) and brown (10YR 4/3) silty clay loam; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) on faces of peds; moderate fine and very fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

Bw1—17 to 24 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) on few faces of peds; moderate fine and very fine subangular blocky structure; friable; few very fine roots; few dark brown (10YR 3/3) worm casts and pore fillings; neutral; gradual smooth boundary.

Bw2—24 to 36 inches; brown (10YR 4/3) silty clay loam; weak medium and fine subangular blocky structure; friable; very few very fine roots; neutral; gradual smooth boundary.

Bw3—36 to 46 inches; brown (10YR 4/3) silty clay loam; few fine distinct gray (10YR 5/1) and strong brown (7.5YR 5/6) mottles; weak fine prismatic and subangular blocky structure; friable; very few very fine roots; neutral; gradual smooth boundary.

BC—46 to 56 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct gray (10YR 5/1) and strong brown (7.5YR 5/6) mottles; weak medium and fine prismatic structure; friable; mildly alkaline; clear wavy boundary.

C—56 to 78 inches; mottled yellowish brown (10YR 5/4) and gray (10YR 5/1) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. Free carbonates are in the lower part of the solum or immediately below the solum, except in pedons on stream terraces. The mollic epipedon is 10 to 20 inches thick.

The A horizon is 10 to 15 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Some pedons do not have an AB or a BA horizon. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is 28 to 34 percent clay. The BC and C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. Mottles and mottled colors increase in abundance with depth. The mottles and grayish colors in the lower part of the Bw horizon and in the BC and C horizons are the result of relict weathering zones in the loess and not of drainage. A 2C horizon of loam or clay loam glacial till or consisting of stratified sandy or gravelly material is below a depth of 48 inches in some pedons.

The Galva soils in map units 310B2, 310C2, 310D2, and 810C2 are taxadjuncts because they do not have a mollic epipedon, which is defined for the series. These soils are classified as fine-silty, mixed, mesic Typic Eutrochrepts.

Hawick Series

The Hawick series consists of excessively drained, very rapidly permeable soils on side slopes of stream terraces. These soils formed in loamy, sandy, and gravelly glacial deposits. The native vegetation was tall, intermediate, and short prairie grasses. Slopes range from 5 to 40 percent.

Typical pedon of Hawick gravelly sandy loam, 18 to 40 percent slopes, in a pasture; 2,170 feet south and 450 feet west of the northeast corner of sec. 7, T. 89 N., R. 41 W.

A1—0 to 3 inches; black (10YR 2/1) gravelly sandy loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; many very fine roots; about 20 percent coarse fragments; few cobble-sized coarse fragments; slight effervescence; moderately alkaline; abrupt smooth boundary.

A2—3 to 9 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) sandy loam, dark gray (10YR 4/1) and grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common very fine roots; about 10 percent coarse fragments; few cobble-sized coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

AB—9 to 13 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; common very fine roots; about 11 percent coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

B—13 to 20 inches; brown (10YR 4/3 and 5/3), stratified gravelly loamy sand and gravelly sand; weak medium subangular blocky structure; very friable; few very fine roots; about 30 percent coarse fragments; lime-cemented sand on undersides of coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

C1—20 to 36 inches; brown (10YR 5/3), stratified gravelly sand and gravelly coarse sand; single grained; loose; very few very fine roots; about 20 percent coarse fragments; lime-cemented sand on undersides of coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

C2—36 to 56 inches; pale brown (10YR 6/3), stratified gravelly sand and gravelly coarse sand; single grained; loose; about 17 percent coarse fragments; lime-cemented sand on undersides of coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

C3—56 to 80 inches; pale brown (10YR 6/3), stratified sand and coarse sand; single grained; loose; about 10 percent coarse fragments; lime-cemented sand on undersides of coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

2C4—80 to 86 inches; light brownish gray (2.5Y 6/2) silt loam; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from about 14 to 30 inches. Depth to carbonates ranges from 0 to about 24 inches. The mollic epipedon is about 7 to 16 inches thick. The solum and the C horizon have 5 to 35 percent gravel, by volume, but some subhorizons have more or less gravel.

The A horizon is 7 to 14 inches thick. It has value of 2 or 3 and chroma of 1 to 3. It is sandy loam, coarse sandy loam, loamy sand, loamy coarse sand, or the gravelly analogs of those textures. The B horizon has value of 3 to 5 and chroma of 3 or 4. It is loamy sand, loamy coarse sand, sand, coarse sand, or the gravelly analogs of those textures. The C horizon has value of 4 to 6 and chroma of 2 to 6. It is sand, coarse sand, or the gravelly analogs of those textures.

Ida Series

The Ida series consists of well drained, moderately permeable soils on upland ridgetops and side slopes. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 2 to 30 percent.

Typical pedon of Ida silt loam, 9 to 14 percent slopes, severely eroded, in a cultivated field; 1,355 feet west and 90 feet south of the northeast corner of sec. 10, T. 86 N., R. 39 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam; about 20 percent streaks and pockets of dark brown (10YR 3/3) surface soil material; weak very fine granular structure; friable; very few very fine roots; few fine and medium concretions of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—6 to 15 inches; brown (10YR 5/3) silt loam; few fine distinct grayish brown (2.5Y 5/2) mottles; massive; friable; very few very fine roots; few fine and medium concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—15 to 30 inches; brown (10YR 5/3) silt loam; common fine distinct grayish brown (2.5Y 5/2) and few fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; very few very fine roots; few fine and medium concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—30 to 46 inches; brown (10YR 5/3) silt loam; many fine distinct grayish brown (2.5Y 5/2) and common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; massive; friable; few fine and medium concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C4—46 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few fine and medium concretions of lime; strong effervescence; moderately alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the A or Ap horizon.

The A horizon has value of 3 or 4 and chroma of 2 or 3. In many pedons it is mixed with these colors and with colors from the substratum. The C horizon has value of 4 or 5 and chroma of 2 to 6. Mottles are the result of relict weathering zones in the loess and not of drainage.

Judson Series

The Judson series consists of well drained, moderately permeable soils on foot slopes and alluvial fans and in upland drainageways. These soils formed in alluvium derived from the adjacent upland soils. The native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Judson silty clay loam, 2 to 5 percent slopes, in a cultivated field; 300 feet south and 185 feet east of the northwest corner of sec. 27, T. 86 N., R. 39 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; black (10YR 2/1) on faces of peds; weak very fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

A1—8 to 16 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; black (10YR 2/1) on faces of peds; weak very fine subangular blocky and granular structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

A2—16 to 26 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; few very dark grayish brown (10YR 3/2) worm casts; slightly acid; gradual smooth boundary.

AB—26 to 32 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) on faces of peds; weak fine and very fine subangular blocky structure; friable; very few very fine roots; slightly acid; gradual smooth boundary.

Bw1—32 to 38 inches; dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) and grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) on faces of peds; weak medium and fine subangular blocky structure; friable; common very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) worm casts; neutral; clear smooth boundary.

Bw2—38 to 45 inches; dark brown (10YR 3/3) and brown (10YR 4/3) silty clay loam; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) on faces of peds; weak medium and fine subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) worm casts; neutral; clear smooth boundary.

BC1—45 to 52 inches; brown (10YR 4/3) silty clay loam; dark brown (10YR 3/3) on faces of peds; weak fine prismatic and subangular blocky structure; friable; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts; neutral; clear smooth boundary.

BC2—52 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) on faces of peds; common fine distinct grayish brown (2.5Y 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) mottles; weak fine prismatic structure; friable; neutral.

The thickness of the solum ranges from 48 to more than 60 inches. The mollic epipedon is 24 to 40 inches thick.

The A horizon is 20 to 28 inches thick. It has chroma of 1 or 2. Most pedons have an AB horizon. The Bw horizon has value and chroma mainly of 3 or 4, but the lower part has value of 5 in some pedons. This horizon is 30 to 34 percent clay. The BC and C horizons have value of 4 or 5 and chroma of 3 or 4.

Kennebec Series

The Kennebec series consists of moderately well drained, moderately permeable soils on flood plains and in upland drainageways, on alluvial fans, and on foot slopes. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Typical pedon of Kennebec silty clay loam, 0 to 2 percent slopes, in a cultivated field; 1,360 feet east and 95 feet south of the northwest corner of sec. 4, T. 86 N., R. 41 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine and very fine subangular blocky and granular structure; friable; few very fine roots; slightly acid; abrupt smooth boundary.

A1—7 to 20 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine and very fine subangular blocky and granular structure; friable; few very fine roots; slightly acid; clear smooth boundary.

A2—20 to 28 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

A3—28 to 36 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium and fine subangular blocky structure; friable; few very fine roots; slightly acid; gradual smooth boundary.

AC—36 to 50 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark gray (10YR 3/1) on faces of peds; weak medium and fine subangular blocky structure; friable; very few very fine roots; neutral; gradual smooth boundary.

C—50 to 60 inches; very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) silty clay loam; very dark gray (10YR 3/1) on faces of peds; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine prismatic and subangular blocky structure; friable; few very fine black (10YR 2/1) concretions of iron and manganese oxides; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. The mollic epipedon is more than 36 inches thick. The solum is mainly 24 to 30 percent clay, but below a depth of 40 inches the content of clay varies more widely.

The A horizon is 30 to 50 inches thick. As much as 18 inches of lighter colored overwash covers the A horizon in some pedons. The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silt loam or silty clay loam. The AC horizon has value of 2 or 3 and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 or 2.

Marcus Series

The Marcus series consists of poorly drained, moderately slowly permeable soils in concave upland drainageways. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Marcus silty clay loam, 0 to 2 percent slopes, in a cultivated field; 1,530 feet west and 120 feet south of the northeast corner of sec. 23, T. 89 N., R. 40 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; very few very fine roots; neutral; clear smooth boundary.

A—7 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine and very fine granular structure; friable; very few very fine roots; neutral; clear smooth boundary.

AB—15 to 20 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few very fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky and granular structure; friable; very few very fine roots; few very fine black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual smooth boundary.

Bg1—20 to 28 inches; mottled olive gray (5Y 4/2) and dark gray (5Y 4/1) silty clay loam; very dark gray (10YR 3/1) on few faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and very fine subangular blocky structure; friable; very few very fine roots; few fine black (10YR 2/1) concretions of iron and manganese oxides; neutral; gradual smooth boundary.

Bg2—28 to 35 inches; mottled gray (5Y 5/1) and olive gray (5Y 5/2) silty clay loam; dark gray (5Y 4/1) on few faces of peds; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; very few very fine roots; few fine black (10YR 2/1) concretions of iron and manganese oxides; mildly alkaline; clear smooth boundary.

Cg1—35 to 44 inches; mottled gray (5Y 5/1) and olive gray (5Y 5/2) silt loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure; friable; common fine black (10YR 2/1) concretions of iron and manganese oxides; common fine and medium concretions and segregations of lime; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg2—44 to 60 inches; mottled olive gray (5Y 5/2) and gray (5Y 5/1) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; massive; friable; few fine black (10YR 2/1) accumulations of iron and manganese oxides; common fine concretions and segregations of lime; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 48 inches. Free carbonates are in the lower part of the solum or immediately below the solum. The mollic epipedon is 15 to 24 inches thick.

The A horizon is 15 to 24 inches thick. It has value of 2 or 3 and chroma of 0 or 1. Most pedons have either an AB or a BA horizon. The Bg horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. Some pedons have a BCg horizon. The Cg horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2.

Marshall Series

The Marshall series consists of well drained, moderately permeable soils on upland ridgetops, side slopes, and stream benches. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 0 to 14 percent.

Typical pedon of Marshall silty clay loam, 2 to 5 percent slopes, in a cultivated field; 2,300 feet north and 300 feet east of the southwest corner of sec. 28, T. 86 N., R. 39 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; few very fine roots; medium acid; abrupt smooth boundary.

A—7 to 10 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; few dark brown (10YR 3/3) and brown (10YR 4/3) worm casts; medium acid; clear smooth boundary.

BA—10 to 14 inches; brown (10YR 4/3) and dark brown (10YR 3/3) silty clay loam; very dark gray (10YR 3/1) on faces of peds; weak very fine subangular blocky structure; friable; few very fine roots; common very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; clear smooth boundary.

Bw1—14 to 20 inches; brown (10YR 4/3) silty clay loam; weak fine and very fine subangular blocky structure; friable; few thin clay films on faces of peds; few very fine roots; few very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) worm casts and pore fillings; slightly acid; clear smooth boundary.

Bw2—20 to 28 inches; brown (10YR 4/3) silty clay loam; weak medium and fine subangular blocky structure; friable; common thin clay films on faces of peds; few very fine roots; neutral; clear smooth boundary.

Bw3—28 to 38 inches; brown (10YR 4/3) silty clay loam; weak medium and fine subangular blocky structure; friable; common thin clay films on faces of peds; very few very fine roots; neutral; clear wavy boundary.

Bw4—38 to 48 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine prismatic and subangular blocky structure; friable; few thin clay films on faces of peds and in pores; very few very fine roots; neutral; gradual wavy boundary.

BC—48 to 60 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (10YR 5/2) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine prismatic structure; friable; few thin clay films in pores; neutral.

The thickness of the solum ranges from 44 to 70 inches. The mollic epipedon is 10 to 18 inches thick.

The A horizon is 10 to 15 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Some pedons have an AB or a BA horizon. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is 28 to 34 percent clay. The BC and C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. The mottles and grayish colors in the lower part of the Bw horizon and in the BC and C horizons are the result of relict weathering zones in the loess and not of drainage.

The Marshall soils in map units 9B2, 9C2, 9D2, and 509C2 do not have a mollic epipedon, which is defined for the series. These soils are classified as fine-silty, mixed, mesic Dystric Eutrochrepts.

Monona Series

The Monona series consists of well drained, moderately permeable soils on upland ridgetops and side slopes. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 5 to 30 percent.

Typical pedon of Monona silty clay loam, 5 to 9 percent slopes, in a cultivated field; 1,720 feet east and 150 feet south of the northwest corner of sec. 30, T. 86 N., R. 41 W.

Ap—0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; slightly acid; abrupt smooth boundary.

A—6 to 10 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky and granular structure; friable; few very fine roots; few very dark grayish brown (10YR 3/2) worm casts; slightly acid; clear smooth boundary.

BA—10 to 16 inches; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

Bw1—16 to 22 inches; brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

Bw2—22 to 30 inches; brown (10YR 4/3) silt loam; dark brown (10YR 3/3) on few faces of peds; weak medium and fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

Bw3—30 to 40 inches; brown (10YR 4/3) silt loam; weak medium and fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

BC—40 to 50 inches; yellowish brown (10YR 5/4) silt loam; few fine distinct light gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak medium and fine prismatic structure; friable; few very fine roots; neutral; gradual smooth boundary.

C1—50 to 62 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct light gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; friable; very few very fine roots; neutral; gradual smooth boundary.

C2—62 to 78 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct light gray (10YR 6/1) mottles; massive; friable; very few very fine roots; neutral.

The thickness of the solum ranges from 30 to 50 inches. Free carbonates are at a depth of 36 to more than 70 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon is 10 to 15 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Some pedons do not have an AB or a BA horizon. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is 28 to 32 percent clay in the upper part and 22 to 27 percent clay in the lower part. The BC and C horizons have value of 4 to 6 and chroma of 2 to 6. Mottles and grayish colors in the lower part of the Bw horizon and in the BC and C horizons are the result of relict weathering zones in the loess and not of drainage.

The Monona soils in map units 100C2, 100C3, 100D2, 100D3, 100E2, 100E3, 100F2, and 100F3 are taxadjuncts because the A horizon is lighter colored and thinner than is defined as the range for the series. These soils are classified as fine-silty, mixed, mesic Dystric Eutrochrepts.

Nodaway Series

The Nodaway series consists of moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium. The native vegetation was mixed hardwood trees and tall prairie grasses. Slopes range from 0 to 2 percent.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, in a cultivated field; 1,550 feet north and 100 feet west of the southeast corner of sec. 20, T. 86 N., R. 40 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

C1—10 to 20 inches; stratified dark grayish brown

(10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) dry; massive with horizontal parting; friable; very few very fine roots; common fine yellowish brown (10YR 5/4) and brown (7.5YR 5/4) iron stains; neutral; gradual smooth boundary.

C2—20 to 37 inches; dark grayish brown (10YR 4/2) silt loam; few strata of very dark grayish brown (10YR 3/2) silt loam; massive with horizontal parting; friable; few fine yellowish brown (10YR 5/4) and brown (7.5YR 5/4) iron stains; neutral; clear smooth boundary.

C3—37 to 57 inches; very dark grayish brown (10YR 3/2) silt loam; few very thin strata of dark grayish brown (10YR 4/2) silt loam; massive with horizontal parting; friable; few fine brown (7.5YR 4/4) iron strains; neutral; clear smooth boundary.

2Ab—57 to 60 inches; black (10YR 2/1) silt loam; weak very fine subangular blocky and granular structure; friable; neutral.

The thickness of the A horizon corresponds to the depth of tillage. Where this soil is undisturbed by tillage, the stratified C horizon extends to the soil surface. The C horizon has value of 3 or 4 and chroma of 1 or 2. A black (10YR 2/1) or very dark gray (10YR 3/1) buried soil is below a depth of 36 inches in many pedons. The buried soil is silt loam or silty clay loam.

Primghar Series

The Primghar series consists of somewhat poorly drained, moderately permeable soils along upland drainageways and the lower side slopes. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 1 to 4 percent.

Typical pedon of Primghar silty clay loam, 1 to 4 percent slopes, in a cultivated field; 2,550 feet south and 80 feet west of the northeast corner of sec. 14, T. 89 N., R. 40 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

A—7 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; few very fine roots; neutral; clear smooth boundary.

AB—14 to 18 inches; black (10YR 2/1) and very dark grayish brown (2.5Y 3/2) silty clay loam, dark gray (10YR 4/1) and grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

Bw1—18 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay loam; very dark grayish brown (2.5Y 3/2) on faces of peds; common fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

Bw2—24 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay loam; very dark grayish brown (2.5Y 3/2) on few faces of peds; common fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; gradual smooth boundary.

Bw3—30 to 38 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; few very fine roots; few very dark grayish brown (2.5Y 3/2) pore fillings; neutral; clear smooth boundary.

BC—38 to 45 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; few very fine roots; few dark grayish brown (2.5Y 4/2) pore fillings; common fine and medium concretions and segregations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—45 to 60 inches; grayish brown (2.5Y 5/2) silt loam; common fine and medium distinct yellowish brown (10YR 5/4 and 5/6) and gray (5Y 6/1) mottles; massive; friable; common fine and medium concretions and segregations of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. Free carbonates are in the lower part of the solum or immediately below the solum. The mollic epipedon is 16 to 24 inches thick.

The A horizon is 16 to 24 inches thick. It has hue of 10YR or is neutral in hue. It has value of 2 or 3 and chroma of 2 or less. The Bw horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 or has chroma of 3 or 4 and has mottles with chroma of 2. The BC and C horizons have hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 4 and are mottled. A 2C horizon of loam or clay loam glacial till is below a depth of 48 inches in some pedons.

Sac Series

The Sac series consists of well drained, moderately slowly permeable soils on upland ridgetops and side slopes. These soils formed in loess and in the underlying glacial till. The native vegetation was tall prairie grasses. Slopes range from 2 to 14 percent.

Typical pedon of Sac silty clay loam, 5 to 9 percent slopes, in a cultivated field; 2,435 feet north and 570 feet west of the southeast corner of sec. 13, T. 89 N., R. 39 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine granular structure; friable; few very fine roots; neutral; abrupt smooth boundary.

A—7 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; very dark brown on faces of peds; weak fine and very fine granular structure; friable; few very fine roots; common very dark brown (10YR 2/2) worm casts and pore fillings; neutral; clear smooth boundary.

BA—12 to 17 inches; very dark grayish brown (10YR 3/2) and brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) on faces of peds; weak fine and very fine subangular blocky structure; friable; few very fine roots; few very dark brown (10YR 2/2) pore fillings; neutral; clear smooth boundary.

Bw1—17 to 23 inches; brown (10YR 4/3) silty clay loam; weak fine and very fine subangular blocky structure; friable; few very fine roots; common very dark grayish brown (10YR 3/2) worm casts and pore fillings; neutral; clear smooth boundary.

Bw2—23 to 31 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 4/3) on faces of peds; weak medium and fine subangular blocky structure; friable; very few very fine roots; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts and pore fillings; neutral; clear wavy boundary.

2BC—31 to 40 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak medium and fine prismatic structure; firm; very few very fine roots; few very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts and pore fillings; few fine concretions and segregations of lime; mildly alkaline; gradual wavy boundary.

2C1—40 to 48 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct gray (10YR 6/1) and yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; very few very fine roots; few fine concretions and segregations of lime; moderately alkaline; gradual wavy boundary.

2C2—48 to 78 inches; yellowish brown (10YR 5/4) clay loam; many fine and medium distinct gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; massive; firm; few fine and medium concretions and segregations of lime; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The depth to clay loam or loam glacial till is 20 to 40 inches. Free carbonates are within a few inches of the upper boundary of the glacial till. The mollic epipedon is 10 to 16 inches thick.

The A horizon is 10 to 14 inches thick. It has value of 2 or 3 and chroma of 1 or 2. Some pedons have an AB or a BA horizon. The Bw horizon has value of 4 or 5 and chroma of 3 or 4. It is 28 to 34 percent clay. In some pedons it has mottles with lower chroma below a depth of 30 inches. The 2B and 2C horizons have value of 4 or 5 and chroma of 3 or 4. They are clay loam or loam.

The Sac soils in map units 78B2, 78C2, and 78D2 do not have a mollic epipedon, which is defined for the series. These soils are classified as fine-silty, mixed, mesic Typic Eutrochrepts.

Steinauer Series

The Steinauer series consists of well drained, moderately slowly permeable soils on upland side slopes and ridgetops. These soils formed in glacial till. The native vegetation was tall and intermediate native grasses. Slopes range from 14 to 40 percent.

Typical pedon of Steinauer clay loam, in an area of Steinauer-Burchard complex, 18 to 40 percent slopes, in a pasture; 2,080 feet south and 280 feet west of the northeast corner of sec. 6, T. 89 N., R. 41 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; weak medium and fine granular structure; friable; common very fine roots; few dark grayish brown (2.5Y 4/2) worm casts; few coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

AC—5 to 12 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) clay loam; weak medium and fine subangular blocky structure; friable; few very fine roots; common very dark grayish brown (10YR 3/2) worm casts and pore fillings; few coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

C1—12 to 20 inches; light olive brown (2.5Y 5/4) clay loam; grayish brown (2.5Y 5/2) on faces of peds; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; few very fine roots; few coarse fragments; few medium and fine segregations and concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—20 to 40 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) mottles; weak medium angular blocky structure; firm; few very fine roots; few coarse fragments; few medium and fine segregations and concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—40 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common fine distinct light gray (10YR 6/1) and yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure; firm; very few very fine roots; few coarse fragments; few medium and fine segregations and concretions of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from about 4 to 20 inches. The depth to carbonates ranges from 0 to 10 inches.

The A horizon is 3 to 6 inches thick. It has value of 2 or 3 and chroma of 1 or 2 in areas that have not been cultivated. In eroded areas it has value of 4 or 5. The A horizon is clay loam or loam. The AC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is mottled.

Terril Series

The Terril series consists of moderately well drained, moderately permeable soils on foot slopes and alluvial fans. These soils formed in alluvium derived from soils in the adjacent uplands. The native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Typical pedon of Terril loam, 5 to 9 percent slopes, in a pasture; 1,780 feet west and 350 feet north of the southeast corner of sec. 5, T. 89 N., R. 41 W.

A1—0 to 8 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine and very fine granular structure; friable; few very fine roots; slightly acid; clear smooth boundary.

A2—8 to 16 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine and very fine subangular blocky and granular structure; friable; few very fine roots; neutral; clear smooth boundary.

A3—16 to 22 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine subangular blocky structure; friable; few very fine roots; neutral; clear smooth boundary.

A4—22 to 30 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine and very fine subangular blocky structure; friable; very few very fine roots; neutral; clear smooth boundary.

A5—30 to 36 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak fine and very fine subangular blocky structure; friable; very few very fine roots; neutral; clear smooth boundary.

BA—36 to 42 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; weak medium and fine subangular blocky structure; friable; very few very fine roots; neutral; clear smooth boundary.

Bw—42 to 50 inches; brown (10YR 4/3) loam; very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) on faces of peds; weak medium and fine subangular blocky structure; friable; very few very fine roots; common very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) worm casts and pore fillings; neutral; clear smooth boundary.

BC—50 to 60 inches; brown (10YR 4/3) loam; dark brown (10YR 3/3) on few faces of peds; weak medium and fine prismatic and subangular blocky structure; friable; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. The mollic epipedon is 24 to more than 40 inches thick.

The A horizon is 24 to 36 inches thick. It has chroma of 1 or 2. Some pedons do not have an AB or a BA horizon. The Bw horizon has value and chroma of 3 or 4. It is loam or clay loam and contains 24 to 30 percent clay. The BC and C horizons have value of 4 or 5 and chroma of 3 or 4. Mottles with chroma of 1 to 6 are in the BC and C horizons in some pedons.

Zook Series

The Zook series consists of poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Typical profile of Zook silty clay loam, 0 to 2 percent slopes, in a cultivated field; 1,100 feet south and 2,225 feet west of the northeast corner of sec. 14, T. 87 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; friable; very few very fine roots; slightly acid; abrupt smooth boundary.

A1—9 to 20 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; few fine faint dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky and granular structure; friable; very few very fine roots; neutral; clear smooth boundary.

A2—20 to 32 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; firm; sheen on faces of peds; very few very fine roots; neutral; gradual smooth boundary.

A3—32 to 40 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine prismatic and subangular blocky structure; firm; sheen on faces of peds; neutral; gradual smooth boundary.

Bg—40 to 60 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; black (N 2/0) on faces of peds; weak fine prismatic and subangular blocky structure; friable; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The mollic epipedon is more than 36 inches thick.

The A horizon is 26 to 40 inches thick. It has hue of 10YR or is neutral in hue. It has chroma of 0 or 1 in most pedons. In some pedons it has value of 3 in the lower part. The Bg and Cg horizons have hue of 10YR to 5Y and value of 2 to 5. They are 36 to 45 percent clay.

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Formation of the Soils

This section describes the major factors of soil formation and relates them to the soils in Ida County. It also provides information on some of the processes of soil horizon development.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geological material. The characteristics of a soil at any given point in time are determined by the physical properties and mineralogical and chemical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or topography; and the length of time that the forces of soil formation have acted on the soil material (Jenny, 1941). Human activities also affect soil formation.

Climate and plant and animal life are the active factors of soil formation. They act on organic and mineral parent material and slowly change it into a natural body with genetically related horizons. The effects of climate and plant and animal life are conditioned by relief and parent material. The parent material affects the kind of soil profile that forms and the rate at which it forms. In extreme cases, it entirely determines the formation of the profile. Finally, time is needed for the effects of the other factors to change parent material into a soil. The time needed may be short or long, but some time is required for the formation of soil horizons. Generally, a long time 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 others (Simonson, 1950). Many of the processes of soil development are not completely understood.

Parent Material

Nearly all of the soils in Ida County formed in materials that were transported from other places by wind, water, or glaciation. The most extensive parent materials in the county are loess, alluvium, glacial drift, and eolian sands.

Loess, a silty material deposited by the wind, is the most extensive parent material in the county. It is the surficial material on uplands and benches in about 71 percent of the county. Loess is also the most uniform parent material in the county. The clay content of the loess increases slightly from the southwestern part of the county to the northeastern part.

The loess varies in thickness. On broad, stable ridgetops in the southwestern part of the county, the loess is about 30 feet thick. In the same landscape positions in the northeastern part of the county, the loess is about 6 feet thick. In most places the loess is thicker on broad, stable ridgetops than on convex side slopes. Galva, Marshall, and Monona soils formed in areas where the loess is more than 40 inches thick. In about 3 percent of the loess-mantled area, the loess is less than 40 inches thick. Arthur soils formed in areas where less than 40 inches of loess is underlain by eolian sands. Sac soils formed where less than 40 inches of loess is underlain by glacial till.

Glacial drift, which is material deposited by glacial ice and glacial meltwater, underlies the loess in the uplands of Ida County, but it is the surficial material in less than 1 percent of the county. Glacial till, which is material deposited by glacial ice, is exposed on upland side slopes. Glacial outwash, which is material deposited by glacial meltwater, is on stream terraces and under the loess on stream benches.

Glacial till from two episodes of glaciation, the Nebraskan and Kansan, is believed to be in Ida County. In the past it was also thought that glacial till from the Iowan or Tazewell glacial period could be differentiated from Kansan till in Ida County (Corman, 1931). Some recent research utilizing mineralogical analysis and radiometric age dating indicates that there may be as many as four distinct till deposits in Ida County. Until more data are available, the glacial till in Ida County may be referred to as Pre-Illinoian glacial till (Prior and others, 1982).

In addition to the glacial till, on some side slopes paleosols that formed in glacial drift are exposed. These paleosols are highly weathered, clayey, gray, and very slowly permeable. They crop out at elevations of about 1,420, 1,360, and 1,320 feet and are indicated on the soil maps with a spot symbol.

The sand and gravel that underlie the soils on stream benches and terraces in Ida County are glacial outwash deposited by more recent episodes than the Pre-Illinoian glaciation. The sand and gravel under the stream benches were deposited by water from the melting Tazewell substage of the Wisconsin glaciation and Iowan erosion sediment (Hoyer, 1980). The Tazewell glaciation itself was north and east of Ida County. The glacial meltwater cut the relatively wide valleys of the Maple, Soldier, and Little Sioux Rivers. The meltwater also cut wide valleys for the tributaries of the Maple River that carried meltwater west and south from the Tazewell glacier.

Glacial meltwater from the most recent glaciation to affect Ida County, the Cary substage of the Wisconsin glaciation, deposited sand and gravel and the silty and loamy overlying sediments of the stream terraces along the Little Sioux River (Hoyer, 1980).

The glacial till in Ida County is clay loam and loam. Steinauer and Burchard soils formed entirely in glacial till. Sac soils formed in 20 to 40 inches of loess and in the underlying glacial till. Galva and Marshall soils formed in loess on stream benches underlain by glacial outwash sands and gravels. Allendorf and Hawick soils formed entirely in glacial outwash on stream terraces.

Eolian sands, including loamy sand and sand deposited by the wind, are the surficial or near-surface parent material in about 1 percent of the county. Most of the eolian sand in the county is south and east of the Maple River Valley southwest of Ida Grove and south of Odebolt Creek southeast of Ida Grove. Dickman soils formed mainly in eolian sands. Bolan soils formed in loam and sandy loam sediments over eolian sands, and Arthur soils formed in loess over eolian sands.

Alluvium is sediment deposited by flowing water on foot slopes, in upland drainageways, and in valleys of streams and rivers. Alluvium is the surficial parent material in about 27 percent of the county. Most of the alluvium in Ida County is material removed by erosion of the soils on loess-covered side slopes and ridgetops in the uplands. Most of the alluvium is silty clay loam. The alluvium in Ida County has been in place for a shorter time than the soil-forming material on upland ridgetops and side slopes. The period of time the alluvium has been in place in Ida County ranges from as recently as the last erosive rainfall to as much as 12,000 years.

Ackmore, Afton, Colo, Ely, Judson, Kennebec, Nodaway, and Zook soils formed in silty clay loam and silt loam alluvium. Terril soils formed in loam alluvium. Alluvium that is moved only a short distance, such as from the top of a hill to the base of a hill, is called local alluvium. Afton, Ely, Judson, and Terril soils formed entirely or partly in local alluvium. Other alluvium has been transported a distance of a few miles to many miles before being deposited in an upland drainageway or on a flood plain. Ackmore, Colo, Kennebec, Nodaway, and Zook soils formed in this kind of alluvium.

Climate

Climate is a major influence on soil development. Soils form more rapidly in a warm, wet climate than in a cool, dry climate. Climate directly influences soil temperature and soil moisture. Thus, it affects the rate of weathering and leaching, the rate of chemical reaction, the kind of vegetation and its growth, and the activity of micro-organisms in the soil.

Erosion and deposition rates are also influenced by climate. In Ida County, the soils in some landscape positions erode about as rapidly as the rate of soil formation. Ida and Steinauer soils are examples. In areas where the climate is wetter and rainfall is less erosive than in Ida County, soils that have developed a subsoil are in the same landscape positions as the Ida and Steinauer soils in Ida County.

Climate influences the formation and distribution of clay in soils. Research indicates that clay formation is more directly related to rainfall frequency in spring and summer than to the total amount of rain (Goddard and others, 1973). The distribution of clay within the profile is about the same in Galva, Marshall, and Monona soils in Ida County. Galva soils in northern Iowa, however, have maximum clay content at a shallower depth than those in Ida County. Marshall and Monona soils in southern Iowa have maximum clay content at a greater depth than those in Ida County.

The local climate in Ida County tends to be slightly cooler and more moist on north- and east-facing slopes than on south- and west-facing slopes. This variation is most noticeable on steep and very steep slopes. In areas of Steinauer-Burchard complex, for example, Burchard soils tend to be on north- and east-facing slopes and Steinauer soils tend to be on south- and west-facing slopes. Generally, soils on north-facing slopes have a higher water content than soils on other slope aspects (Hanna and others, 1982).

The climate has fluctuated during the time the soils in the county have been forming. Beginning about 14,000 years ago, when loess deposition ended (Ruhe, 1969), temperatures began warming. The warming trend continued until about 7,000 years ago. From about

7,500 years ago to about 4,500 years ago, the climate was warmer and drier than before or after this period (Hallberg, Hoyer, and Miller, 1974; Van Zant and Hallberg, 1976). During this period and up to the present time, the climate has varied from year to year and over periods of several years. The analysis of plant pollen from marshes and bogs in Iowa (Baker and others, 1987) and tree ring analysis of Iowa's oldest oak trees (Duvic and Blasing, 1983) indicate that the past climate in the area has been both warmer and cooler and wetter and drier than it is at present.

Plant and Animal Life

Plants and animals change the soils as they use them in their life processes. Plants generally produce more noticeable changes than animals. Native prairie grasses were the dominant vegetation when the soils in the survey area were forming. These grasses have many fibrous roots that extend several feet into the soil. The grass roots die and are replaced by new roots much more often than in a tree-root system, and thus they add more organic matter to the soil. Soils that formed under prairie grasses have a thicker and darker surface soil than soils that formed under trees.

A very small proportion of the soils in Ida County formed partially under trees. According to surveyors' notes, 640 acres in Ida County was forested at the time of settlement (Thomson and Hertel, 1981). In fact, there may have been even fewer than 640 acres of forest land (Thomson, 1987). Soils that formed partially under trees were identified in the previous soil survey of Ida County (Benton and Geib, 1939) as well as in this soil survey. The surface layer and subsurface layer of these soils are less clayey than the Monona soils with which they are associated, and they have a more clayey and more strongly developed subsoil. These soils were mapped as inclusions with the Monona soils in this soil survey because they occur on only a small acreage in Ida County.

Burrowing animals, such as badgers and pocket gophers, move large amounts of soil from the subsoil to the soil surface. They are active in relatively small areas. In most places in this survey area, the soils appear undisturbed by burrowing animals. Earthworms and soil insects have a much more widespread effect. Earthworms move up and down in soils as soil moisture or temperature changes. In most of the soil profiles examined in the county, earthworms had moved materials from one soil horizon to another. Earthworms are beneficial in several ways. The worm channels they leave improve soil aeration and the rate of water infiltration. Earthworm castings, except when they are fresh, enhance the stability of soil aggregates (Shipitalo and Protz, 1988).

Micro-organisms, such as bacteria and fungi, modify plant residues into soil humus and release plant nutrients. Individual genera of bacteria and fungi tend to colonize and decompose specific plant residues and to prefer specific soil temperature and moisture states (Broder and Wagner, 1988). The diversity of bacteria and fungi genera in a soil, however, ensures that plant residues are continually being decomposed, except when the soil is frozen.

Relief

Relief, or topography, refers to the shape of the landscape. It influences soil formation through its effect on drainage, runoff, and erosion. Relief includes slope gradient, slope aspect, and landscape position. Relief affects both surface drainage and internal soil drainage. Poorly drained soils, such as Afton and Marcus soils, are nearly level and are in plane or concave landscape positions. Excess water runs off slowly and saturates the soil. In contrast, runoff is very rapid on the steep Monona soils and the soil is seldom, if ever, saturated with water. Generally, more water is available for leaching and for chemical and biological reactions in nearly level soils than in the more sloping soils. As a result, nearly level soils generally have a thicker topsoil, contain more organic matter, and have a more clayey subsoil than steep soils that formed in the same parent material.

Water erosion also increases with increasing slope, even with similar management. For example, most steep Monona soils that have been cultivated for many years are severely eroded. In general, unless soil management has changed, soil removal is progressing much more rapidly than soil formation on the severely eroded soils in the county.

Slope aspect, the shape of slopes, and landscape position also influence soil development. In the uplands, the landscape position affects the erodibility of the soil. Soils on convex ridgetops and side slopes are more erodible than soils on plane or concave side slopes (Johnson, 1988). The effect of slope aspect increases with increasing slope. South-facing slopes tend to be warmer and drier than north-facing slopes. In areas that still support native vegetation, the kind and amount of vegetation on south-facing slopes are generally different than on north-facing slopes. Some research on cultivated soils indicates a higher available water capacity on north-facing slopes than on south-facing slopes and a higher available water capacity on foot slopes and back slopes than in other landscape positions (Hanna and others, 1982).

Topography affects the age of soils. In general, most soils on uplands are older than most soils on flood plains and stream terraces. Of the soils in the uplands, those in landscape positions that have a faster rate of erosion than the rate of soil formation are younger than soils in landscape positions that do not erode as rapidly as the rate of soil formation. Ida and Steinauer soils are younger than the adjacent Monona and Marshall soils because their geologic erosion rates have been greater than their soil formation rates. Soils on uplands and stream benches, such as Galva, Marshall, and Monona soils, have been forming longer than soils on alluvial terraces, such as Allendorf soils. Soils on flood plains are among the youngest in the county.

Topography influences soil color through its effect on soil drainage. Soils on ridgetops and side slopes, such as Galva and Sac soils, have a brown or yellowish brown subsoil and do not have ground water within a depth of 6 feet. Soils in swales and other less sloping areas, such as Marcus and Afton soils, have a mottled or gray subsoil and have ground water within a depth of 1 to 3 feet during part of the year.

Human Activities

The settlement of Ida County resulted in changes in the conditions under which the soils were forming. The most immediate changes were the result of cultivation and erosion. Observations made during mapping indicate that even very steep Monona soils were cultivated in a few places.

Most soils that were forming under prairie vegetation, such as Galva, Marshall, and Monona soils, had a dark surface layer and subsurface layer 16 or more inches thick. Presently, Galva, Marshall, and the moderately eroded Monona soils do not have a dark subsurface layer and have some light colored subsoil material mixed into the surface layer.

Erosion has changed not only the thickness of the surface layer but also some of its properties. In some soils in the county, the upper part of the subsoil has a higher clay content and a lower content of organic matter than the surface layer. Thus, as erosion progresses and more subsoil material is incorporated into the surface layer, the surface layer becomes clayey, less fertile, and less friable than the surface layer in an uneroded soil.

Human activities have also increased the bulk density of soils. This characteristic is often referred to as soil compaction. In some cases this change is desirable, for example, to increase the weight-bearing capacity of a soil. In areas used for crop production, however, soil compaction generally reduces soil productivity and increases the runoff rate and the hazard of erosion. Soil compaction reduces the capacity of the surface layer to transmit water and air and reduces the growth of plant roots. Minimizing tillage, deferring tillage when the soils are wet, reducing equipment weight, and, where practical, keeping wheel traffic in the same travel lanes help to prevent soil compaction (Swan and others, 1987).

Applications of commercial fertilizer, manure, and lime have improved the production capacity of most cultivated soils in the county. Applications of manure help to control runoff and erosion by increasing the water infiltration rate and increasing the number of large soil aggregates (Mazurak and others, 1975). Moderately eroded and severely eroded soils tend to benefit most from applications of manure and commercial fertilizer because they have lost a large proportion of their original organic matter and fertility.

Erosion is the main cause of losses in organic matter content. Even soils that have not eroded under cultivation, however, such as Primghar and some Galva soils, have less organic matter and lower fertility than they had under the native prairie vegetation. In only 15 years of continuous corn production, the content of organic matter in Galva soils decreased by 7 percent (Barnhart and others, 1978). One long-term study indicates that crop rotations maintain a higher content of organic matter and result in higher corn yields than continuous cropping of corn (Odell and others, 1984). Two cultivated and uncultivated Iowa soils were recently compared. The surface layer of the cultivated soils had lower pH values, lower cation-exchange capacities, less organic matter, and less nitrogen than that of the uncultivated soils (Zhang and others, 1988). Maintaining the content of organic matter at the level that existed under prairie vegetation is not economically feasible. Minimizing the reduction of organic matter content, however, is practical and beneficial, especially on the more sloping soils. Controlling erosion, which is the major cause of organic matter losses, helps to maintain the content of organic matter.

Time

Time is necessary for climate, relief, and plant and animal life to change parent material into soils. Soil formation begins wherever new parent material is exposed or deposited. In the climate of Ida County and nearby areas, the period of time needed for the formation of topsoil ranges from one hundred to several hundred years. In an area in eastern Iowa where the parent material has been exposed for 100 years, the content of organic matter in the surface layer is the same as that in the adjacent soils (Hallberg, Wollenhaupt, and Miller, 1978). It is believed that at least a thousand years is needed for the formation of a well developed subsoil (Simonson, 1959).

Most information about the age of soils in Iowa has been obtained by radiocarbon dating of organic materials, such as wood or bones that are buried in the soil. The loess in which many Ida County soils formed is buried beneath glacial till from the Cary substage of the Wisconsin glaciation east and south of Ida County. Wood from trees that were growing when the Cary till buried them was radiocarbon dated. The dates, about 14,000 radiocarbon years before present, indicate the age of the top of the buried loess (Ruhe, 1969). Thus, no soil that formed in loess in Ida County could be older than about 14,000 years, and most soils are much younger.

The most stable and oldest surfaces on the loess-mantled uplands are the broad ridgetops. Radiocarbon dating indicates that soils on these ridgetops, such as Galva and Marshall soils, are no older than 14,000 years. On side slopes the soils are much younger because geologic erosion has removed soil material from the slopes. Much of this erosion is likely to have occurred mainly when the climate and vegetation were changing, such as the warmer and drier period about 6,000 to 7,000 years ago. The base of the upland valley fill alluvium in western Iowa has been radiocarbon dated. The results of this testing indicate that alluvium deposition began about 6,800 years ago (Ruhe, 1959; Huddleston and Riecken, 1973).

The soils on uplands have a wide range in age, depending on the amount of geologic erosion and recent accelerated erosion. Except for a few soils, such as Ida and Steinauer soils, the soils on uplands are older than the soils on flood plains. Of the soils on flood plains, the frequently flooded soils are the youngest because they continually receive fresh deposition. For example, some Colo soils receive deposition each time they are flooded. In most places, however, they do not have stratification in the upper part.

Recently, Colo soils from many locations were investigated. Almost half of them had some evidence of post-settlement deposition but did not have stratification. Also, the Colo soils with and without post-settlement deposition had similar average contents of sand, silt, clay, and organic matter in the upper 12 inches (Collins and Fenton, 1984).

Processes of Horizon Development

The factors of soil formation result in horizon development or differentiation through their effects on the soil-forming processes. These processes are additions, removals, transfers, and transformations (Simonson, 1959). These processes determine the kind of soil that forms and how rapidly soil formation progresses. Depending on the balance between these processes, certain kinds of horizons develop in some soils and other kinds of horizons develop in other soils.

The addition of organic matter by growing plants results in horizon differentiation within a relatively short time in areas where plants grow well. For example, where fresh soil material was exposed and then left undisturbed, the content of organic matter in the A horizon was nearly the same as that of the adjacent cultivated soil within a period of 100 years (Hallberg, Wollenhaupt, and Miller, 1978).

Removal of organic matter from the soils in Ida County is the most rapid where the soils on uplands are eroding. Removal of many other substances has also affected the soils in the county. Calcium carbonate has been removed from the upper horizons of nearly all of the soils. Some clay has been removed from the A horizon of many soils, such as Marshall and Monona soils. Nitrate nitrogen moves downward in soils with the percolating water and is removed unless it is taken up by growing plants. Sandy soils, such as Dickman soils, are the most likely to have nitrogen removed by percolating water.

The transfer of substances from one horizon to another is a major cause of horizon differentiation in the soils in Ida County. Some soils on uplands and on stream benches have more clay in the upper part of the B horizon than in the A horizon. This characteristic is mainly the result of the transfer of clay from the A horizon to the B horizon. Clay particles or clay minerals are carried downward by percolating water. Most of the water moves down in the soil pores and spaces between soil peds. In the drier B horizon, the water is drawn into the peds and the clay is left in films in the pores and on the faces of peds. These clay films are apparent in the B horizon of some of the soils in the county. Although most transfers are related to water moving downward in soils, some are related to plants and animals. Plant nutrients, such as nitrogen and phosphorus, are transferred downward with percolating water from the A horizon to the B horizon. They are then taken up by plants and returned to the A horizon in the plant residues. Earthworms and other animals also transfer soil material from one horizon to another. They transfer dark material from the A horizon into the upper part of the B horizon.

Transformations occur in all soil horizons but are most numerous in the A horizon. Soils that formed under prairie grasses, including Galva, Primghar, and Marcus soils, have large amounts of nitrogen and other plant nutrients associated with the organic matter content. When these soils are cultivated and the organic matter oxidizes, these nutrients are transformed into inorganic phosphorus as the level of organic matter declines (Sharpley and Smith, 1985). Some fertilizers, such as anhydrous ammonia, hydrolyze organic matter. The hydrolyzed organic matter is transformed into inorganic plant nutrients by microbes (Norman and others, 1988). The nitrogen is transformed into ammonia and nitrate forms that are used by crop plants. If the soil is too wet, however, some of the nitrogen is transformed into nitrous oxide and elemental nitrogen and is lost to the atmosphere (Sexstone and others, 1985).

The gray colors in the subsoil of soils that have a seasonal high water table, such as Afton and Marcus soils, are the result of the transformation of ferric iron into mobile ferrous iron. The ferrous iron moves with water in the soil and forms mottles surrounded by grayish soil material.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form

a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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. Synonvm: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Low strength. The soil is not strong enough to support loads.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage.

Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

Phosphorus. The amount of phosphorus available to plants at a depth of 30 to 42 inches is expressed in parts per million and based on the weighted average of air-dried soil samples. Terms describing the amount of available phosphorus are:

Very low	less than 7.5 ppm
Low	7.5 to 13.0 ppm
Medium	13.0 to 22.5 ppm
High	more than 22.5 ppm

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Potassium. The amount of potassium available to plants at a depth of 12 to 24 inches is expressed in parts per million and based on the weighted average of air-dried soil samples. Terms describing the amount of available potassium are:

Very low	less than 50 ppm
Low	50 to 79 ppm
Medium	79 to 125 ppm
High	more than 125 ppm

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1961-90 at Ida Grove, Iowa)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	27.4	7.0	17.2	54	-25	1	0.70	0.17	1.16	2	6.4
February----	32.9	11.9	22.4	61	-21	6	.79	.20	1.30	2	7.2
March-------	45.6	23.8	34.7	79	-6	79	1.92	.71	2.92	4	7.5
April-------	61.8	36.1	49.0	88	14	298	2.73	1.32	3.96	5	1.3
May---------	73.0	47.4	60.2	92	26	629	4.23	2.63	5.67	7	.0
June--------	82.4	57.5	69.9	98	39	895	4.73	2.59	6.61	6	.0
July--------	86.2	62.4	74.3	99	46	1,054	3.70	2.03	5.17	6	.0
August------	83.2	59.4	71.3	96	42	965	4.22	2.02	6.13	5	.0
September---	75.1	50.5	62.8	93	28	684	3.31	1.53	4.83	5	.0
October-----	63.9	38.5	51.2	86	17	361	2.40	.85	3.69	4	.4
November----	46.4	25.6	36.0	71	-1	73	1.12	.30	1.84	2	3.2
December----	30.8	11.9	21.4	59	-19	5	.90	.39	1.33	2	8.0
Yearly:											
Average---	59.1	36.0	47.5	---	---	---	---	---	---	---	---
Extreme---	105	-32	---	100	-27	---	---	---	---	---	---
Total-----	---	---	---	---	---	5,050	30.74	22.17	36.60	50	34.0

* 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 (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1961-90 at Ida Grove, Iowa)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 27	May 12	May 17
2 years in 10 later than--	Apr. 21	May 7	May 12
5 years in 10 later than--	Apr. 12	Apr. 27	May 2
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 1	Sept. 24	Sept. 14
2 years in 10 earlier than--	Oct. 7	Sept. 29	Sept. 19
5 years in 10 earlier than--	Oct. 20	Oct. 9	Sept. 29

TABLE 3.--GROWING SEASON

(Recorded in the period 1961-90 at Ida Grove, Iowa)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	162	144	129
8 years in 10	171	151	136
5 years in 10	189	165	150
2 years in 10	207	179	163
1 year in 10	217	186	170

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1B	Ida silt loam, 2 to 5 percent slopes	465	0.2
1C	Ida silt loam, 5 to 9 percent slopes	1,660	0.6
1C3	Ida silt loam, 5 to 9 percent slopes, severely eroded	1,890	0.7
1D	Ida silt loam, 9 to 14 percent slopes	1,595	0.6
1D3	Ida silt loam, 9 to 14 percent slopes, severely eroded	4,470	1.6
1E	Ida silt loam, 14 to 20 percent slopes	695	0.3
1E3	Ida silt loam, 14 to 20 percent slopes, severely eroded	2,185	0.8
1F3	Ida silt loam, 20 to 30 percent slopes, severely eroded	210	0.1
8B	Judson silty clay loam, 2 to 5 percent slopes	3,785	1.4
8C	Judson silty clay loam, 5 to 9 percent slopes	5,875	2.1
9B	Marshall silty clay loam, 2 to 5 percent slopes	3,740	1.4
9B2	Marshall silty clay loam, 2 to 5 percent slopes, moderately eroded	1,670	0.6
9C	Marshall silty clay loam, 5 to 9 percent slopes	3,270	1.2
9C2	Marshall silty clay loam, 5 to 9 percent slopes, moderately eroded	7,350	2.7
9D	Marshall silty clay loam, 9 to 14 percent slopes	560	0.2
9D2	Marshall silty clay loam, 9 to 14 percent slopes, moderately eroded	2,700	1.0
11B	Colo-Judson silty clay loams, 0 to 5 percent slopes	20,865	7.4
22D3	Dow silt loam, 9 to 14 percent slopes, severely eroded	245	0.1
26	Kennebec silty clay loam, 0 to 2 percent slopes	9,265	3.4
26B	Kennebec silty clay loam, 2 to 5 percent slopes	11,340	4.1
27B	Terril loam, 2 to 5 percent slopes	205	0.1
27C	Terril loam, 5 to 9 percent slopes	225	0.1
28C2	Dickman sandy loam, 5 to 9 percent slopes, moderately eroded	365	0.1
28D2	Dickman sandy loam, 9 to 14 percent slopes, moderately eroded	365	0.1
31	Afton silty clay loam, 0 to 2 percent slopes	2,455	0.9
35E2	Steinauer-Burchard complex, 14 to 18 percent slopes, moderately eroded	435	0.2
35G	Steinauer-Burchard complex, 18 to 40 percent slopes	560	0.2
54	Zook silty clay loam, 0 to 2 percent slopes	475	0.2
59D2	Burchard clay loam, 5 to 14 percent slopes	1,075	0.4
78B	Sac silty clay loam, 2 to 5 percent slopes	200	0.1
78B2	Sac silty clay loam, 2 to 5 percent slopes, moderately eroded	785	0.3
78C	Sac silty clay loam, 5 to 9 percent slopes	420	0.2
78C2	Sac silty clay loam, 5 to 9 percent slopes, moderately eroded	2,085	0.8
78D2	Sac silty clay loam, 9 to 14 percent slopes, moderately eroded	650	0.2
91B	Primghar silty clay loam, 1 to 4 percent slopes	3,940	1.4
92	Marcus silty clay loam, 0 to 2 percent slopes	640	0.2
99C2	Exira silty clay loam, 5 to 9 percent slopes, moderately eroded	630	0.2
99D2	Exira silty clay loam, 9 to 14 percent slopes, moderately eroded	4,010	1.5
99D3	Exira silty clay loam, 9 to 14 percent slopes, severely eroded	1,730	0.6
99E2	Exira silty clay loam, 14 to 20 percent slopes, moderately eroded	320	0.1
100C	Monona silty clay loam, 5 to 9 percent slopes	1,850	0.7
100C2	Monona silty clay loam, 5 to 9 percent slopes, moderately eroded	9,825	3.6
100C3	Monona silty clay loam, 5 to 9 percent slopes, severely eroded	305	0.1
100D	Monona silty clay loam, 9 to 14 percent slopes	1,910	0.7
100D2	Monona silty clay loam, 9 to 14 percent slopes, moderately eroded	23,080	8.3
100D3	Monona silty clay loam, 9 to 14 percent slopes, severely eroded	4,850	1.8
100E	Monona silty clay loam, 14 to 20 percent slopes	875	0.3
100E2	Monona silty clay loam, 14 to 20 percent slopes, moderately eroded	3,620	1.3
100E3	Monona silty clay loam, 14 to 20 percent slopes, severely eroded	4,315	1.6
100F	Monona silt clay loam, 20 to 30 percent slopes	245	0.1
100F2	Monona silty clay loam, 20 to 30 percent slopes, moderately eroded	390	0.1
100F3	Monona silty clay loam, 20 to 30 percent slopes, severely eroded	415	0.2
133	Colo silty clay loam, 0 to 2 percent slopes	6,700	2.4
133+	Colo silt loam, overwash, 0 to 2 percent slopes	5,050	1.8
220	Nodaway silt loam, 0 to 2 percent slopes	2,295	0.8
309	Allendorf silty clay loam, 0 to 3 percent slopes	280	0.1
310	Galva silty clay loam, 0 to 2 percent slopes	845	0.3
310B	Galva silty clay loam, 2 to 5 percent slopes	27,085	9.7
310B2	Galva silty clay loam, 2 to 5 percent slopes, moderately eroded	8,770	3.2
310C	Galva silty clay loam, 5 to 9 percent slopes	18,960	6.9
310C2	Galva silty clay loam, 5 to 9 percent slopes, moderately eroded	24,800	8.9
310D	Galva silty clay loam, 9 to 14 percent slopes	395	0.1
310D2	Galva silty clay loam, 9 to 14 percent slopes, moderately eroded	6,075	2.2
428B	Ely silty clay loam, 1 to 4 percent slopes	1,265	0.5
430	Ackmore silt loam, 0 to 2 percent slopes	2,415	0.9

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
430B	Ackmore silt loam, 2 to 5 percent slopes	1,730	0.6
474C	Bolan loam, 5 to 9 percent slopes	415	0.2
474D2	Bolan loam, 9 to 14 percent slopes, moderately eroded	420	0.2
475B	Arthur silty clay loam, 2 to 5 percent slopes	210	0.1
475C2	Arthur silty clay loam, 5 to 9 percent slopes, moderately eroded	580	0.2
475D2	Arthur silty clay loam, 9 to 14 percent slopes, moderately eroded	315	0.1
509	Marshall silty clay loam, benches, 0 to 2 percent slopes	745	0.3
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes	2,035	0.7
509C	Marshall silty clay loam, benches, 5 to 9 percent slopes	410	0.1
509C2	Marshall silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	605	0.2
740C	Hawick gravelly sandy loam, 5 to 9 percent slopes	120	*
740E	Hawick gravelly sandy loam, 9 to 18 percent slopes	130	*
740G	Hawick gravelly sandy loam, 18 to 40 percent slopes	140	0.1
810	Galva silty clay loam, benches, 0 to 2 percent slopes	1,470	0.5
810B	Galva silty clay loam, benches, 2 to 5 percent slopes	2,860	1.0
810C2	Galva silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	640	0.2
1220	Nodaway silt loam, channeled, 0 to 2 percent slopes	885	0.3
5010	Pits, sand and gravel	55	*
5040	Orthents, loamy	515	0.2
	Water	100	*
	Total	276,400	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
1B	Ida silt loam, 2 to 5 percent slopes
8B	Judson silty clay loam, 2 to 5 percent slopes
9B	Marshall silty clay loam, 2 to 5 percent slopes
9B2	Marshall silty clay loam, 2 to 5 percent slopes, moderately eroded
11B	Colo-Judson silty clay loams, 0 to 5 percent slopes (where drained)
26	Kennebec silty clay loam, 0 to 2 percent slopes
26B	Kennebec silty clay loam, 2 to 5 percent slopes
27B	Terril loam, 2 to 5 percent slopes
31	Afton silty clay loam, 0 to 2 percent slopes (where drained)
54	Zook silty clay loam, 0 to 2 percent slopes (where drained)
78B	Sac silty clay loam, 2 to 5 percent slopes
78B2	Sac silty clay loam, 2 to 5 percent slopes, moderately eroded
91B	Primghar silty clay loam, 1 to 4 percent slopes
92	Marcus silty clay loam, 0 to 2 percent slopes (where drained)
133	Colo silty clay loam, 0 to 2 percent slopes (where drained)
133+	Colo silt loam, overwash, 0 to 2 percent slopes (where drained)
220	Nodaway silt loam, 0 to 2 percent slopes
309	Allendorf silty clay loam, 0 to 3 percent slopes
310	Galva silty clay loam, 0 to 2 percent slopes
310B	Galva silty clay loam, 2 to 5 percent slopes
310B2	Galva silty clay loam, 2 to 5 percent slopes, moderately eroded
428B	Ely silty clay loam, 1 to 4 percent slopes
430	Ackmore silt loam, 0 to 2 percent slopes
430B	Ackmore silt loam, 2 to 5 percent slopes
475B	Arthur silty clay loam, 2 to 5 percent slopes
509	Marshall silty clay loam, benches, 0 to 2 percent slopes
509B	Marshall silty clay loam, benches, 2 to 5 percent slopes
810	Galva silty clay loam, benches, 0 to 2 percent slopes
810B	Galva silty clay loam, benches, 2 to 5 percent slopes

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
1B----------------- Ida	IIe	65	120	40	66	5.0	3.0	4.9	8.3
1C----------------- Ida	IIIe	51	115	39	63	4.8	2.8	4.7	8.0
1C3---------------- Ida	IIIe	46	102	34	56	4.3	2.5	4.2	7.2
1D----------------- Ida	IIIe	42	106	36	58	4.5	2.6	4.3	7.5
1D3---------------- Ida	IIIe	37	93	31	51	3.9	2.3	3.8	6.5
1E----------------- Ida	IVe	33	89	30	49	3.7	2.2	3.6	6.2
1E3---------------- Ida	IVe	28	76	25	42	3.2	1.9	3.1	5.3
1F3---------------- Ida	VIe	9	---	---	---	2.9	1.7	2.8	4.8
8B----------------- Judson	IIe	76	138	46	76	5.8	3.4	5.7	9.7
8C----------------- Judson	IIIe	61	133	45	73	5.6	3.3	5.5	9.4
9B----------------- Marshall	IIe	77	136	46	75	5.7	3.3	5.6	9.5
9B2---------------- Marshall	IIe	76	132	44	73	5.5	3.2	5.4	9.2
9C----------------- Marshall	IIIe	64	131	44	72	5.5	3.2	5.4	9.2
9C2---------------- Marshall	IIIe	62	127	43	70	5.3	3.1	5.2	8.9

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
9D----------------- Marshall	IIIe	55	122	41	67	5.1	3.0	5.0	8.5
9D2---------------- Marshall	IIIe	53	118	40	65	5.0	2.9	4.8	8.3
11B---------------- Colo-Judson	IIw	62	128	43	70	3.8	3.1	5.2	6.3
22D3--------------- Dow	IIIe	34	81	27	45	3.4	2.0	3.3	5.7
26----------------- Kennebec	IIw	78	130	49	98	5.5	3.2	5.3	9.2
26B---------------- Kennebec	IIe	73	127	48	95	5.3	3.1	5.2	8.9
27B---------------- Terril	IIe	75	133	50	100	5.6	3.3	5.5	9.4
27C---------------- Terril	IIIe	61	128	48	96	5.4	3.1	5.2	9.0
28C2--------------- Dickman	IVe	16	62	22	47	2.6	1.5	2.5	4.3
28D2--------------- Dickman	IVe	6	53	19	40	2.2	1.3	2.2	3.7
31----------------- Afton	IIw	75	135	51	101	4.1	3.3	5.5	6.8
35E2--------------- Steinauer-Burchard	VIe	26	---	---	---	2.9	1.7	2.8	4.8
35G---------------- Steinauer-Burchard	VIIe	5	---	---	---	---	1.4	---	---
54----------------- Zook	IIw	64	115	39	63	3.5	2.8	4.7	5.8
59D2--------------- Burchard	IIIe	37	91	30	50	3.8	2.2	3.7	6.3
78B---------------- Sac	IIe	69	122	46	92	5.1	3.0	5.0	8.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
78B2 Sac	IIe	67	118	44	89	5.0	2.9	4.8	8.3
78C Sac	IIIe	53	117	44	88	4.9	2.9	4.8	8.2
78C2 Sac	IIIe	51	113	42	85	4.7	2.8	4.6	7.8
78D2 Sac	IIIe	38	104	39	78	4.4	2.6	4.3	7.3
91B Primghar	IIe	81	142	50	107	5.7	3.5	5.8	9.5
92 Marcus	IIw	78	140	49	105	4.2	3.4	5.7	7.0
99C2 Exira	IIIe	59	123	41	68	5.2	3.0	5.0	8.7
99D2 Exira	IIIe	50	114	38	63	4.8	2.8	4.7	8.0
99D3 Exira	IVe	47	105	35	58	4.4	2.6	4.3	7.3
99E2 Exira	IVe	42	97	32	53	4.1	2.4	4.0	6.8
100C Monona	IIIe	58	130	44	72	5.5	3.2	5.3	9.2
100C2 Monona	IIIe	56	126	42	69	5.3	3.1	5.2	8.9
100C3 Monona	IIIe	54	117	39	64	4.9	2.9	4.8	8.2
100D Monona	IIIe	49	121	41	67	5.1	3.0	5.0	8.5
100D2 Monona	IIIe	47	117	39	64	4.9	2.9	4.8	8.2
100D3 Monona	IIIe	44	108	36	59	4.5	2.7	4.4	7.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
100E----------------- Monona	IVe	40	104	35	57	4.4	2.6	4.3	7.3
100E2---------------- Monona	IVe	38	100	34	55	4.2	2.5	4.1	7.0
100E3---------------- Monona	IVe	35	91	30	50	3.8	2.2	3.7	6.3
100F----------------- Monona	VIe	20	---	---	---	3.9	2.3	3.9	6.5
100F2---------------- Monona	VIe	18	---	---	---	3.8	2.2	3.7	6.3
100F3---------------- Monona	VIIe	16	---	---	---	3.5	2.0	3.4	6.5
133------------------ Colo	IIw	75	124	42	68	3.7	3.1	5.1	6.2
133+----------------- Colo	IIw	80	132	44	73	4.0	3.2	5.4	6.7
220------------------ Nodaway	IIw	79	135	45	74	5.7	3.3	5.5	9.5
309------------------ Allendorf	IIs	63	101	38	76	4.2	2.5	4.1	7.0
310------------------ Galva	I	78	137	48	103	5.8	3.4	5.6	9.7
310B----------------- Galva	IIe	73	134	47	101	5.6	3.3	5.5	9.3
310B2---------------- Galva	IIe	71	130	46	98	5.5	3.2	5.3	9.2
310C----------------- Galva	IIIe	57	129	45	97	5.4	3.2	5.3	9.0
310C2---------------- Galva	IIIe	55	125	44	94	5.3	3.1	5.1	8.8
310D----------------- Galva	IIIe	47	120	42	90	5.0	3.0	4.9	8.3

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
310D2: Galva	IIIe	45	116	41	87	4.9	2.9	4.8	8.2
428B: Ely	IIe	78	138	46	76	5.5	3.4	5.7	9.2
430: Ackmore	IIw	79	134	45	74	4.0	3.3	5.5	5.4
430B: Ackmore	IIw	74	131	44	72	3.9	3.2	5.4	6.5
474C: Bolan	IIIe	31	70	26	53	2.9	1.7	2.9	4.8
474D2: Bolan	IIIe	19	57	21	43	2.4	1.4	2.3	4.0
475B: Arthur	IIe	53	104	35	57	4.4	2.6	4.3	7.3
475C2: Arthur	IIIe	36	95	32	52	4.0	2.3	3.9	6.7
475D2: Arthur	IIIe	26	86	29	47	3.6	3.1	3.5	6.0
509: Marshall	I	82	139	47	76	5.8	3.4	5.7	9.7
509B: Marshall	IIe	77	136	46	75	5.7	3.3	5.6	9.5
509C: Marshall	IIIe	64	131	44	72	5.5	3.2	5.4	9.2
509C2: Marshall	IIIe	62	127	43	70	5.3	3.1	5.2	8.8
740C: Hawick	IVs	5	---	---	---	1.3	0.8	1.3	2.2
740E: Hawick	VIs	5	---	---	---	---	0.5	0.5	---
740G: Hawick	VIIs	5	---	---	---	---	0.5	---	---

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY, CORN SUITABILITY RATING, AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn suitability rating	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
		RV*	Bu	Bu	Bu	Tons	AUM**	AUM**	AUM**
810----------------- Galva	I	78	137	48	103	5.8	3.4	5.6	9.7
810B---------------- Galva	IIe	73	134	47	101	5.6	3.3	5.5	9.3
810C2--------------- Galva	IIIe	55	125	44	94	5.3	3.1	5.1	8.8
1220---------------- Nodaway	Vw	25	---	---	---	---	3.0	---	---
5010. Pits									
5040. Orthents									

* Relative value: The value for corn suitability rating (CSR).

** Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class*	Trees to plant
26, 26B------------ Kennebec	3A	Slight	Slight	Slight	Slight	Moderate	Bur oak-------------	63	3	Bur oak, black walnut, hackberry, green ash, eastern cottonwood, American sycamore.
							Black walnut--------	79	---	
							Hackberry-----------	---	---	
							Green ash-----------	---	---	
							Eastern cottonwood--	---	---	
220---------------- Nodaway	3A	Slight	Slight	Slight	Slight	Moderate	White oak-----------	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.
430, 430B---------- Ackmore	4A	Slight	Slight	Slight	Slight	Moderate	White oak-----------	65	4	Red pine, cottonwood, sugar maple, black walnut.
1220--------------- Nodaway	3A	Slight	Slight	Slight	Slight	Moderate	White oak-----------	65	3	Eastern white pine, red pine, black walnut, sugar maple, European larch.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1B, 1C, 1C3, 1D, 1D3, 1E, 1E3, 1F3 Ida	Silver buffaloberry, American plum.	Rocky Mountain juniper, Russian-olive, hackberry, Siberian peashrub, eastern redcedar.	Siberian elm, green ash, ponderosa pine, honeylocust.	---	---
8B, 8C Judson	---	Siberian peashrub, lilac.	Bur oak, hackberry, eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, honeylocust, green ash.	---
9B, 9B2, 9C, 9C2, 9D, 9D2 Marshall	---	American plum, lilac, Siberian peashrub.	Bur oak, hackberry, blue spruce, eastern redcedar, Russian-olive.	Honeylocust, ponderosa pine, green ash.	---
11B:					
Colo	---	Redosier dogwood, American plum.	White fir, white spruce, hackberry, Amur maple, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.
Judson	---	Siberian peashrub, lilac.	Bur oak, hackberry, eastern redcedar, blue spruce, Russian-olive.	Ponderosa pine, honeylocust, green ash.	---
22D3 Dow	Fragrant sumac	Siberian peashrub	Eastern redcedar, Osage-orange, honeylocust, Russian-olive, northern catalpa, green ash, bur oak, black locust.	Siberian elm	---
26, 26B Kennebec	Peking cotoneaster	Siberian peashrub, American plum, lilac.	Ponderosa pine, Manchurian crabapple, eastern redcedar.	Golden willow, honeylocust, hackberry, green ash.	Eastern cottonwood.
27B, 27C. Terril					
28C2, 28D2. Dickman					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
31----------------- Afton	Lilac-------------	Siberian peashrub	Eastern redcedar, hackberry, Russian-olive, ponderosa pine, blue spruce.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
35E2: Steinauer.					
Burchard---------	Peking cotoneaster	American plum, lilac.	Eastern redcedar, Russian mulberry, green ash, hackberry, bur oak.	Austrian pine, Scotch pine, honeylocust.	---
35G: Steinauer.					
Burchard.					
54----------------- Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.
59D2-------------- Burchard	Peking cotoneaster	American plum, lilac.	Eastern redcedar, Russian mulberry, green ash, hackberry, bur oak.	Austrian pine, Scotch pine, honeylocust.	---
78B, 78B2, 78C, 78C2, 78D2------- Sac	---	Siberian peashrub, American plum, lilac.	Eastern redcedar, Russian-olive, blue spruce, bur oak, hackberry.	Ponderosa pine, honeylocust, green ash.	---
91B--------------- Primghar	Peking cotoneaster	American plum, lilac, Siberian peashrub.	Eastern redcedar, ponderosa pine, Manchurian crabapple.	Golden willow, honeylocust, green ash, hackberry.	Eastern cottonwood.
92----------------- Marcus	Lilac-------------	Siberian peashrub	Eastern redcedar, blue spruce, ponderosa pine, hackberry.	Green ash, silver maple, honeylocust, golden willow.	Eastern cottonwood.
99C2, 99D2, 99D3, 99E2------------- Exira	---	Lilac, Amur honeysuckle, Amur maple, autumn-olive.	Eastern redcedar, green ash, hackberry, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
100C, 100C2, 100C3, 100D, 100D2, 100D3, 100E, 100E2, 100E3, 100F, 100F2, 100F3----- Monona	---	American plum, lilac, Siberian peashrub.	Russian-olive, blue spruce, bur oak, eastern redcedar, hackberry.	Ponderosa pine, honeylocust, green ash.	---
133, 133+--------- Colo	---	Redosier dogwood, American plum.	White fir, white spruce, hackberry, Amur maple, tall purple willow.	Green ash, golden willow.	Silver maple, eastern cottonwood.
220--------------- Nodaway	---	Amur honeysuckle, autumn-olive, Amur maple, lilac.	Eastern redcedar	Austrian pine, hackberry, honeylocust, green ash, eastern white pine, pin oak.	Eastern cottonwood.
309--------------- Allendorf	---	American plum, Siberian peashrub, lilac.	Eastern redcedar, Russian-olive, blue spruce, bur oak, hackberry.	Honeylocust, ponderosa pine, green ash.	---
310, 310B, 310B2, 310C, 310C2, 310D, 310D2------ Galva	---	American plum, Siberian peashrub, lilac.	Eastern redcedar, Russian-olive, blue spruce, bur oak, hackberry.	Honeylocust, ponderosa pine, green ash.	---
428B. Ely					
430, 430B--------- Ackmore	---	Redosier dogwood, lilac.	Amur maple, blue spruce, northern whitecedar, white spruce.	Hackberry, green ash, eastern white pine, Austrian pine.	Silver maple.
474C, 474D2------- Bolan	Lilac, Russian-olive, Siberian peashrub.	Eastern redcedar, hackberry, Manchurian crabapple.	Honeylocust, green ash, eastern white pine, bur oak.	---	---
475B, 475C2, 475D2------------ Arthur	Siberian peashrub	Eastern redcedar, Russian-olive, American plum, lilac.	Honeylocust, green ash, ponderosa pine, hackberry, blue spruce, bur oak, Scotch pine.	---	---
509. Marshall					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
509B, 509C, 509C2-Marshall	---	American plum, lilac, Siberian peashrub.	Bur oak, hackberry, blue spruce, eastern redcedar, Russian-olive.	Honeylocust, ponderosa pine, green ash.	---
740C, 740E, 740G--Hawick	Siberian peashrub	Late lilac, honeysuckle, Persian lilac, common chokecherry, Manchurian crabapple, northern whitecedar, sargent crabapple, silver buffaloberry, birchleaf buckthorn.	Jack pine, Austrian pine, eastern redcedar, green ash, thornless honeylocust, Russian-olive, ponderosa pine, white spruce, silver maple.	Eastern white pine, red pine, Siberian elm, Scotch pine, eastern cottonwood.	---
810, 810B, 810C2--Galva	---	American plum, Siberian peashrub, lilac.	Eastern redcedar, Russian-olive, blue spruce, bur oak, hackberry.	Honeylocust, ponderosa pine, green ash.	---
1220--------------Nodaway	---	Amur honeysuckle, autumn-olive, Amur maple, lilac.	Eastern redcedar	Austrian pine, hackberry, honeylocust, green ash, eastern white pine, pin oak.	Eastern cottonwood.
5010. Pits					
5040. Orthents					

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1B---------- Ida	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
1C---------- Ida	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
1C3---------- Ida	Slight----------	Slight----------	Severe: slope.	Severe: erodes easily.	Slight.
1D---------- Ida	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
1D3---------- Ida	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
1E---------- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1E3---------- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
1F3---------- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
8B---------- Judson	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
8C---------- Judson	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
9B, 9B2---------- Marshall	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
9C, 9C2---------- Marshall	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
9D, 9D2---------- Marshall	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
11B:					
Colo----------	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Judson----------	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
22D3---------- Dow	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
26---------- Kennebec	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
26B---------- Kennebec	Severe: flooding.	Slight----------	Moderate: slope, flooding.	Slight----------	Moderate: flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
27B-------------------- Terril	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
27C-------------------- Terril	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
28C2------------------- Dickman	Slight----------	Slight----------	Severe: slope.	Slight----------	Moderate: droughty.
28D2------------------- Dickman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
31--------------------- Afton	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight----------	Moderate: flooding.
35E2:					
Steinauer-------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Burchard--------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
35G:					
Steinauer-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Burchard--------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
54--------------------- Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
59D2------------------- Burchard	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
78B, 78B2-------------- Sac	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
78C, 78C2-------------- Sac	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
78D2------------------- Sac	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
91B-------------------- Primghar	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
92--------------------- Marcus	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
99C2------------------- Exira	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
99D2------------------- Exira	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
99D3: Exira	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
99E2: Exira	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
100C, 100C2: Monona	Slight	Slight	Severe: slope.	Slight	Slight.
100C3: Monona	Slight	Slight	Severe: slope.	Severe: erodes easily.	Slight.
100D, 100D2: Monona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
100D3: Monona	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
100E, 100E2: Monona	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
100E3: Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
100F, 100F2: Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
100F3: Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
133, 133+: Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
220: Nodaway	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
309: Allendorf	Slight	Slight	Slight	Slight	Slight.
310: Galva	Slight	Slight	Slight	Slight	Slight.
310B, 310B2: Galva	Slight	Slight	Moderate: slope.	Slight	Slight.
310C, 310C2: Galva	Slight	Slight	Severe: slope.	Slight	Slight.
310D, 310D2: Galva	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
428B: Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
430, 430B: Ackmore	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
474C------------------ Bolan	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
474D2----------------- Bolan	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
475B------------------ Arthur	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
475C2----------------- Arthur	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
475D2----------------- Arthur	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
509------------------- Marshall	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
509B------------------ Marshall	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
509C, 509C2----------- Marshall	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
740C------------------ Hawick	Slight----------	Slight----------	Severe: slope, small stones.	Slight----------	Slight.
740E------------------ Hawick	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight----------	Moderate: slope.
740G------------------ Hawick	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Slight----------	Severe: slope.
810------------------- Galva	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
810B------------------ Galva	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
810C2----------------- Galva	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
1220------------------ Nodaway	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
5010. Pits					
5040. Orthents					

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1B----------------- Ida	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1C, 1C3, 1D, 1D3--- Ida	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1E, 1E3------------ Ida	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
1F3---------------- Ida	Poor	Fair	Good	Poor	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
8B----------------- Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8C----------------- Judson	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
9B, 9B2------------ Marshall	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
9C, 9C2, 9D, 9D2--- Marshall	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
11B:										
Colo---------------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Judson-------------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
22D3--------------- Dow	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
26----------------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
26B---------------- Kennebec	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
27B---------------- Terril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
27C---------------- Terril	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
28C2, 28D2--------- Dickman	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
31----------------- Afton	Good	Good	Good	Fair	Poor	Good	Fair	Good	Fair	Fair.
35E2:										
Steinauer---------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Burchard----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
35G:										
Steinauer	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Burchard	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
54 Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
59D2 Burchard	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
78B, 78B2 Sac	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
78C, 78C2, 78D2 Sac	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
91B Primghar	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
92 Marcus	Good	Good	Good	Fair	Poor	Good	Fair	Good	Fair	Fair.
99C2, 99D2, 99D3, 99E2 Exira	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Fair	Poor.
100C, 100C2, 100C3, 100D, 100D2, 100D3 Monona	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
100E, 100E2, 100E3 Monona	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
100F, 100F2, 100F3 Monona	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
133, 133+ Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
220 Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
309 Allendorf	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
310, 310B, 310B2 Galva	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
310C, 310C2, 310D, 310D2 Galva	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
428B Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
430, 430B---------- Ackmore	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
474C--------------- Bolan	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
474D2-------------- Bolan	Fair	Fair	---	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
475B--------------- Arthur	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
475C2, 475D2------- Arthur	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
509, 509B---------- Marshall	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
509C, 509C2-------- Marshall	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
740C, 740E--------- Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
740G--------------- Hawick	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.
810, 810B---------- Galva	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
810C2-------------- Galva	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
1220--------------- Nodaway	Poor	Fair	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair.
5010. Pits										
5040. Orthents										

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1B----------------- Ida	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength, frost action.	Slight.
1C, 1C3----------- Ida	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength, frost action.	Slight.
1D, 1D3----------- Ida	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
1E, 1E3, 1F3------ Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
8B----------------- Judson	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
8C----------------- Judson	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
9B, 9B2----------- Marshall	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
9C, 9C2----------- Marshall	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
9D, 9D2----------- Marshall	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
11B:						
Colo--------------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
Judson-----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
22D3-------------- Dow	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
26, 26B----------- Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
27B: Terril	Slight	Slight	Slight	Slight	Severe: low strength.	Slight.
27C: Terril	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
28C2: Dickman	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
28D2: Dickman	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
31: Afton	Moderate: wetness, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: flooding.
35E2, 35G:						
Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Burchard	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
54: Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
59D2: Burchard	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
78B, 78B2: Sac	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
78C, 78C2: Sac	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
78D2: Sac	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
91B: Primghar	Moderate: wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
92: Marcus	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
99C2: Exira	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
99D2, 99D3 Exira	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
99E2 Exira	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
100C, 100C2, 100C3 Monona	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
100D, 100D2, 100D3 Monona	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
100E, 100E2, 100E3, 100F, 100F2, 100F3 Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
133, 133+ Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
220 Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
309 Allendorf	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Slight.
310, 310B, 310B2 Galva	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
310C, 310C2 Galva	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
310D, 310D2 Galva	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
428B Ely	Severe: excess humus, wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
430, 430B Ackmore	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
474C Bolan	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
474D2 Bolan	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
475B Arthur	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
475C2 Arthur	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
475D2 Arthur	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
509, 509B Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
509C, 509C2 Marshall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
740C Hawick	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
740E Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
740G Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
810, 810B Galva	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
810C2 Galva	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
1220 Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.
5010. Pits						
5040. Orthents						

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1B----------------- Ida	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
1C, 1C3------------- Ida	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
1D, 1D3------------- Ida	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
1E, 1E3, 1F3-------- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
8B----------------- Judson	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
8C----------------- Judson	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
9B, 9B2------------- Marshall	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
9C, 9C2------------- Marshall	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
9D, 9D2------------- Marshall	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
11B:					
Colo----------------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Judson--------------	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
22D3---------------- Dow	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
26, 26B------------- Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
27B----------------- Terril	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
27C----------------- Terril	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
28C2, 28D2----------- Dickman	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
31------------------ Afton	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack.
35E2, 35G:					
Steinauer-----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: hard to pack, slope.
Burchard-----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
54------------------ Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
59D2---------------- Burchard	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
78B, 78B2----------- Sac	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
78C, 78C2----------- Sac	Moderate: percs slowly.	Severe: slope.	Slight-----------	Slight-----------	Good.
78D2---------------- Sac	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
91B----------------- Primghar	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack.
92------------------ Marcus	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
99C2---------------- Exira	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
99D2, 99D3---------- Exira	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
99E2---------------- Exira	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
100C, 100C2, 100C3-- Monona	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
100D, 100D2, 100D3-- Monona	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
100E, 100E2, 100E3, 100F, 100F2, 100F3-Monona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
133, 133+-----------Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
220-----------------Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
309-----------------Allendorf	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
310-----------------Galva	Slight-----------	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
310B, 310B2---------Galva	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
310C, 310C2---------Galva	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
310D, 310D2---------Galva	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
428B----------------Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
430, 430B-----------Ackmore	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
474C, 474D2---------Bolan	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
475B----------------Arthur	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
475C2, 475D2--------Arthur	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
509-----------------Marshall	Slight-----------	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
509B----------------Marshall	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
509C, 509C2---------Marshall	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
740C, 740E---------- Hawick	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
740G---------------- Hawick	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
810----------------- Galva	Slight-----------	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
810B---------------- Galva	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
810C2--------------- Galva	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
1220---------------- Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
5010. Pits					
5040. Orthents					

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1B, 1C, 1C3 Ida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1D, 1D3 Ida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
1E, 1E3 Ida	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1F3 Ida	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
8B, 8C Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9B Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9B2 Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
9C Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
9C2 Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
9D Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
9D2 Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
11B:				
Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
22D3 Dow	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
26, 26B Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
27B, 27C Terril	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
28C2, 28D2 Dickman	Good	Probable	Improbable: too sandy.	Poor: too sandy.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
31: Afton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
35E2:				
Steinauer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Burchard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
35G:				
Steinauer	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Burchard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
54: Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
59D2: Burchard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
78B, 78B2, 78C, 78C2: Sac	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
78D2: Sac	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
91B: Primghar	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
92: Marcus	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
99C2: Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
99D2, 99D3: Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
99E2: Exira	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
100C: Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
100C2, 100C3: Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
100D: Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
100D2, 100D3 Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
100E, 100E2, 100E3 Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
100F, 100F2, 100F3 Monona	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
133, 133+ Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
220 Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
309 Allendorf	Good	Probable	Probable	Poor: area reclaim.
310, 310B, 310B2, 310C, 310C2 Galva	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
310D, 310D2 Galva	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
428B Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
430, 430B Ackmore	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
474C Bolan	Good	Probable	Improbable: too sandy.	Fair: thin layer.
474D2 Bolan	Good	Probable	Improbable: too sandy.	Fair: thin layer, slope.
475B Arthur	Good	Probable	Improbable: too sandy.	Fair: thin layer.
475C2 Arthur	Good	Probable	Improbable: too sandy.	Fair: too clayey, thin layer.
475D2 Arthur	Good	Probable	Improbable: too sandy.	Fair: too clayey, thin layer, slope.
509, 509B, 509C Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
509C2 Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
740C, 740E------------ Hawick	Good-----------------	Probable-------------	Probable-------------	Poor: too sandy, small stones, area reclaim.
740G------------------ Hawick	Poor: slope.	Probable-------------	Probable-------------	Poor: too sandy, small stones, area reclaim.
810, 810B, 810C2------ Galva	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
1220------------------ Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
5010. Pits				
5040. Orthents				

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
1B, 1C, 1C3------- Ida	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
1D, 1D3, 1E, 1E3, 1F3-------------- Ida	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
8B, 8C------------ Judson	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
9B, 9B2, 9C, 9C2-- Marshall	Moderate: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
9D, 9D2----------- Marshall	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
11B:						
Colo--------------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness--------	Wetness.
Judson-----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
22D3-------------- Dow	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
26---------------- Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable------	Favorable.
26B--------------- Kennebec	Moderate: seepage, slope.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Favorable------	Favorable.
27B, 27C---------- Terril	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Favorable------	Favorable.
28C2-------------- Dickman	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Too sandy, soil blowing.	Droughty.
28D2-------------- Dickman	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, too sandy, soil blowing.	Slope, droughty.
31---------------- Afton	Moderate: seepage.	Moderate: hard to pack, wetness.	Severe: slow refill.	Deep to water	Erodes easily	Erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
35E2, 35G: Steinauer	Severe: slope.	Moderate: piping, hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
Burchard	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
54 Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
59D2 Burchard	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
78B, 78B2, 78C, 78C2 Sac	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
78D2 Sac	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
91B Primghar	Moderate: seepage.	Severe: thin layer.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
92 Marcus	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action	Erodes easily, wetness.	Wetness, erodes easily.
99C2 Exira	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
99D2, 99D3, 99E2 Exira	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
100C, 100C2, 100C3 Monona	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
100D, 100D2, 100D3, 100E, 100E2, 100E3, 100F, 100F2, 100F3 Monona	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
133, 133+ Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
220 Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
309 Allendorf	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Erodes easily, too sandy.	Erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
310----------------- Galva	Moderate: seepage.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
310B, 310B2, 310C, 310C2------------- Galva	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
310D, 310D2-------- Galva	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
428B--------------- Ely	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action	Erodes easily, wetness.	Erodes easily.
430----------------- Ackmore	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness	Wetness.
430B--------------- Ackmore	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Wetness	Wetness.
474C--------------- Bolan	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy	Favorable.
474D2-------------- Bolan	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy.	Slope.
475B, 475C2-------- Arthur	Severe: seepage.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
475D2-------------- Arthur	Severe: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
509----------------- Marshall	Moderate: seepage.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
509B, 509C, 509C2- Marshall	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
740C--------------- Hawick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy	Droughty.
740E, 740G--------- Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, too sandy.	Slope, droughty.
810----------------- Galva	Moderate: seepage.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.
810B, 810C2-------- Galva	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Erodes easily	Erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
1220------------- Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Erodes easily	Erodes easily.
5010. Pits						
5040. Orthents						

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1B, 1C, 1C3, 1D, 1D3, 1E, 1E3, 1F3-------------	0-6	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	95-100	30-40	5-15
Ida	6-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	95-100	30-40	5-15
8B, 8C-----------	0-32	Silty clay loam	CL, ML	A-6, A-7	0	100	100	100	95-100	35-50	10-25
Judson	32-38	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
	38-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
9B---------------	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	10-38	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	38-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
9B2--------------	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	6-10	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	10-48	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	48-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
9C---------------	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	10-38	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	38-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
9C2--------------	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	6-10	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	10-48	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	48-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
9D---------------	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	8-38	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	38-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
9D2--------------	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
Marshall	6-10	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	10-48	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	48-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
11B:											
Colo------------	0-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	36-52	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	52-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Judson----------	0-32	Silty clay loam	CL, ML	A-6, A-7	0	100	100	100	95-100	35-50	10-25
	32-38	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	30-50	15-25
	38-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
22D3------------- Dow	0-5	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	5-60	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
26, 26B---------- Kennebec	0-36	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-20
	36-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
27B, 27C--------- Terril	0-30	Loam-------------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
	30-42	Loam, clay loam	CL, CL-ML	A-6, A-7	0-5	95-100	90-100	70-90	60-80	30-45	10-25
	42-60	Clay loam, loam, sandy loam.	CL, SC, SC-SM, CL-ML	A-6, A-4	0-5	95-100	90-100	65-95	35-85	20-40	5-20
28C2, 28D2------- Dickman	0-7	Sandy loam-------	SM, SC-SM, SC	A-2, A-4	0	95-100	95-100	55-95	25-40	20-30	2-8
	7-37	Sandy loam, loamy fine sand.	SM, SC-SM, SC	A-2, A 4	0	95-100	85-100	55-95	25-45	15-25	2-8
	37-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	95-100	75-100	50-80	5-10	0-14	NP
31--------------- Afton	0-27	Silty clay loam	MH, CH	A-7	0	100	100	100	95-100	50-65	20-35
	27-42	Silty clay loam, silt loam.	CL, CH	A-7	0	100	100	100	95-100	40-60	20-35
	42-60	Clay loam, silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	80-100	60-90	35-50	20-30
35E2:											
Steinauer--------	0-5	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	85-100	55-90	30-50	15-25
	5-40	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	12-30
	40-60	Loam, clay loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	60-75	25-55	10-30
Burchard---------	0-7	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	14-24
	7-24	Clay loam--------	CL	A-6, A-7	0-5	95-100	85-100	75-95	65-80	35-50	20-30
	24-60	Clay loam--------	CL	A-6, A-7	0-5	95-100	85-100	75-95	60-80	35-50	15-30
35G:											
Steinauer--------	0-5	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	85-100	55-90	30-50	15-25
	5-40	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	12-30
	40-60	Loam, clay loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	60-75	25-55	10-30
Burchard---------	0-11	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	14-24
	11-24	Clay loam--------	CL	A-6, A-7	0-5	95-100	85-100	75-95	65-80	35-50	20-30
	24-60	Clay loam--------	CL	A-6, A-7	0-5	95-100	85-100	75-95	60-80	35-50	15-30
54--------------- Zook	0-20	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	20-40	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	40-60	Silty clay loam, silty clay, silt loam.	CH, CL, ML, MH	A-7, A-6	0	100	100	95-100	95-100	35-80	10-50
59D2------------- Burchard	0-5	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	14-24
	5-24	Clay loam--------	CL	A-6, A-7	0-5	95-100	85-100	75-95	65-80	35-50	20-30
	24-60	Clay loam--------	CL	A-6, A-7	0-5	95-100	85-100	75-95	60-80	35-50	15-30

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
78B-------------- Sac	0-12	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	12-31	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	31-60	Loam-------------	CL, CL-ML	A-6, A-4	2-5	95-100	90-100	75-90	65-80	25-40	5-20
78B2------------- Sac	0-7	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	7-30	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	30-60	Loam-------------	CL, CL-ML	A-6, A-4	2-5	95-100	90-100	75-90	65-80	25-40	5-20
78C-------------- Sac	0-12	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	12-31	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	31-60	Loam-------------	CL, CL-ML	A-6, A-4	2-5	95-100	90-100	75-90	65-80	25-40	5-20
78C2, 78D2------- Sac	0-7	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	7-30	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	30-60	Loam-------------	CL, CL-ML	A-6, A-4	2-5	95-100	90-100	75-90	65-80	25-40	5-20
91B-------------- Primghar	0-18	Silty clay loam	MH, CH	A-7	0	100	100	95-100	90-100	50-60	20-30
	18-45	Silty clay loam	CL, CH	A-7	0	100	100	95-100	90-100	40-55	20-30
	45-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	90-100	30-40	11-20
92--------------- Marcus	0-20	Silty clay loam	MH, CH	A-7	0	100	100	95-100	90-100	50-65	20-35
	20-35	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	20-35
	35-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	85-95	30-40	15-25
99C2, 99D2------- Exira	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	7-21	Silty clay loam, silt loam.	CL, ML	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	21-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
99D3------------- Exira	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	7-21	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	21-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
99E2------------- Exira	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	7-21	Silty clay loam, silt loam.	CL, ML	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	21-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
100C------------- Monona	0-10	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	10-22	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	22-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
100C2, 100C3----- Monona	0-7	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	7-20	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	20-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
100D-------------	0-10	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	10-22	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	22-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
100D2, 100D3-----	0-7	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	7-20	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	20-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
100E-------------	0-10	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	10-22	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	22-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
100E2, 100E3-----	0-7	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	7-20	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	20-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
100F-------------	0-10	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	10-22	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	22-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
100F2, 100F3-----	0-7	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	7-20	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	20-60	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
133--------------	0-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
Colo	36-52	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	52-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
133+-------------	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Colo	12-47	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	47-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
220--------------	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
Nodaway	10-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
309--------------	0-14	Silty clay loam	CL	A-6	0	95-100	95-100	95-100	85-95	30-40	10-20
Allendorf	14-34	Silty clay loam, silt loam, loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	80-95	25-40	5-20
	34-39	Very gravelly sandy loam.	ML, SM	A-4	0-5	85-100	85-100	65-90	40-60	25-35	3-10
	39-60	Very gravelly loamy sand, gravelly sand, sand.	SW, SM, SP-SM, SP	A-1	2-50	60-95	40-95	20-40	3-25	---	NP
310, 310B--------	0-12	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
Galva	12-46	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	46-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
310B2------------ Galva	0-7	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	7-40	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	40-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
310C------------- Galva	0-12	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	12-46	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	46-54	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	54-60	Clay loam, loam	CL	A-6	2-5	95-100	90-100	75-90	65-80	30-40	10-20
310C2------------ Galva	0-7	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	7-40	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	40-54	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	54-60	Clay loam, loam	CL	A-6	2-5	95-100	90-100	75-90	65-80	30-40	10-20
310D------------- Galva	0-12	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	12-46	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	46-54	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	54-60	Clay loam, loam	CL	A-6	2-5	95-100	90-100	75-90	65-80	30-40	10-20
310D2------------ Galva	0-7	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	7-40	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	40-54	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	54-60	Clay loam, loam	CL	A-6	2-5	95-100	90-100	75-90	65-80	30-40	10-20
428B------------- 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
	30-46	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	46-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
430, 430B-------- Ackmore	0-8	Silt loam--------	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	8-30	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	8-20
	30-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	95-100	85-100	35-60	15-30
474C------------- Bolan	0-11	Loam-------------	CL, ML	A-4, A-6	0	100	100	85-95	50-70	30-40	5-15
	11-32	Loam, fine sandy loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	100	80-90	40-55	25-35	5-15
	32-40	Fine sandy loam, sandy loam.	SM, SC-SM, SC	A-4	0	100	100	80-90	35-50	15-25	2-8
	40-60	Loamy fine sand, fine sand, loamy sand.	SM, SP-SM	A-2	0	100	100	70-85	10-30	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
474D2------------ Bolan	0-8	Loam-------------	CL, ML	A-4, A-6	0	100	100	85-95	50-70	30-40	5-15
	8-32	Loam, fine sandy loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	100	80-90	40-55	25-35	5-15
	32-40	Fine sandy loam	SM, SC-SM, SC	A-4	0	100	100	80-90	35-50	15-25	2-8
	40-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2	0	100	100	70-85	10-30	---	NP
475B------------- Arthur	0-11	Silty clay loam	CL, ML	A-6, A-7-6	0	100	100	85-100	85-95	35-50	10-25
	11-32	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	100	85-100	80-100	35-50	10-25
	32-40	Loamy sand, sand, sandy loam.	SC-SM, SM, SP-SM, SC	A-2, A-1	0	100	100	30-70	10-25	<20	NP-10
	40-60	Sand, loamy sand	SC-SM, SM, SP-SM	A-2, A-1, A-3	0	100	100	25-70	5-25	<20	NP-5
475C2, 475D2----- Arthur	0-7	Silty clay loam	CL, ML	A-6, A-7-6	0	100	100	85-100	85-95	35-50	10-25
	7-26	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	100	85-100	80-100	35-50	10-25
	26-30	Loamy sand, sand, sandy loam.	SC-SM, SM, SP-SM, SC	A-2, A-1	0	100	100	30-70	10-25	<20	NP-10
	30-60	Sand, loamy sand	SC-SM, SM, SP-SM	A-2, A-1, A-3	0	100	100	25-70	5-25	<20	NP-5
509, 509B, 509C-- Marshall	0-18	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	18-48	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	48-60	Silt loam, silty clay loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
509C2------------ Marshall	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	8-48	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	48-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
740C, 740E, 740G- Hawick	0-13	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	13-20	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-5	75-95	60-95	35-70	5-25	0-14	NP
	20-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
810, 810B-------- Galva	0-14	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	14-50	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	50-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
810C2------------ Galva	0-7	Silty clay loam	ML, CL, MH, CH	A-7	0	100	100	95-100	90-100	40-55	15-25
	7-30	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	30-50	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	15-25
	50-60	Clay loam, loam	CL	A-6	2-5	95-100	90-100	75-90	65-80	30-40	10-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1220-------------- Nodaway	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	10-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
5010. Pits											
5040. Orthents											

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodi-bility group
								K	T	
	In	Pct	g/cc	In/hr	In/in	pH				
1B, 1C-----------	0-6	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.32	5	4L
Ida	6-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
1C3--------------	0-6	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.43	4	4L
Ida	6-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
1D---------------	0-6	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.32	5	4L
Ida	6-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
1D3--------------	0-6	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.43	4	4L
Ida	6-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
1E---------------	0-6	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.32	5	4L
Ida	6-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
1E3, 1F3---------	0-6	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.43	4	4L
Ida	6-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43		
8B, 8C-----------	0-32	27-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
Judson	32-38	30-35	1.35-1.45	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.43		
	38-60	25-32	1.35-1.45	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.43		
9B---------------	0-10	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
Marshall	10-38	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	38-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
9B2--------------	0-6	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Marshall	6-10	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32		
	10-48	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	48-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
9C---------------	0-10	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
Marshall	10-38	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	38-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
9C2--------------	0-6	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Marshall	6-10	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32		
	10-48	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	48-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
9D---------------	0-8	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
Marshall	8-38	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	38-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
9D2--------------	0-6	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
Marshall	6-10	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32		
	10-48	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	48-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
11B:										
Colo-------------	0-36	27-36	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	36-52	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	52-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.32		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
11B:										
Judson----------	0-32	27-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	32-38	30-35	1.35-1.45	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.43		
	38-60	25-32	1.35-1.45	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.43		
22D3------------- Dow	0-5	18-25	1.20-1.45	0.6-2.0	0.22-0.24	6.6-8.4	Low----------	0.43	4	4L
	5-60	18-25	1.30-1.45	0.6-2.0	0.20-0.22	7.9-8.4	Low----------	0.43		
26, 26B---------- Kennebec	0-36	27-30	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	7
	36-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
27B, 27C--------- Terril	0-30	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6
	30-42	24-30	1.40-1.45	0.6-2.0	0.17-0.19	6.1-7.3	Low----------	0.28		
	42-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32		
28C2, 28D2------- Dickman	0-7	6-18	1.30-1.40	2.0-6.0	0.13-0.15	5.6-6.5	Low----------	0.20	3	3
	7-37	6-18	1.35-1.50	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.20		
	37-60	1-10	1.50-1.60	6.0-20	0.02-0.07	5.6-7.8	Low----------	0.15		
31--------------- Afton	0-27	33-38	1.25-1.30	0.2-0.6	0.21-0.23	6.1-7.8	High---------	0.32	5	4
	27-42	25-35	1.25-1.30	0.2-0.6	0.18-0.20	7.4-8.4	High---------	0.43		
	42-60	25-30	1.30-1.45	0.2-2.0	0.14-0.16	7.4-8.4	Moderate-----	0.43		
35E2:										
Steinauer-------	0-5	27-32	1.20-1.35	0.2-0.6	0.19-0.22	7.4-8.4	Moderate-----	0.32	5	4L
	5-40	27-32	1.30-1.50	0.2-0.6	0.17-0.19	7.9-8.4	Moderate-----	0.37		
	40-60	24-35	1.30-1.65	0.2-0.6	0.16-0.19	7.9-8.4	Moderate-----	0.37		
Burchard--------	0-7	27-30	1.40-1.60	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.28	5	6
	7-24	27-35	1.40-1.60	0.2-0.6	0.15-0.17	6.1-8.4	Moderate-----	0.37		
	24-60	18-35	1.40-1.60	0.2-0.6	0.14-0.16	7.4-8.4	Moderate-----	0.37		
35G:										
Steinauer-------	0-5	27-32	1.20-1.35	0.2-0.6	0.19-0.22	7.4-8.4	Moderate-----	0.32	5	4L
	5-40	27-32	1.30-1.50	0.2-0.6	0.17-0.19	7.9-8.4	Moderate-----	0.37		
	40-60	24-35	1.30-1.65	0.2-0.6	0.16-0.19	7.9-8.4	Moderate-----	0.37		
Burchard--------	0-11	27-30	1.40-1.60	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.28	5	6
	11-24	27-35	1.40-1.60	0.2-0.6	0.15-0.17	6.1-8.4	Moderate-----	0.37		
	24-60	18-35	1.40-1.60	0.2-0.6	0.14-0.16	7.4-8.4	Moderate-----	0.37		
54--------------- Zook	0-20	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.37	5	7
	20-40	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28		
	40-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28		
59D2------------- Burchard	0-5	27-30	1.40-1.60	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.28	5	6
	5-24	27-35	1.40-1.60	0.2-0.6	0.15-0.17	6.1-8.4	Moderate-----	0.37		
	24-60	18-35	1.40-1.60	0.2-0.6	0.14-0.16	7.4-8.4	Moderate-----	0.37		
78B-------------- Sac	0-12	32-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	12-31	30-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	31-60	27-35	1.65-1.80	0.2-0.6	0.14-0.16	6.6-8.4	Moderate-----	0.37		
78B2------------- Sac	0-7	32-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	7-30	30-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	30-60	27-35	1.65-1.80	0.2-0.6	0.14-0.16	6.6-8.4	Moderate-----	0.37		
78C-------------- Sac	0-12	32-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	12-31	30-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	31-60	27-35	1.65-1.80	0.2-0.6	0.14-0.16	6.6-8.4	Moderate-----	0.37		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	g/cc	In/hr	In/in	pH				
78C2, 78D2-------- Sac	0-7	32-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	7-30	30-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	30-60	27-35	1.65-1.80	0.2-0.6	0.14-0.16	6.6-8.4	Moderate-----	0.37		
91B-------------- Primghar	0-18	35-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	4
	18-45	30-35	1.30-1.35	0.6-2.0	0.18-0.20	6.1-8.4	High---------	0.43		
	45-60	25-30	1.35-1.40	0.6-2.0	0.20-0.22	7.9-8.4	Moderate-----	0.43		
92--------------- Marcus	0-20	35-40	1.30-1.35	0.2-0.6	0.21-0.23	6.1-7.8	High---------	0.28	5	4
	20-35	30-35	1.35-1.40	0.2-0.6	0.18-0.20	6.1-8.4	High---------	0.43		
	35-60	22-30	1.35-1.45	0.6-2.0	0.20-0.22	7.9-8.4	Moderate-----	0.43		
99C2, 99D2------- Exira	0-7	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.6-6.5	Moderate-----	0.32	5	7
	7-21	25-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
	21-60	20-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
99D3------------- Exira	0-7	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.6-6.5	Moderate-----	0.43	4	7
	7-21	25-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
	21-60	20-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
99E2------------- Exira	0-7	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.6-6.5	Moderate-----	0.32	5	7
	7-21	25-35	1.30-1.35	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43		
	21-60	20-30	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43		
100C------------- Monona	0-10	27-35	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	7
	10-22	24-28	1.25-1.30	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	22-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100C2------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100C3------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.43	4	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100D------------- Monona	0-10	27-35	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	7
	10-22	24-28	1.25-1.30	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	22-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100D2------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100D3------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.43	4	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100E------------- Monona	0-10	27-35	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	7
	10-22	24-28	1.25-1.30	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	22-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100E2------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100E3------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.43	4	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
100F------------- Monona	0-10	27-35	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	7
	10-22	24-28	1.25-1.30	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	22-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100F2------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
100F3------------ Monona	0-7	27-35	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.43	4	7
	7-20	24-28	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	20-60	18-24	1.35-1.40	0.6-2.0	0.18-0.20	6.6-8.4	Low----------	0.43		
133-------------- Colo	0-36	27-36	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	36-52	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	52-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.32		
133+------------- Colo	0-12	20-26	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6
	12-47	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28		
	47-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.32		
220-------------- Nodaway	0-10	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.32	5	6
	10-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.43		
309-------------- Allendorf	0-14	27-32	1.25-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	4	7
	14-34	24-32	1.25-1.40	0.6-2.0	0.20-0.22	6.1-7.8	Moderate-----	0.43		
	34-39	18-24	1.40-1.50	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.24		
	39-60	2-8	1.50-1.70	>20	0.02-0.06	7.4-8.4	Low----------	0.10		
310, 310B-------- Galva	0-12	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5-4	4
	12-46	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	46-60	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
310B2------------ Galva	0-7	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	4
	7-40	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	40-60	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
310C------------- Galva	0-12	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5-4	4
	12-46	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	46-54	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
	54-60	22-30	1.60-1.80	0.6-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.43		
310C2------------ Galva	0-7	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	4
	7-40	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	40-54	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
	54-60	22-30	1.60-1.80	0.6-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.43		
310D------------- Galva	0-12	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5-4	4
	12-46	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	46-54	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
	54-60	22-30	1.60-1.80	0.6-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.43		
310D2------------ Galva	0-7	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	4
	7-40	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	40-54	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
	54-60	22-30	1.60-1.80	0.6-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.43		
428B------------- Ely	0-30	27-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	30-46	28-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	46-60	20-30	1.40-1.45	0.6-2.0	0.18-0.20	6.6-8.4	Moderate-----	0.43		

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group
	In	Pct	g/cc	In/hr	In/in	pH				
430, 430B-------- Ackmore	0-8	18-27	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6
	8-30	18-30	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32		
	30-60	26-38	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.8	High---------	0.32		
474C------------- Bolan	0-11	20-26	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	4	6
	11-32	12-20	1.45-1.50	0.6-2.0	0.17-0.19	5.6-6.5	Low----------	0.24		
	32-40	10-16	1.50-1.60	2.0-6.0	0.11-0.13	5.6-7.3	Low----------	0.24		
	40-60	2-8	1.60-1.70	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17		
474D2------------ Bolan	0-8	20-26	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	4	6
	8-32	12-20	1.45-1.50	0.6-2.0	0.17-0.19	5.6-6.5	Low----------	0.24		
	32-40	10-16	1.50-1.60	2.0-6.0	0.11-0.13	5.6-7.3	Low----------	0.24		
	40-60	2-8	1.60-1.70	6.0-20	0.08-0.10	5.6-7.3	Low----------	0.17		
475B------------- Arthur	0-11	27-34	1.25-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	7
	11-32	24-32	1.25-1.40	0.6-2.0	0.22-0.24	6.1-7.3	Moderate-----	0.43		
	32-40	5-15	1.40-1.50	2.0-20.0	0.05-0.15	6.6-7.8	Low----------	0.17		
	40-60	2-10	1.50-1.70	2.0-20.0	0.05-0.13	6.6-7.8	Low----------	0.17		
475C2, 475D2----- Arthur	0-7	27-34	1.25-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	7
	7-26	24-32	1.25-1.40	0.6-2.0	0.22-0.24	6.1-7.3	Moderate-----	0.43		
	26-30	5-15	1.40-1.50	2.0-20.0	0.05-0.15	6.6-7.8	Low----------	0.17		
	30-60	2-10	1.50-1.70	2.0-20.0	0.05-0.13	6.6-7.8	Low----------	0.17		
509, 509B, 509C-- Marshall	0-18	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7
	18-48	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
	48-60	22-30	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43		
509C2------------ Marshall	0-8	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7
	8-48	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32		
	48-60	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43		
740C, 740E, 740G- Hawick	0-13	2-10	1.50-1.65	2.0-20	0.03-0.13	6.1-7.8	Low----------	0.10	5	8
	13-20	1-10	1.50-1.65	6.0-20	0.03-0.10	6.1-7.8	Low----------	0.10		
	20-60	1-5	1.55-1.65	20-40	0.02-0.06	7.4-8.4	Low----------	0.10		
810, 810B-------- Galva	0-14	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5-4	4
	14-50	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	50-60	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
810C2------------ Galva	0-7	34-39	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	4
	7-30	30-39	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43		
	30-50	25-30	1.35-1.45	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43		
	50-60	22-30	1.60-1.80	0.6-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.43		
1220------------- Nodaway	0-10	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.32	5	6
	10-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.43		
5010. Pits										
5040. Orthents										

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "occasional," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1B, 1C, 1C3, 1D, 1D3, 1E, 1E3, 1F3: Ida	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
8B, 8C: Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
9B, 9B2, 9C, 9C2, 9D, 9D2: Marshall	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
11B:												
Colo	B/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
22D3: Dow	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
26, 26B: Kennebec	B	Occasional	Brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	High	Moderate	Low.
27B, 27C: Terril	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
28C2, 28D2: Dickman	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
31: Afton	C/D	Occasional	Very brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
35E2, 35G:												
Steinauer	B	None	---	---	>6.0	---	---	>80	---	Moderate	High	Low.
Burchard	B	None	---	---	>6.0	---	---	>80	---	Moderate	Moderate	Low.
54: Zook	C/D	Occasional	Brief or long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
59D2: Burchard	B	None	---	---	>6.0	---	---	>80	---	Moderate	Moderate	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
78B, 78B2, 78C, 78C2, 78D2 Sac	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
91B Primghar	B	None	---	---	3.0-5.0	Apparent	Nov-Jul	>60	---	High	Moderate	Moderate.
92 Marcus	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
99C2, 99D2, 99D3, 99E2 Exira	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
100C, 100C2, 100C3, 100D, 100D2, 100D3, 100E, 100E2, 100E3, 100F, 100F2, 100F3 Monona	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
133, 133+ Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
220 Nodaway	B	Occasional	Very brief or brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>80	---	High	Moderate	Low.
309 Allendorf	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
310, 310B, 310B2, 310C, 310C2, 310D, 310D2 Galva	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
428B Ely	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
430, 430B Ackmore	B	Occasional	Very brief or brief.	Sep-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
474C, 474D2 Bolan	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
475B, 475C2, 475D2 Arthur	B	None	---	---	>6.0	---	---	>60	---	High	Low	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
509, 509B, 509C, 509C2------------ Marshall	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
740C, 740E, 740G-- Hawick	A	None---------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
810, 810B, 810C2-- Galva	B	None---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
1220-------------- Nodaway	B	Frequent----	Very brief or brief.	Feb-Nov	3.0-5.0	Apparent	Apr-Jul	>80	---	High-----	Moderate	Low.
5010. Pits												
5040. Orthents												

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
Ackmore	Fine-silty, mixed, nonacid, mesic Aeric Fluvaquents
Afton	Fine-silty, mixed, mesic Cumulic Haplaquolls
*Allendorf	Fine-silty over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Arthur	Fine-silty over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Bolan	Coarse-loamy, mixed, mesic Typic Hapludolls
Burchard	Fine-loamy, mixed, mesic Typic Argiudolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
*Dickman	Sandy, mixed, mesic Typic Hapludolls
Dow	Fine-silty, mixed (calcareous), mesic Typic Udorthents
Ely	Fine-silty, mixed, mesic Cumulic Hapludolls
*Exira	Fine-silty, mixed, mesic Typic Hapludolls
Galva	Fine-silty, mixed, mesic Typic Hapludolls
Hawick	Sandy, mixed, mesic Entic Hapludolls
Ida	Fine-silty, mixed (calcareous), mesic Typic Udorthents
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Marcus	Fine, montmorillonitic, mesic Typic Haplaquolls
Marshall	Fine-silty, mixed, mesic Typic Hapludolls
Monona	Fine-silty, mixed, mesic Typic Hapludolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Orthents	Orthents, loamy
Primghar	Fine-silty, mixed, mesic Aquic Hapludolls
Sac	Fine-silty, mixed, mesic Typic Hapludolls
Steinauer	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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