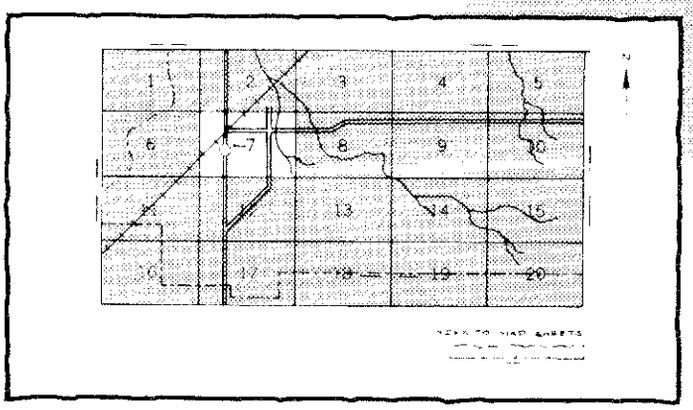
SOIL SURVEY OF

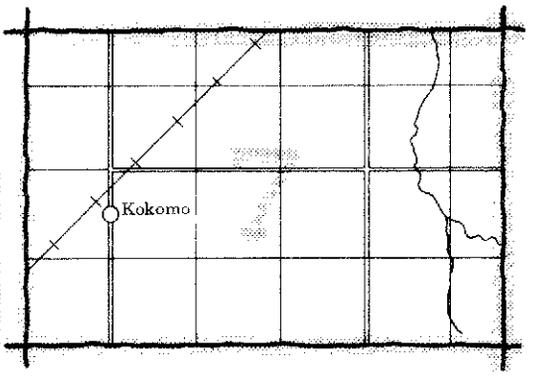
DODGE COUNTY, NEBRASKA

U. S. Department of Agriculture
Soil Conservation Service
in cooperation with
Conservation and Survey Division,
University of Nebraska

HOW TO USE

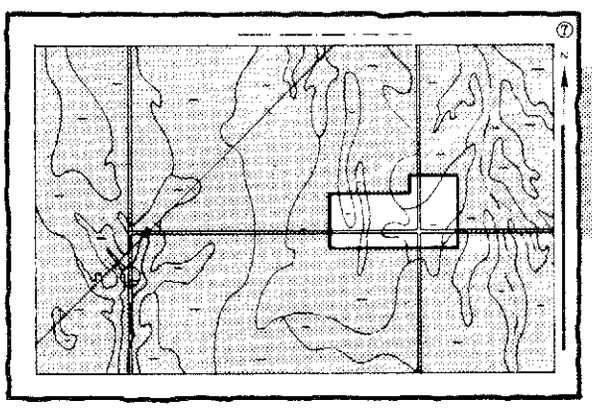
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

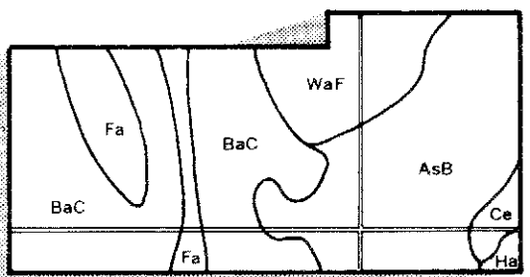




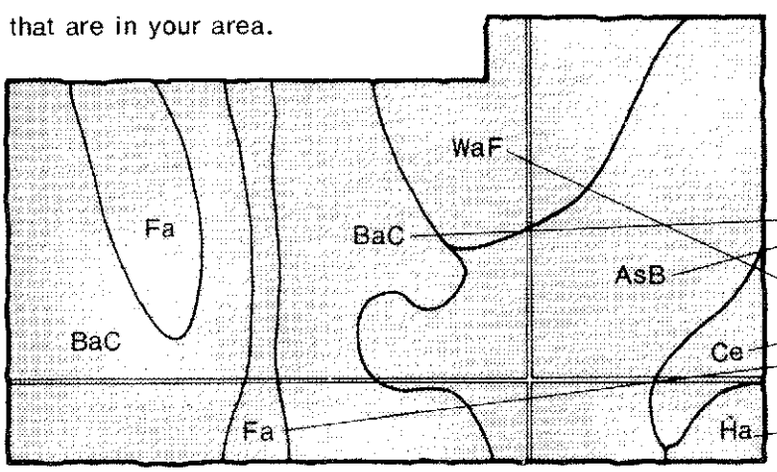
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.



Symbols

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BaC
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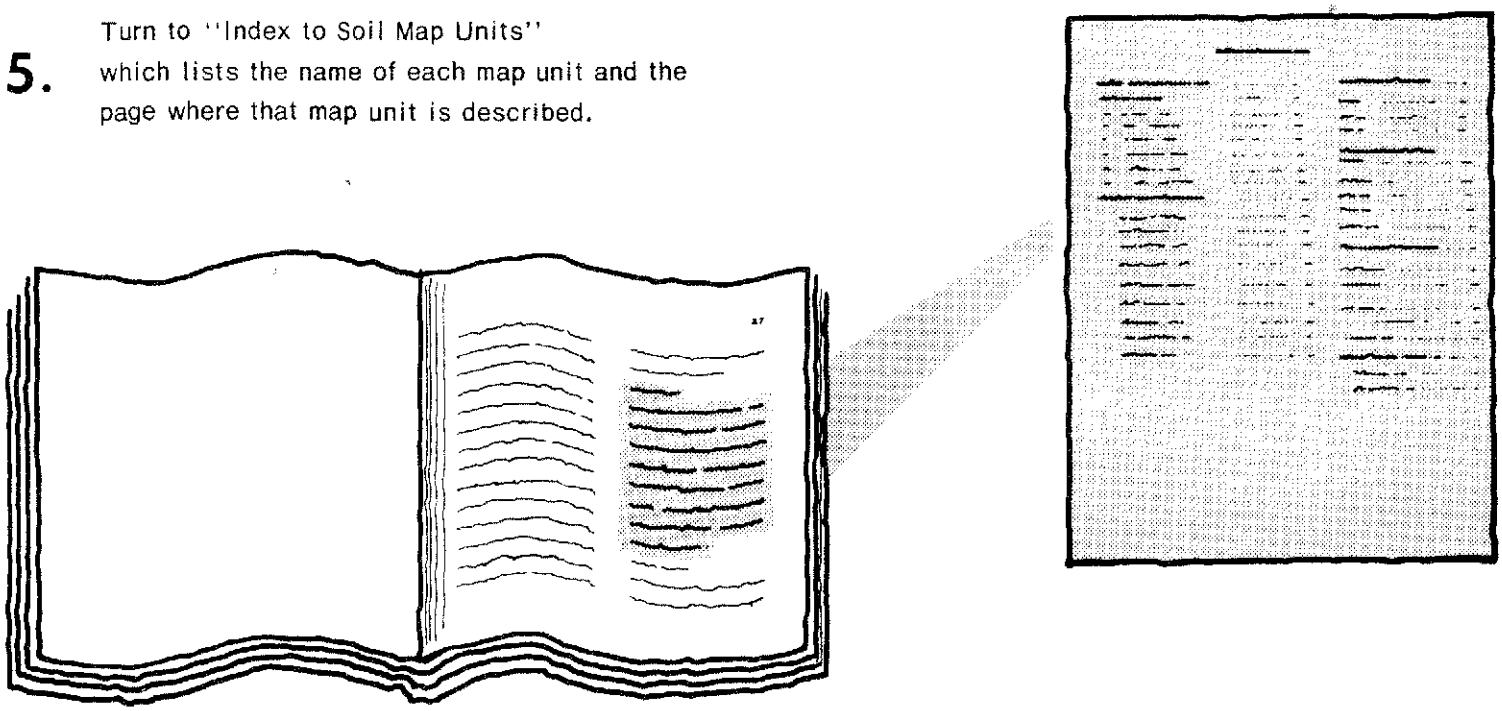
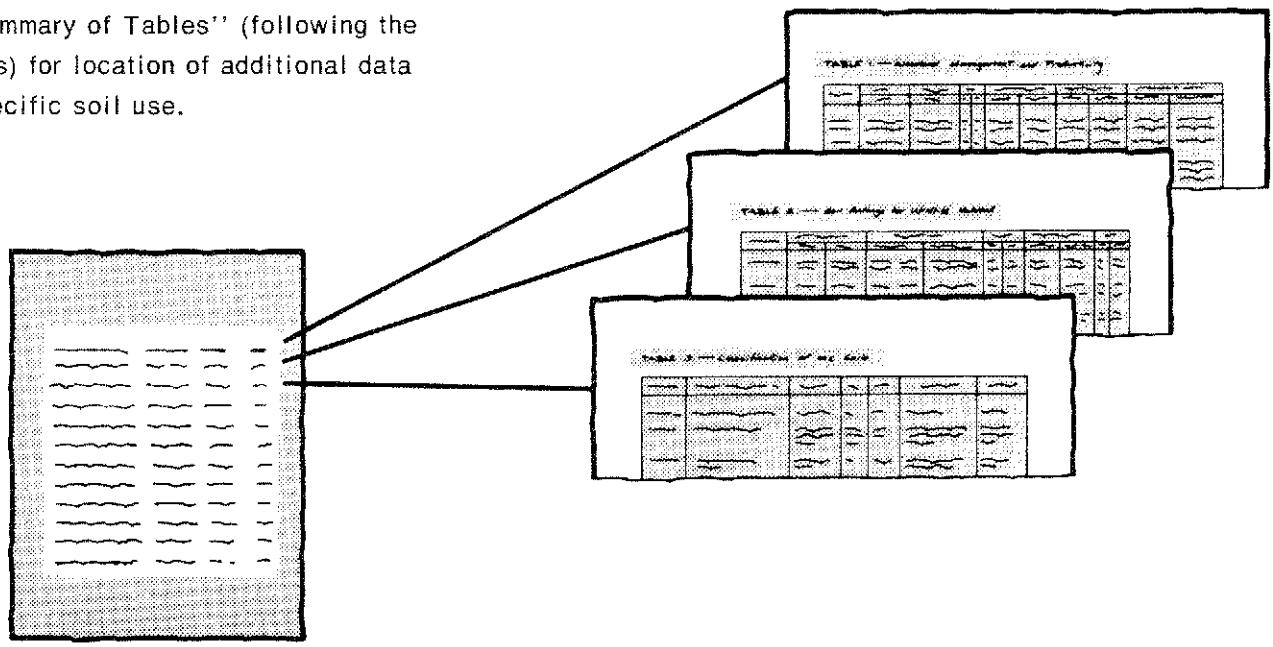
THIS SOIL SURVEY

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



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



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

This is a publication of the National Cooperative Soil Survey, a Joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In this survey, the Dodge County Board of Supervisors and the Lower Elkhorn and Lower Platte North Natural Resources Districts also contributed. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, marital status, or age.

Major fieldwork for this soil survey was done in the period 1961-1975. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Lower Elkhorn and Lower Platte North Natural Resources Districts.

Cover: The Nora-Judson-Moody association is used mostly for cultivated crops; some is in tame pasture.

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Issued February 1979

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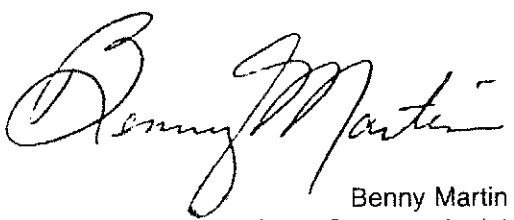
Foreword

This soil survey contains much information useful in land-planning programs in Dodge County, Nebraska. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

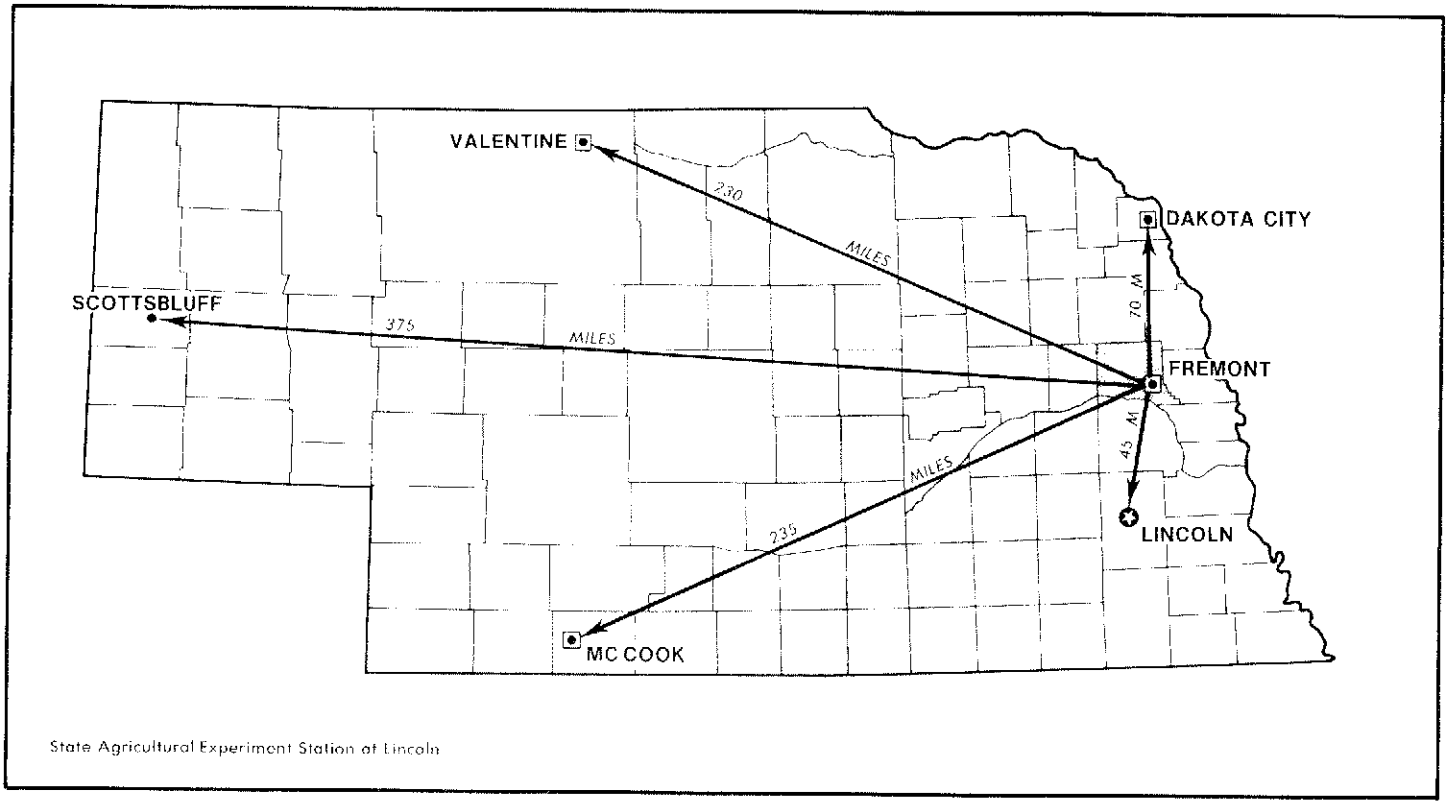
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be too unstable to be used as a foundation for buildings or roads. Very 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.



Benny Martin
State Conservationist
Soil Conservation Service



Location of Dodge County in Nebraska.

SOIL SURVEY OF DODGE COUNTY, NEBRASKA

By Paul A. Bartlett, Soil Conservation Service, and Byron E. Koepke, University of Nebraska

U. S. Department of Agriculture, Soil Conservation Service,
in cooperation with Conservation and Survey Division, University of Nebraska

DODGE COUNTY is in the east-central part of Nebraska. It is bordered on the south by Saunders and Douglas Counties, on the west by Colfax County, on the north by Cuming and Burt Counties, and on the east by Burt and Washington Counties. Dodge County takes in an area of 531 square miles, or 337,984 acres. Fremont is the largest town and the county seat.

Commerce and industry are important in the county, particularly in Fremont. Agriculture is the main industry in Dodge County. Corn, soybeans, alfalfa, small grains, and grain sorghum are grown extensively. These crops are used as feed for cattle, hogs, and sheep and for cash income.

The major soils on the uplands are silty; they formed in loess. The minor soils formed in glacial till and eolian sands. Erosion by water is the main hazard on upland soils. Conserving water by controlling runoff and maintaining soil fertility are the major concerns of management.

Soils in the valleys formed in alluvium or a mixture of alluvium and colluvium. Wetness from the seasonal high water table and occasional flooding are the main hazards on soils on bottom lands. Maintaining fertility and managing water for irrigation are concerns of management on these soils.

Most soils in Dodge County are silty, loamy, or clayey. In a few areas in the north-central part and on bottom lands the soils are sandy. The soils are deep over loess, sand, or alluvium to shallow over mixed sand and gravel. They are somewhat excessively drained to very poorly drained and nearly level to very steep.

The first soil survey of Dodge County was published in 1918 (*3*). This survey updates the first survey and gives additional information and has maps that show the soils in greater detail.

General nature of the county

This section provides general information about Dodge County. It discusses history and population, climate, geology, ground water supply, physiography, relief, and drainage, manufacturing and agricultural business, transportation, school facilities, and trends in farming and soil use.

History and population

The first permanent settlement in what is now Dodge County dates back to 1854. It was near the mouth of Maple Creek. The county was organized in 1854, and Fontanelle was the county seat. Fremont became the county seat in 1860.

The early settlers came mostly from Iowa, Illinois, Missouri, Indiana, and eastern states. In 1870, a large number of Swedish and Danish immigrants settled mostly in the central part of the county. German families also arrived at about this time. A Bohemian colony was established in the northwestern part of the county, and the Scotch and Irish settled around North Bend.

In 1970, Dodge County had a population of 34,782. Fremont, the largest town, had a population of 22,962. Most residents earn their living by farming or in related industries.

Climate

Prepared by Climatology Office, Conservation and Survey Division, University of Nebraska.

Dodge County has a continental climate, that is, warm summers, cold winters, and moderate rainfall. The county lies between two distinctive climatic zones--the humid east and the dry west. Consequently, the climate fluctuates between these two zones, at times is similar to that of either zone or is a combination of both.

The Rocky Mountains in the distant west form the only climatic barrier. The county is fully exposed in other directions. Most of the precipitation originates in the Gulf of Mexico and the Caribbean Sea. Recorded data at Fremont in a 94-year period indicate that in the driest year (1936) precipitation was 16.53 inches and in the wettest year (1915) it was 45.15 inches. About 75 percent of the annual precipitation falls in April through September (table 1).

In the winter, snow is the main form of precipitation. It is frequently accompanied by strong northerly winds and falling temperatures. Before the winds diminish, the snow is piled into drifts. The temperature always falls below zero sometime in winter.

Early in spring, snow is the main form of precipitation, but gradually the snow is replaced by slow, steady rains. Showers and thunderstorms become more frequent, and by May they are the main form of precipitation. Temperature changes are frequent and extreme.

More than 40 percent of the annual precipitation usually falls in summer. In about 25 percent of the years, the temperature fails to reach 100 degrees, but it does reach the mid to high 90s.

In the latter part of August cool air occasionally moves from the north into the area. In autumn the cool periods are more frequent and longer. Precipitation decreases rapidly in October and November. In autumn there are many sunny, pleasant days and clear, cool nights.

Temperature records, begun at Fremont in 1885, show the highest recorded temperature as 116 degrees on July 25, 1936, and the lowest recorded temperature as 31 degrees below zero on January 19, 1892, February 13, 1905, and January 12, 1912.

The average date of the last 32-degree temperature in spring is April 30. The average date of the first 32-degree temperature in fall is October 10 (table 2).

Local topography has little effect on average temperatures over a long period of time. For example, long-term average temperatures recorded on flatland do not differ greatly from those recorded on rolling hills or in valleys in the immediate area. Record temperatures may, however, differ markedly over short distances.

When freeze data are used, dates should be adjusted to fit the exposure. In less exposed areas, the last freeze in spring occurs at an earlier date and the first freeze in fall at a later date.

Annual evaporation from small lakes and farm ponds averages 42 inches. About 77 percent of that amount occurs in May through October.

Geology

In Dodge County, loess, till, and alluvium are at the surface or near the surface. The bedrock throughout the county is of Cretaceous age and is at a depth of 30 to 275 feet. There are no known areas where the bedrock crops out in Dodge County.

Throughout the county, deposits of sand and gravel or of till overlie the bedrock. The sand and gravel deposits are excellent sources of ground water, but the till generally yields only small amounts of water to wells. Till consists mostly of clay, though it has scattered lenses of sand and pockets of gravelly sand. It is the underlying material in all the uplands. It is thin or not present in the valleys of the Elkhorn and Platte Rivers and in the lower valleys of the main tributaries of the Elkhorn River. On the soil maps, outcrops of till are indicated, mainly in areas of Steinauer soils, by the symbol for till outcrop.

Overlying the till are silt, sand, and clay capped by brown loess. The brown loess crops out on upland slopes in many places, but the outcrop seldom is more than a narrow band on a smooth slope or a small area on a convex slope. On the soil maps, outcrops of brown loess are indicated by a symbol for 'Loveland outcrop."

A thick layer of buff-colored loess mantles the brown loess and is the geologic material at the surface on nearly all of the uplands and on the stream terraces. It is a slightly clayey calcareous silt that is moderately permeable to air and water. The soils in the areas of buff-colored loess are Belfore and Fillmore soils on flats and Moody, Nora, Monona, and Crofton soils on slopes. North of the town of Scribner there is an area of eolian sand, and locally on the edges of stream terraces there are small areas of eolian sand and outcrops of fluvial sand. Thurman and Leisy soils are in these areas.

Alluvium in the valleys consists mostly of clayey silt washed from adjacent uplands. There are areas of silty clay alluvium in some of the larger valleys. Close to the rivers the alluvium is sandy loam, sand, or gravelly sand that derived mostly from upgradient areas outside the county. Soils in areas that are dominantly silty are Calco, Kennebec, Gibbon, and Colo soils. Luton and Zook soils are in areas of clayey material; Janude, Wann, Alda, Boel, and Cass soils in areas of loamy material; and Platte and Inavale soils and Riverwash in areas of sandy material.

The land surface was stable before agricultural disturbance. There was slight movement of surface materials by water and minimal movement or shifting by the winds. Row crops have replaced the native tall grass prairie vegetation, and the surface material is no longer well protected from erosion. The nearly level and gently sloping silty areas, however, remain stable with only slight movement of the surface material by wind or water. In areas of rolling and steep soils, there is much movement of surface material by water; these are high-sediment producing areas. Sandy areas are subject to considerable shifting of the surface material by wind and some movement by water, but very little material is moved out of the areas.

The small valleys in the uplands have always been overflowed by runoff from adjacent slopes, and some of the surface material that washed from the slopes is added to the valley alluvium. Under native prairie vegeta-

tion, dark-colored alluvium was laid down in thin increments with minimal stratification, because of the slight movement of surface material. As row crops replaced the native vegetation, the alluvium added by each overflow became lighter in color and thicker, and the stratification became more evident. In most small valleys, 2 to 5 feet of alluvium overlies the dark-colored preagriculture land surface.

The broad valleys of the rivers receive slight additions of material when they are infrequently overflowed by runoff from adjacent uplands. They are not subject to overflow from the rivers because they are above the level of the present high water flows. The areas adjacent to the river channels are frequently or occasionally overflowed. Scour and deposition occur during overflow, but the streams carry so much sediment at flood stage that most of the scoured material is shifted rather than removed. Fine and coarse material is added to the areas overflowed.

Ground water supply

Wells throughout Dodge County provide water for domestic and livestock use, for industrial use, and for irrigating crops.

On the uplands, water suitable for domestic and livestock use comes from deposits of sand and gravel in the glacial till, from beneath the till, or from the sandstone of the Dakota Formation. Deposits of sand and gravel lie beneath the valleys of the Platte and Elkhorn Rivers, Pebble Creek, Logan Creek, and Cuming Creek. These deposits yield water of good quality and in sufficient quantity for industrial and domestic needs. In most of these valley areas, irrigation wells can be developed. There were 775 registered irrigation wells in Dodge County as of December 31, 1975.

The water from the sand and gravel beneath the valleys is rated "hard" or "very hard." Water from sand or gravel lenses in till is also rated "hard" or "very hard." It commonly has sulphates and iron in amounts that are objectionable but not a health hazard to people or livestock. Water from sandstone of the Dakota Formation is low in sulphates and may have objectionable quantities of iron, sodium chloride, or fluoride. Ground water can be contaminated by drainage from feedlots, septic tanks, or from other waste disposal. If a domestic well is installed, samples of the water should be tested for contamination.

Physiography, relief, and drainage

Dodge County is in the Great Plains. The most prominent relief in Dodge County is in the bluff areas that border the Platte and Elkhorn River valleys. Slope is steep and very steep. Maximum relief between ridgetops and the bottom of adjacent drainageways is about 120 to 150 feet.

All of the uplands is reached by drainageways except for small nearly level areas that have shallow depressions. The uplands are made up of a succession of ridgetops, adjacent side slopes, and stream valleys. The ridgetops are commonly rounded and gently sloping. The side slopes are gently sloping to moderately steep. About 51 percent of Dodge County is upland.

The Elkhorn and Platte River valleys are mainly nearly level. Small drainageways transect the valleys to the larger streams. Stream terraces make up about 5 percent of the county and bottom lands about 44 percent.

Dodge County is drained by the Platte and Elkhorn Rivers and their tributaries. The streams flow south or southeast except for Maple Creek, which flows mostly eastward. Several small creeks enter Dodge County from the north or west and feed into the Elkhorn River. These creeks are Maple, Pebble, Logan, Rawhide, Cuming, and Clark Creeks. Nearly all of the rivers and major creeks flow constantly, except during times of prolonged drought.

The lowest elevation in the county is in the southeastern part and is about 1,165 feet above sea level. The highest point is in the northwestern part and is about 1,590 feet above sea level. Fremont is at an elevation of about 1,190 feet.

Manufacturing and agricultural business

Many firms that manufacture products for national markets are in the city of Fremont. The products are agricultural and nonagricultural, for example, canned soups, agricultural feeds, campers, dairy products, lead products, boxes, steel products, alfalfa meal, and processed soybeans. Many businesses make, sell, and service machinery used in agriculture.

Fattened cattle and hogs are shipped to Omaha or are purchased by local meat packers. Dairy and poultry products produced on the farm are marketed inside and outside the county. Grain and feed products not used on the farm are sold at local elevators and shipped to other markets.

Transportation

Dodge County has good facilities for transportation. Railroads provide adequate service to nearly all parts of the county. Bus lines serve most communities. Air service is available at Fremont and nearby Omaha.

The county is traversed by several all-weather surface highways. U.S. Highway 30 provides an east-west route in the southern part of the county; U.S. Highway 77 provides a north-south route mainly in the eastern part of the county. U.S. Highway 275 follows the Elkhorn valley in the north-central part. Nebraska Highway 91 serves mainly east-west travelers in the northeastern part of the county.

The rural road system is well developed. Roads generally run along section lines. A few of these roads are hard surfaced for a few miles from towns, but most are graveled.

School facilities

There are elementary and high schools throughout the county. Midland Lutheran College is a 4-year liberal arts school. There are private, business, and vocational training schools.

Trends in farming and soil use

Farming has been a major part of the economy in Dodge County since it was settled. The 1968 Nebraska Agricultural Statistics listed 1,300 farms in Dodge County. But by 1975 the number of farms had dropped to 1,140. This reduction was due mostly to an increase in the size of the farms and partly to the effects of urbanization, mainly around Fremont. Continued use of farmland for urban expansion, industrialization, and roads can be expected in the immediate future.

Increased irrigation and use of commercial fertilizer has increased the production of farm products. Irrigated acres increased from 29,500 in 1964 to 67,000 in 1975. In 1964, 19,266 tons of commercial fertilizer were sold, compared to 37,094 tons in 1974.

Corn is the main cultivated crop in the county. The acreage of dryland corn increased from 89,620 acres in 1964 to 95,000 acres in 1974. Acreage of irrigated corn increased from 13,390 acres in 1964 to 36,000 acres in 1974. Soybeans have increased in importance as a cash crop. In 1964, 47,460 acres were in soybeans, and in 1974 the acreage had increased to 83,000 acres.

The acreage of oats, wheat, and sorghum is in a general downtrend. The acreage of alfalfa, tame grass, and wild hay remains about constant.

Feeding livestock for meat production has increased in recent years. The number of hogs fed increased from 59,180 in 1964 to 80,000 in 1974. The number of cattle raised increased from 76,290 in 1964 to 80,700 in 1974. The number of dairy cows decreased from 2,840 in 1964 to 1,900 in 1974. The number of poultry and sheep on farms has decreased in recent years. The number of horses used for recreation has increased.

Bluegrass sod is grown for commercial use. Small vegetable and potato gardens supplement home-food supplies, and some produce is sold locally. Between 1,000 and 1,500 acres of popcorn is grown in Dodge County each year. A few acres of bluegrass sod is grown for sodding lawns.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After classifying and naming the soils, the soil scientists drew the boundaries of the soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil. Map units are described under "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their characteristics may be modified during the course of the survey. New interpretations are made for local use, mainly through field observation of different soils in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same soils.

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

General soil map for broad land-use planning

The general soil map at the back of this publication shows map units that have a distinct pattern of soils, relief, and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscape in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Descriptions of soil associations

1. Moody-Nora-Belfore association

Deep, well drained, nearly level to strongly sloping, silty soils; on loess uplands

This soil association consists mainly of uplands with alternating divides and narrow drainageways. The ridgetops are narrow and gently sloping, and the side slopes are strongly sloping. The association includes a few nearly level flats on the broad divides.

This soil association makes up about 11 percent of the county. It consists of about 63 percent Moody soils, 20 percent Nora soils, 15 percent Belfore soils, and 2 percent soils of minor extent.

Moody soils are gently sloping to strongly sloping and are on ridgetops and side slopes. They are deep, well drained soils. The surface layer is friable silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 24 inches thick. The underlying material, to a depth of 36 inches, is silt loam.

Nora soils are strongly sloping and are on narrow ridgetops and side slopes. They are deep, well drained soils. The surface layer is friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam. The underlying material is silty clay loam.

Belfore soils are nearly level, deep, and well drained. The surface layer is friable silty clay loam. The subsoil is mainly firm silty clay loam. The underlying material is silty clay loam.

The minor soils are the poorly drained Calco soils and the well drained Judson soils. Calco soils are at the bottom of large, nearly level drainageways. Judson soils are at the base of slopes and on side slopes of small drainageways.

Most of the acreage of this association is cultivated. The main crops are corn, soybeans, alfalfa, wheat, and grain sorghum. Some small areas are in pasture, which is grazed by cattle and sheep. A center pivot sprinkler system, sprinkler pipe, or self propelled big gun type sprinklers are used for irrigation. Corn, soybeans, and alfalfa are the main irrigated crops. The soils in this association have high potential for irrigation, particularly those that are nearly level and very gently sloping.

Controlling erosion, conserving water, and maintaining fertility are the main concerns of management. Wetness of some of the minor soils in the larger drainageways limits their use.

Farms, on the average, are about 400 acres in size and are diversified. They are mainly a combination of cash-grain and livestock farms. Soybeans and wheat are grown for cash. Much of the corn and hay is fed to cattle and hogs to fatten them for market. Fattened cattle and hogs commonly are marketed locally through sale barns and direct livestock buyers, but a few of the livestock are shipped to terminal markets in large cities outside the county.

Markets for most farm products are readily accessible. Gravel, asphalt, or improved dirt roads are on most section lines and paved state and federal highways cross the area.

2. Zook-Kennebec-Judson association

Deep, poorly drained and well drained, nearly level to gently sloping, silty and clayey soils; on bottom lands and foot slopes

This soil association is mainly on bottom lands of the Elkhorn River valley and the valleys of Logan, Maple, and Pebble Creeks (fig. 1). It also includes stream terraces of these valleys and the foot slopes to the adjacent uplands.

This soil association makes up about 17 percent of the survey area. It consists of about 44 percent Zook soils, 13 percent Kennebec soils, 9 percent Judson soils, and 34 percent minor soils.

Zook soils are nearly level and on the lowest part of the bottom lands. They are deep, poorly drained soils. The surface layer is friable silty clay loam or very sticky silty clay, and the subsoil and underlying material are very sticky silty clay.

Kennebec soils are nearly level and are on some of the highest parts of the bottom lands. They are deep, well drained soils. The surface layer is friable silt loam to a depth of 29 inches. The underlying material is a browner silt loam.

Judson soils are gently sloping and are at the base of slopes or along narrow drainageways. They are deep, well drained soils. The surface layer is friable heavy silt loam. The subsoil is friable silty clay loam. The underlying material is slightly lighter colored silty clay loam.

The minor soils in this association are Colo, Monona, Moody, Platte, Inavale, Saltine, Gibbon, and Wann soils. Calco soils are poorly drained and on bottom lands. Colo soils are somewhat poorly drained and on bottom lands. The well drained Monona and Moody soils are on stream terraces. Platte soils are somewhat poorly drained, and the Inavale soils are somewhat excessively drained. They are both on bottom lands. The saline-alkali Saltine soils and the somewhat poorly drained Gibbon soils are on bottom lands.

Most of the acreage of this association is in cultivated crops. The main crops are corn, soybeans, alfalfa, wheat, and grain sorghum. A few areas along the Elkhorn River and adjacent to the creek channels are in native grasses. These areas are either grazed by cattle or cut for native hay. Other areas are in tame pasture and are used for grazing. Some areas are irrigated either by the gravity method or by sprinkler systems. The water supply is from wells, from Maple Creek or from the Elkhorn River. Corn, soybeans, and alfalfa are the main irrigated crops. Most of the soils in this association can be irrigated, except in the areas of the Maple Creek bottom land where underground water is not available.

Occasional flooding and soil wetness from the underlying water table are the main limitations of soils in this association. Surface drainage is needed in places, particularly on the fine textured soils, so that tillage operations can be more timely. Maintaining high fertility, good tilth on the fine textured soils, and good water management are the main concerns of management.

Farms, on the average, are about 240 acres in size. Many farmsteads are in the association, but they are mainly on the well drained soils. They are diversified and are mainly a combination of cash-grain and livestock farms. Soybeans are grown for cash. Much of the grain and hay is fed to cattle and hogs to fatten them for market. Most cash crops and livestock are marketed locally; some livestock is shipped to terminal markets in large cities outside the county. Some dairy stock is kept on the farm. Most of the milk produced is shipped by truck to markets outside the county. Some cow and calf herds are kept on the farm, and the calves are either sold under contract or marketed locally after fattening.

Markets are readily accessible. Gravel or improved dirt roads are readily available but not on all section lines. Concrete or asphalt state and federal highways cross the area; U.S. Highway 275 is the main highway.

3. Moody-Thurman-Leisy association

Deep, well drained and somewhat excessively drained, nearly level to strongly sloping, silty, sandy, and loamy soils; on uplands

This soil association is on uplands. The area consists of undulating or gently sloping ridgetops and the adjacent, steeper side slopes (fig. 2). Low areas between the divides are nearly level and consist of foot slopes or small depressions.

This soil association makes up about 1 percent of the county. It consists of about 40 percent Moody soils, 39 percent Thurman soils, 18 percent Leisy soils, and 3 percent minor soils.

Moody soils are nearly level to strongly sloping and are on ridgetops, side slopes, and broad flats. They are deep, well drained soils. The surface layer is friable silty clay loam. The subsoil is friable silty clay loam. The underlying material, at a depth of 36 inches, is lighter colored silt loam.

The Thurman soils generally have complex slopes and are on some of the highest parts of the landscape. They are deep, somewhat excessively drained soils. The surface layer is loose, loamy fine sand. The transition layer is lighter colored loamy fine sand. The underlying material, at a depth of 20 inches, is fine sand.

The Leisy soils are moderately sloping to strongly sloping and are on both ridgetops and side slopes. They are deep, well drained soils. The surface layer is friable fine sandy loam. The upper part of the subsoil is friable loam, and the lower part is friable silty clay loam.

The minor soils in this association include the Fillmore soils in shallow depressions and the Judson soils that are at the base of slopes and on side slopes of some of the small drainageways.

Most of the acreage of this association is in cultivated crops, except for areas of the steeper and very sandy soils. Many of these areas have been planted back to native grasses. Some areas of native grass are cut for hay or grazed, and some provide habitat for wildlife. A few areas are in tame pasture grasses, which are grazed by cattle. Corn, soybeans, wheat, grain sorghum, and alfalfa are the main crops. Some of the more level and less sandy areas are irrigated, mainly by sprinkler systems, with water pumped from wells. Corn and soybeans are the main irrigated crops. The potential for irrigation is medium due to the terrain, type of soils, and availability of water.

Soil blowing and droughtiness are the main hazards on the loamy and sandy soils of this association. Maintaining the organic matter content and improving fertility are important concerns of management, especially on the sandy soils. Proper grazing use, deferred grazing, and a planned grazing system are needed where the soils are in range.

Farms, on the average, are about 240 acres in size. Farmsteads are common. The farms are diversified and

are mainly a combination of cash-grain and livestock farms. Soybeans and wheat are grown for cash. Much of the grain and hay is fed to cattle and hogs to fatten them for market. Most cash crops and livestock are marketed locally; some livestock is shipped to terminal markets in large cities outside the county. A few cow and calf herds are kept on the farm.

The farm-to-market roads are gravel or improved dirt roads and are adequate. A few county roads are hard surfaced. There are no towns in this association, but Scribner is nearby and much of the farm produce is marketed there.

4. Moody-Fillmore association

Deep, well drained and poorly drained, nearly level to gently sloping, silty soils; on loess uplands

This soil association is on uplands. Much of it consists of broad divides, high stream terraces, and side slopes, which are eroded terrace edges. Shallow swales and depressions are common (fig. 3).

This soil association makes up about 19 percent of the survey area. It consists of about 92 percent Moody soils, 6 percent Fillmore soils, and 2 percent minor soils.

Moody soils are nearly level to gently sloping and are on divides, side slopes, and flats. They are deep, well drained soils. The surface layer is friable silty clay loam, and the subsoil is friable silty clay loam. The underlying material, at a depth of 36 inches, is lighter colored silt loam.

Fillmore soils are in nearly level, upland depressions. They are deep, poorly drained soils. The surface layer is friable silt loam that is grayer in the lower part than in the upper part. The subsoil is very sticky silty clay. The underlying material is slightly lighter colored silty clay at a depth of about 40 inches.

The minor soils in this association include the gently sloping, well drained Judson soils, which are on foot slopes and side slopes of some of the small drainageways. Other minor soils are the strongly sloping, well drained Moody and Nora soils, which are on some of the steeper side slopes of the large stream valleys.

Most of the acreage of this association is in cultivated crops. The main crops are corn, soybeans, wheat, grain sorghum, and alfalfa. A few small areas are in tame pasture grasses, which are grazed by cattle and sheep. Some farms are irrigated by the center pivot sprinkler system and others by sprinkler pipe and gated pipe. Corn, soybeans, and a smaller acreage of alfalfa are the main irrigated crops. The soils in this association have high potential for further irrigation.

Soil erosion in the gently sloping areas and ponding of water after heavy rains in the depressions are the main hazards in this association. Conserving water and maintaining fertility are the main concerns of management.

Farms, on the average, are about 400 acres in size and are diversified. They are mainly a combination of cash-grain and livestock farms. Soybeans and wheat are grown for cash. Much of the grain and hay is fed to cattle and hogs to fatten them for market. Fattened cattle and hogs generally are marketed locally through sale barns and to direct livestock buyers; a small percentage of livestock is shipped to terminal markets in large cities outside the county. A few cow-calf herds and dairy herds are kept on the farm. Most calves are sold locally, and the milk produced is shipped by truck to areas outside the county.

Markets are readily accessible. Gravel and asphalt roads are on most section lines, and state and county highways cross the area.

5. Nora-Moody-Judson association

Deep, well drained, gently sloping to moderately steep, silty soils; on uplands and foot slopes

This soil association is mainly on uplands that have narrow divides and side slopes (fig. 4). The ridgetops are gently sloping, and the side slopes are strongly sloping to steep. Some of the broader divides are nearly level. Narrow valleys of both permanent and intermittent streams drain this dissected landscape. Narrow foot slopes are the base of many upland areas.

This soil association makes up about 18 percent of the county. It consists of about 44 percent Nora soils, 40 percent Moody soils, 10 percent Judson soils, and 6 percent minor soils.

Nora soils are strongly sloping to moderately steep and are mainly on side slopes and a few narrow ridgetops. They are deep, well drained soils. The surface layer is friable silt loam, and the subsoil is slightly lighter colored silty clay loam. The underlying material is silty clay loam.

Moody soils are gently sloping on the ridgetops and are strongly sloping near the upper end of drainageways. They are deep, well drained soils. The surface layer is friable silty clay loam, and the subsoil is a browner silty clay loam. The underlying material, at a depth of 36 inches, is lighter colored silt loam.

Judson soils are gently sloping and are on foot slopes or on side slopes of narrow drainageways. They are deep, well drained soils. The surface layer is friable silt loam, and the subsoil is silty clay loam and browner than the surface layer. The underlying material is yellowish brown, lighter colored than the subsoil, and is light silty clay loam.

The minor soils in this association include the weakly developed Crofton soils on side slopes and narrow ridgetops, the somewhat poorly drained Colo soils in narrow drainageways, the well drained Kennebec soils on the higher part of bottom lands, and the moderately steep and steep Steinauer soils, which formed in glacial till and are on the middle part of side slopes. Belfore soils are nearly level and are on the broad divides.

Most of the acreage of this association is in cultivated crops. The main crops are corn, soybeans, alfalfa, wheat, and grain sorghum. A few small areas are in tame pasture grasses, which are grazed by cattle, or in native grasses, which are either grazed by cattle or mowed for hay. A few areas are irrigated by self-propelled sprinkler systems. Potential for irrigation is medium. An adequate supply of water for wells is lacking in some areas, and some soils are too steep.

Conserving water and maintaining good tilth and high fertility are the main concerns of management in this association. On uplands, soil erosion is the main hazard. In the narrow valleys, local flooding is a hazard, and wetness limits the use of some soils.

Farms, on the average, are about 280 acres in size and are diversified. The sections generally have from 1 to 5 farmsteads. Farms are mainly a combination of cash-grain and livestock farms. Soybeans are grown for cash. Nearly all of the grain and hay produced is fed to livestock on the farm. Many cattle and hogs are marketed locally through livestock buyers or sale barns. A few livestock are shipped to terminal markets in large cities outside the county.

Markets are easily accessible. Good graveled roads between farms and markets are on most section lines. One blacktop road crosses the area. There are no towns in this association, but Scribner and Dodge are nearby.

6. Gibbon-Luton-Janude association

Deep, poorly drained, somewhat poorly drained and well drained, nearly level, silty, loamy, and clayey soils; on bottom lands

This soil association is on bottom lands of the Platte and Elkhorn Rivers (fig. 5). The seasonal high water table is between a depth of 2 to 8 feet in most of the area.

This soil association makes up about 25 percent of the county. It consists of about 35 percent Gibbon soils, 24 percent Luton soils, 16 percent Janude soils, and 25 percent minor soils.

Gibbon soils are nearly level. They are deep and somewhat poorly drained. The surface layer is friable silty clay loam about 22 inches thick. The underlying material is lighter in color and is silty clay loam in the upper part, fine sandy loam in the middle part, and fine sand in the lower part.

Luton soils are nearly level and are on the lower part of this association. They are deep, poorly drained soils. The surface layer is very sticky silty clay. Most of the subsoil is a grayer silty clay. The underlying material is mottled silty clay.

Janude soils are nearly level and are at the highest elevation in this association. They are deep, well drained soils. The surface layer, transition layer, and underlying material are loam.

The minor soils in this association include the saline-alkali Saltine soils that are in a complex with Gibbon soils and are in low areas of the landscape. The Moody soils are on stream terraces, higher than the major soils. Zook soils are on the lower part of the bottom lands.

Most of the acreage of this association is in cultivated crops. Corn, soybeans, small grain, grain sorghum, and alfalfa are the main crops. A few small areas of tame pasture grasses are grazed by cattle, and a few small areas of native grasses are mowed for hay. Much of the area is irrigated. Water is pumped from wells and distributed either by gated pipe or by the center pivot sprinkler system. Corn and soybeans are the main irrigated crops. There is good potential for developing more irrigation, except in areas along the Elkhorn River where underground water is not available in large quantity.

Soil wetness due to a seasonal high water table is the main limitation in this association. Surface drainage is needed on the fine textured and the somewhat poorly drained soils so that tillage operations can be more timely. Maintaining the organic matter content, improving tilth, and maintaining high fertility are the main concerns of management.

Farms, on the average, are about 400 acres in size and are mainly the cash-grain type. A few are cash-grain and livestock farms. Most sections have from 2 to 4 farmsteads. Corn, soybeans, wheat, and grain sorghum are grown for cash. On the diversified farms, the grain and hay are fed to cattle and hogs to fatten them for market. Fattened cattle and hogs generally are marketed locally through sale barns or to direct livestock buyers; a small percentage of livestock is shipped to terminal markets in large cities outside the county. A few cow-calf herds and dairy herds are kept on the farm. Most calves are sold locally, and the milk produced is shipped by truck to areas outside the county.

Markets are readily accessible. Gravel roads are on most section lines, and state and county highways cross the area. Fremont, the county seat, is in this association and serves as a shopping and cultural center for Dodge County.

7. Inavale-Cass-Wann association

Deep, somewhat excessively drained, well drained and somewhat poorly drained, nearly level and very gently sloping, sandy and loamy soils; on bottom lands

This soil association is on the bottom lands of the Platte and Elkhorn River valleys. The soils are nearly level for the most part, except some areas are dissected by shallow swales and channels and a few areas have gently undulating topography (fig. 5).

This soil association makes up about 9 percent of the county. It consists of about 22 percent Inavale soils, 17 percent Cass soils, 15 percent Wann soils, and 46 percent minor soils.

The Inavale soils are deep, somewhat excessively drained, nearly level or very gently sloping, and are in channeled areas adjacent to the Platte and Elkhorn Rivers. They have a surface layer of loose loamy fine sand about 7 inches thick. A transition layer of slightly lighter colored loamy fine sand about 21 inches thick is below the surface layer. The underlying material is very pale brown fine sand.

The Cass soils are nearly level and are on the higher part of the landscape in this association. They are deep, well drained soils. The surface layer is very friable fine sandy loam. A transition layer of slightly lighter colored sandy loam is below the surface layer. The underlying material is brown loamy fine sand in the upper part and lighter colored fine sand in the lower part.

The Wann soils are deep, nearly level, and on the lower part of the landscape of this association. They are somewhat poorly drained soils. The surface layer is friable fine sandy loam. The upper part of the underlying material is slightly lighter colored fine sandy loam, and the lower part is loamy coarse sand.

The minor soils in this association include the Alda, Colo, and Gibbon soils that are nearly level and are on slightly lower positions than most of the surrounding soils. Boel soils are nearly level and are on slightly higher positions than the surrounding soils. Platte soils are in low channeled areas. Pits and dumps and Riverwash are near channels of the Platte River.

A large part of this association is in mixed native grasses and trees or tame pasture grasses. These areas are used mainly for grazing cattle, for recreation, and for wildlife habitat. Many large gravel pits along the Platte River are used for boating and fishing. There are sites for summer cabins as well as for permanent houses along the pits. There are very few gravel pits along the Elkhorn River. Wildlife is fairly abundant along the Platte and Elkhorn Rivers. Deer, rabbits, raccoons, waterfowl, and other birds and animals are along these rivers. The cultivated areas are mainly in corn and soybeans. A few areas along the Platte River are irrigated from wells, either by gated pipe or by self-propelled sprinkler systems. A few areas along the Elkhorn River are irrigated, generally by water pumped from the river. Irrigation has low potential in this association because of the type of soils, the flooding hazard, and the lack of underground water in the Elkhorn River Valley.

Soil blowing and droughtiness are hazards where the soils are sandy, loamy, or shallow. Occasional flooding or soil wetness from the high water table are problems in some areas. Conserving water, maintaining a plant cover, and maintaining high fertility are the main concerns of management. Proper grazing use and a planned grazing system are needed where the soils are in range.

Farms, on the average, are about 300 acres in size and are diversified. There are only a few farmsteads in this association. They are mainly a combination of cash-grain and livestock farms. Soybeans are grown for cash. Much of the grain and hay is fed to cattle and hogs to fatten them for market. Fattened cattle and hogs generally are marketed locally through sale barns and direct livestock buyers; a few of the livestock are shipped to terminal markets in large cities outside the county. A few cow-calf herds are kept on the farm, and the calves are sold locally.

Farm to market roads are few, but they generally are graveled and are adequate for marketing the farm products. A few hard surfaced highways cross the association.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The descriptions, along with the soil maps, can be used to determine the potential of a soil and to manage it for food and fiber production; to plan land use and improve soil resources; and to enhance, protect, and preserve the environment. More information on each map unit, or soil, is given under "Use and management of the soils."

A symbol identifying the soil on the detailed soil maps precedes the name of each map unit. Each soil description includes general facts about the soil. It briefly describes the soil profile. Each description also lists the principal hazards and limitations to be considered in planning management.

The map units on the detailed soil maps represent areas on the landscape made up of one or more soils.

Soils that have about the same profile make up a *soil series*. Except for differences in texture of the surface layer or of the underlying substratum, all the soils of a series have horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped.

Soils of one series can differ in texture, 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 phases. Most delineations shown on the detailed soil map are phases of a soil series. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Moody silty clay loam, 2 to 6 percent slopes, is one of several phases within the Moody series.

Some map units are made up of two or more major soils. Such map units are called soil complexes and undifferentiated groups.

A *soil complex* consists of two or more soils that are so intricately mixed or so small that they cannot be shown separately on the soil maps. Each area consists of the two or more major soils. The pattern and proportion of the soils are somewhat similar in all areas. Sal-

tine-Gibbon complex, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the major soils or may have all of them. Kennebec and Colo soils, channeled, 0 to 2 percent slopes, is an undifferentiated group in this survey area.

Most map units include small, scattered areas of soils other than those in the name of the map unit. Some of these soils have properties that differ from those of the major soil or soils. Such differences could significantly affect use and management of the map unit. These soils are mentioned in each map unit description. Some included areas are identified by a spot symbol on the soil maps.

Most mapped areas include areas that have little or no soil material and support little or no vegetation. Such areas are called *miscellaneous areas*; they are shown on the soil maps and given descriptive names. Riverwash is an example. Some of these areas that are too small to be shown on the soil maps are identified by a spot symbol.

The acreage and proportionate extent of each map unit are given in table 3. Additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

A given soil in this county may be identified by a different name in a recently published soil survey of an adjacent county. Because concepts of soil classification have changed, some boundaries on the soil maps and in this soil survey do not match those on the maps in a published soil survey of an adjoining county.

Detailed information about soil terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*4*).

Soil descriptions

Af—Alda fine sandy loam, 0 to 2 percent slopes. This soil is moderately deep over coarse sand and gravelly sand. It is a nearly level, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. It is occasionally flooded. The areas are 5 to 50 acres in size.

Typically, the surface layer is very friable fine sandy loam about 12 inches thick. The upper part is black, and the lower part is very dark gray. A transitional layer of grayish brown fine sandy loam about 8 inches thick is below the surface layer. In the upper part, the underlying material is light brownish gray fine sandy loam, and in the lower part, to a depth of 60 inches, it is very pale brown and pale brown stratified coarse sand and gravelly sand.

Included with this soil in mapping are small areas of Boel loam, Inavale loamy fine sand, and Wann fine sandy loam. Boel soils are coarser in the upper part of the underlying material and are in areas somewhat higher than Alda soils. The better drained Inavale soils are at a higher elevation than the Alda soils. The Wann soils do not have appreciable amounts of gravel in the underlying material. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the upper part and very rapid in the underlying sand and gravel. The available water capacity is low. Moisture is released readily to plants. The water table ranges from a depth of 2 feet in most wet years to a depth of 4 feet in most dry years. Growth of plant roots of the crops commonly grown in the county is limited to the soil material above the coarse sand and gravel. The content of organic matter is moderate, and natural fertility is medium. Runoff is slow. The intake rate of water is moderately high.

Most of the acreage is cultivated. This soil has fair potential for cultivated crops under both dryland and irrigation management. It has good potential for pasture and range, fair potential for trees and shrubs, and fair potential for most recreation uses. It has poor potential for both sanitary facilities and building site developments.

Under dryland management, this soil is not well suited to cultivated crops because it is droughty late in summer. Corn, soybeans, and grass are the crops commonly grown in the area. Because of wetness, this soil warms up more slowly in spring than better drained soils; therefore, tillage operations are slightly delayed. During midsummer, however, the water table is commonly at a low of about 5 feet. The available water capacity is low. Conservation tillage practices and keeping crop residue on the surface help conserve moisture for crops, build up the supply of organic matter, and improve natural fertility.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and to close sown crops such as alfalfa, tame grass for pasture, and small grain. Wetness, caused mainly by a high water table in spring, is the main limitation. Late in summer, low moisture retention is also a concern of management. Gravity type irrigation systems are suitable, but sprinkler systems are best. The application rate of water in a sprinkler system can be adjusted. Applications should be frequent because of the low moisture retention of the soil. Maintaining crop residue on the surface and minimum tillage help to control soil blowing.

This soil is suited to range and pasture grasses. Pastures commonly consist of bromegrass or bluegrass and less commonly of native grasses. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to plantings of trees and shrubs in windbreaks. Only those species that are tolerant of the moderately high water table should be used. These are listed in table 6. The herbaceous vegetation on this soil is abundant. Cultivating between the rows and using appropriate herbicides in the row help to control weeds and grasses.

Occasional flooding and wetness make the soil generally not suitable for use as septic tank absorption fields. Sewage lagoons on the soil perform satisfactorily if they are protected from flooding. The lagoons should be lined to prevent seepage into the ground water.

Roads are subject to damage by frost action and flooding. Constructing roads on suitable fill material and providing adequate side ditches and culverts help prevent damage from flooding and frost. A gravel barrier in the subgrade helps prevent frost damage.

Capability units IIIw-6 dryland and IIIw-9 irrigated; Subirrigated range site; windbreak suitability group 2.

Ag—Alda loam, 0 to 2 percent slopes. This soil is moderately deep over coarse sand and gravelly sand. It is a nearly level, somewhat poorly drained soil on bottom lands of the Platte River and Elkhorn River valleys. It is occasionally flooded. The areas are 5 to 40 acres in size.

Typically, the surface layer is black, friable loam about 13 inches thick. A transitional layer of grayish brown loam about 4 inches thick is below the surface layer. In the upper part, the underlying material is grayish brown fine sandy loam, and in the lower part, to a depth of 60 inches, it is very pale brown and pale brown stratified coarse sand and gravelly sand.

Included with this soil in mapping are small areas of Boel loam, Inavale loamy fine sand, and Wann loam. The Boel soils are coarser in the upper part of the underlying material and are in areas very slightly higher in the landscape. Inavale soils are somewhat excessively drained and are at a slightly higher elevation than the Alda soils. The deep Wann soils are at a similar elevation as Alda soils. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the upper part and very rapid in the underlying sand and gravel. The available water capacity is low. Moisture is released readily to plants. The seasonal high water table is at a depth of about 2 feet in most wet years and at a depth of 4 feet in most dry years. In late summer, it recedes to a depth of about 5 feet. Growth of plant roots of the crops commonly grown in the area is limited to the soil material above the coarse sand and gravelly sand in the underlying material. The content of organic matter is moderate, and natural fertility is medium. Runoff is slow. Water intake rate is moderate.

Most of the acreage is cultivated. This soil has fair potential for dryland and irrigated cultivated crops. It has good potential for pasture and range, fair potential for trees and shrubs in windbreaks, and fair potential for recreation uses. It has poor potential for sanitary facilities and building site developments.

Under dryland management, this soil is only fairly well suited to cultivated crops because it is droughty in summer. Corn, soybeans, small grain, grain sorghum, grasses, and legumes are the commonly grown crops. This soil is wet early in spring because of the high water table; consequently, tillage is delayed. Late in summer, the water table recedes to a depth of about 5 feet. Conservation tillage, such as minimum tillage, and leaving crop residue on the surface can help conserve moisture and improve the organic matter content and natural fertility.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and close-sown crops such as alfalfa, tame grass pasture, and small grain. Wetness caused mainly by a moderately high water table is the main limitation. This soil warms up slowly in spring, and tillage is delayed. Moisture retention is low because of the coarse textured underlying material, and this is a concern of management. A gravity system of irrigation is suitable, but land leveling generally is needed for even distribution of water and uniform drainage. A sprinkler system is more suitable than other methods of irrigation. The water application rate of a sprinkler system can be adjusted to the moisture intake rate of the soil. Application of water should be frequent because of the low moisture retention.

This soil is suited to both range and pasture grasses. Pastures commonly consist of bromegrass or bluegrass and, less commonly, native grasses. Proper use, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to plantings of trees and shrubs in windbreaks. Only species tolerant of the moderately high water table are suited. The herbaceous vegetation that grows on this soil is abundant. Cultivation between the rows and proper use of appropriate herbicides in the row helps control weeds.

Because of occasional flooding, wetness, and seepage, this soil is poorly suited to use as septic tank absorption fields and for sewage lagoons unless special designs or installation procedures are used. Seepage into the ground water is a hazard. The surface of roads can be waterproofed by installing a gravel subgrade barrier as protection against frost action.

Capability units IIIw-4 dryland and IIIw-7 irrigated; Subirrigated range site; windbreak suitability group 2.

Be—Belfore silty clay loam, 0 to 2 percent slopes. This is a nearly level soil that formed in loess on uplands. The areas are 40 to 240 acres in size.

Typically, the surface layer is friable silty clay loam about 14 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The subsoil is about 31 inches thick. The upper part is friable,

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

Included with this soil in mapping are small areas of the poorly drained Fillmore silt loam in shallow depressions and the gently sloping Moody silty clay loam on long narrow ridgetops. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is released slowly to plants. The organic matter content is moderate, and runoff is slow. The subsoil has a high shrink-swell potential. Natural fertility is high. Intake rate of water is low.

Practically all the acreage is cultivated. This soil has good potential for cultivated crops and for trees and shrubs in windbreaks. It has fair potential for pasture and range grasses, good potential for cultivated crops under irrigation, fair or good potential for wildlife habitat, and poor or fair potential for most recreational uses. It has fair or good potential for most sanitary facilities and poor potential for building site developments.

Under dryland management, this soil is suited to corn, soybeans, small grains, and alfalfa. Row crops can be grown in consecutive years where proper amounts and kinds of fertilizer are applied and where weeds and insects are controlled. Conservation of water is an important concern of management. Mulch planting and the conservation of crop residue help to conserve moisture for use by crops, build up the supply of organic matter, and improve fertility. Lime is needed to reduce soil acidity if alfalfa is to be grown.

If irrigated, this soil is suited to row crops such as corn, soybeans, grain sorghum, and to close sown crops such as alfalfa, tame grass pasture, and small grain. Gravity and sprinkler methods of irrigation can be used for all crops. Land leveling and water reuse pits generally are needed for the most efficient use of water if furrow irrigation is used. The center-pivot sprinkler system is particularly well suited.

This soil is suited to pasture, generally bromegrass, or a mixture of bromegrass and alfalfa, or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Proper grazing use, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is well suited to trees and shrubs in windbreaks. If the soil cracks, light cultivation and supplemental water help to close the cracks and protect the roots. Weeds can be controlled by cultivation between the rows, by hand hoeing within the row of trees, or by careful use of appropriate herbicides. Newly planted trees may need supplemental watering during times when natural rainfall is deficient.

The moderately slow permeability of this soil is a problem if it is used as a septic tank absorption field, but the problem can be overcome by increasing the size of the absorption field. Because of the shrink-swell potential of the soil, foundations for buildings and roads and streets need treatment. Foundations can be backfilled with sand or with sand and gravel. The base for roads and streets can be treated with additives such as hydrated lime to prevent shrinking and swelling. The surface pavement of roads and streets needs to be thick enough to compensate for the low strength of the soil material.

Capability units I-1 dryland and I-3 irrigated; Clayey range site; windbreak suitability group 4.

Bo—Boel loam, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained soil on bottom lands of the Platte River and Elkhorn River valleys. It is occasionally flooded. The areas are 20 to 160 acres in size.

Typically, the surface layer is black, friable loam about 10 inches thick. In the upper part, the underlying material is pale brown, mottled loamy very fine sand; in the middle part, it is light gray, mottled loamy very fine sand; and in the lower part, to a depth of 60 inches, it is white fine sand.

Included with this soil in mapping are small areas of Alda loam, Inavale loamy fine sand, and Wann fine sandy loam. Alda soils are moderately deep over gravelly sand and are at a slightly lower elevation than the Boel soils. The somewhat excessively drained Inavale soils are at a higher elevation than the Boel soils. The moderately coarse textured Wann soils are at about the same elevation as Boel soils. These included soils make up 5 to 10 percent of this map unit.

Permeability is rapid, and the available water capacity is moderate. Moisture is released readily to plants. The water table is at a depth of about 2 feet in most wet years and at a depth of 3.5 feet in most dry years. Late in summer, the water table recedes. The content of organic matter is moderately low, and natural fertility is medium. Runoff is slow. The water intake rate is moderately high.

Most of the acreage is grassland, but some is cultivated. This soil has fair potential for cultivated crops and for trees and shrubs in windbreaks and good potential for pasture and range grasses. It has fair potential for cultivated crops if gravity or sprinkler irrigation systems are used, fair to good potential for habitat for wildlife, and poor to fair potential for recreation uses. It has poor potential for sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, grain sorghum, small grain, and grasses and legumes for hay and pasture. Because the soil warms up slowly in spring, tillage is delayed. In summer, when the water table is lowest, this soil is droughty. Conservation tillage and the conservation of crop residue help to conserve moisture, build up the supply of organic matter, and improve fertility. Flooding can be controlled by dikes and levees or by dams and terraces on the higher lying soils.

Under irrigation, this soil is moderately well suited to corn, grain sorghum, and to close sown crops such as alfalfa, tame grass pasture, and small grain. Because of a seasonal high water table, wetness is the main limitation. Tillage operations in spring generally are delayed by wetness. This soil is subject to flooding on an average of once every 3 to 5 years, but crop losses generally are slight. Sprinkler and gravity systems of irrigation are suited. Because the underlying material is coarse textured, the length of runs needs to be short under a gravity irrigation system. Where these soils are irrigated by gravity, some land leveling generally is needed for an even distribution of water and uniform drainage.

This soil is suited to range and pasture. Tame pastures generally are made up of bromegrass, bluegrass, or a mixture of bromegrass and alfalfa. Proper degree of use, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil generally is suited to windbreaks and plantings in recreational and wildlife areas. Only species of trees and shrubs that are tolerant of a moderately high water table are suited. Cultivation between the rows, hand hoeing, or use of appropriate herbicides within the rows controls weeds and grasses. Supplemental watering may be necessary during the summer, when the water table is lowest.

Because of occasional flooding and the high water table, this soil generally is not suitable for use as septic tank absorption fields and for sewage lagoons. Alternate sites may need to be considered for sanitary facilities to avoid contamination of underground water. Constructing roads on suitable fill material and providing adequate side ditches and culverts help protect the roads from flood damage.

Capability units IIIw-4 dryland and IIIw-8 irrigated; Subirrigated range site; windbreak suitability group 2.

Ca—Calco silty clay loam, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained soil generally on bottom lands of narrow upland drainageways. A few areas are on broader bottom lands of the Elkhorn River and Logan Creek valleys. It is occasionally flooded. The areas are 5 to 20 acres in size.

Typically, the surface layer is friable, black silty clay loam about 39 inches thick. A transition layer of friable, very dark gray silty clay loam about 7 inches thick is below the surface layer. The underlying material is dark gray, mottled silty clay loam to a depth of 60 inches. In a few small areas are soils that are noncalcareous throughout the profile.

Included with this soil in mapping are small areas of the finer textured Zook soils. These soils are on the same landscape as the Calco soil. Also included are small areas that have a thin deposit of silt loam on the surface and a few very poorly drained areas that range in size from 1/2 acre to 2 acres. These included soils and areas make up 3 to 8 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. The seasonal high water table ranges from a depth of 2 feet in wet years to a depth of 3 feet in dry years. Moisture is released readily to plants. Tillage and planting generally are delayed by wetness, and the soil becomes warm later in spring than in areas of better drained soils. The content of organic matter and natural fertility are high. The shrink-swell potential is high. Rate of water intake is low.

Most of the acreage is cultivated. This soil has good potential for dryland or irrigated crops, grasses, and for hay and pasture. It has fair potential for trees and shrubs in windbreaks, good potential for habitat for openland wildlife, and poor potential for recreational uses. This soil has poor potential for most sanitary facilities and building site developments.

Under dryland management, this soil is suited to corn, soybeans, small grains, and mixtures of grasses and legumes for hay or pasture. Row crops can be grown in consecutive years if proper amounts of fertilizer are applied and if weeds and insects are controlled. Tillage operations may need to be delayed because of wetness in spring and because of the occasional flooding. Tile drains and surface ditches help lower the water table and thus control wetness. Dikes along drainageways, dams upstream, or a combination of terraces, grassed waterways, and dams within the watershed help to protect these areas from flooding.

If irrigated, this soil is suited to corn, soybeans, grain sorghum, and close sown crops such as alfalfa, tame grass pasture, and small grain. Because of a seasonal high water table, wetness is the main limitation. This soil is subject to flooding on an average of once every 3 to 5 years, but crop losses generally are slight. Installing shallow V-ditches or perforated tile to lower the water table helps to improve drainage. In places, locating suitable outlets is a problem. Gravity systems and sprinkler systems are suitable irrigation methods. Land leveling generally is needed for an even distribution of water and uniform drainage if a gravity system is used. Diversions help prevent flooding by runoff from other areas.

This soil is suited to pasture and rangeland. Pastures generally are made up of bromegrass alone or mixed with alfalfa or orchardgrass and alfalfa. Grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Pastures may respond to nitrogen and phosphate.

This soil generally is suited to windbreaks and wildlife plantings. Only those species of trees and shrubs that can tolerate a moderately high water table and occasional flooding are suited. Herbaceous vegetation is abundant and persistent. Weeds and grasses can be controlled by clean cultivation, hand hoeing, or careful use of appropriate herbicides.

Wetness from the water table and occasional flooding are severe limitations for septic tank absorption fields, sewage lagoons, and building sites. Special design or installation procedures are needed, or an alternate site may need to be selected. If a drainage outlet is available, V-ditches or tile drains can be installed to help lower the water table. Dikes and levees may be needed to protect the areas from flooding. Tile drains can be installed around foundations and then backfilled with gravel. Roads can be constructed on compacted fill material and provided with adequate side ditches as protection from flood water and soil wetness.

Capability units IIw-4 dryland and IIw-3 irrigated; Subirrigated range site; windbreak suitability group 2.

Cb—Calco silty clay loam, wet, 0 to 2 percent slopes. This is a deep, nearly level, poorly drained soil on low bottom lands. It is within and adjacent to old abandoned stream channels or broad flat drainageways. It is frequently flooded during heavy rains and periods of high stream flow. The areas are 5 to 20 acres in size.

Typically, the surface layer is friable, black silty clay loam about 40 inches thick. A transition layer of friable, very dark gray silty clay loam about 7 inches thick is below the surface layer. The underlying material is dark gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the strongly alkaline Gibbon Variant soils and areas of wetter marshy lands. These soils are in similar landscapes. Also included are small areas that have a thin deposit of silt loam on the surface that range in size from 1/2 to 2 acres. These included soils and areas make up 3 to 8 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. The content of organic matter and natural fertility are high. The water table is about 1/2 foot above the surface in most wet years and about 2 feet below the surface in most dry years. Runoff is slow. The shrink-swell potential is high.

Nearly all the acreage is used for range, except small areas near cultivated fields, which are used by wildlife for habitat. This soil has very poor potential for dryland or irrigated crops. It has poor potential for trees and shrubs in windbreaks, good potential for range grasses, and fair potential for wetland wildlife habitat. This soil has fair potential for pasture or hay (fig. 6) and poor potential for recreation uses. It has poor potential for most sanitary facilities and building site development.

Unless drained, this soil is not suited to the cultivated crops commonly grown in the area. Tile drains, land shaping, and V-ditches can provide better internal and external drainage.

This soil is not suitable for pasture because of wetness. Areas generally are made up of bluegrass, sedges, prairie cordgrass, and reedgrass. Artificial drainage is necessary for the most common tame grasses used in pastures.

This soil is used for range. It is grazed mainly during dry periods. Overgrazing reduces the productive cover. Proper grazing use and a planned grazing system help to improve the range condition. Use should be restricted during the wettest periods to prevent the formation of small mounds or bogs that make further grazing and haying difficult.

This soil is poorly suited to windbreaks. Only those trees and shrubs that tolerate a very high water table and flooding are suited. These hazards can be minimized by using trees and shrubs listed for this soil in table 6. Establishing trees can be very difficult in wet years, and special protection may be needed to keep the seedlings from drowning out. Planting on built-up areas or using dikes can protect the new seedlings.

The high water table and frequent flooding make this soil poorly suited to use as septic tank absorption fields, sewage lagoons, and building sites. Unless special designs or installation procedures are used, alternate sites should be selected. Roads need to be constructed on built-up areas that have adequate side ditches to carry the floodwater away.

Capability unit Vw-7 dryland; Wet Land range site; windbreak suitability group 6.

Cc—Cass fine sandy loam, 0 to 2 percent slopes. This is a deep, nearly level, well drained soil on bottom lands of the Platte and Elkhorn River valleys. It is rarely flooded. The areas are 10 to 50 acres in size.

Typically, the surface layer is very friable, very dark brown fine sandy loam 20 inches thick. A transition layer of very friable, dark brown sandy loam 18 inches thick is below the surface layer. In the upper part, the underlying material is brown loamy very fine sand, and in the lower part, to a depth of 60 inches, it is brown fine sand. In this map unit are small areas with a loam surface layer and areas where silty clay loam soil material is below a depth of 40 inches.

Included with this soil in mapping are small areas of coarser textured Inavale soils and the somewhat poorly drained Wann soils. Inavale soils are on narrow ridges that are slightly higher in the landscape, and Wann soils are in lower lying parts of the landscape. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid, and the available water capacity is moderate. Moisture is released readily to plants. Natural fertility is medium. Phosphorus and nitrogen are needed for highest production. The content of organic matter is moderate. Runoff is slow. Intake rate of water is moderately high.

Most of the acreage is cultivated. This soil has good potential for growing dryland or irrigated crops, hay, pasture, and trees. It has good potential for habitat for openland wildlife and good potential for most recreation uses, but it is poor for camp areas because of the hazard of flooding. It has fair or poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, and small grain. Grasses and legumes can be grown for hay and pasture. Row crops can be grown in consecutive years if management is at a high level. Droughtiness and soil blowing generally are problems if the soil is dry farmed. A conservation tillage system that includes the use of mulch planting and the conservation of crop residue helps control soil blowing, builds up the supply of organic matter, and conserves moisture for use by crops. The soil is suited to gravity and sprinkler irrigation systems.

If irrigated, this soil is suited to row crops such as corn, soybeans, and grain sorghum, and to close sown crops such as alfalfa, tame grass pasture, and small grains. For gravity irrigation the length of runs, frequency of irrigation, and the amount of water applied need to be lower on this soil than on similar soils that have clayey material in the substratum. Land leveling is needed for efficient irrigation if a furrow system is used.

This soil is used for both pasture and range. Pastures generally are made up of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Controlled grazing and rotation grazing help to keep the grasses in good condition. Pastures may respond to nitrogen and phosphate.

This soil can be used for windbreaks and plantings for wildlife. Those trees and shrubs that are suited to moderately sandy soil and can tolerate somewhat droughty conditions are suited. Soil blowing and insufficient moisture are the principal hazards in establishing trees. Soil blowing can be reduced or prevented by maintaining strips of sod or a cover crop between the tree rows.

Rare flooding is a hazard for septic tank absorption fields, sewage lagoons, and building sites. Dikes can be constructed to protect the areas from flooding. Sewage lagoons can be lined to prevent seepage. Buildings and roads can be constructed on fill material to protect them from floodwaters. A gravel subgrade barrier can be used to help overcome the effect of frost action on roads and streets.

Capability units IIs-6 dryland and IIs-8 irrigated; Sandy Lowland range site; windbreak suitability group 3.

Cd—Cass fine sandy loam, clayey substratum, 0 to 2 percent slopes. This is a deep, nearly level, well drained soil on high bottom lands of the Platte and Elkhorn River valleys. It is rarely flooded. The areas are 10 to 80 acres in size.

Typically, the surface layer is friable, very dark grayish brown fine sandy loam about 18 inches thick. In the upper part, the underlying material is dark grayish brown fine sandy loam; in the middle part, it is black silty clay loam; and in the lower part, to a depth of 60 inches, it is dark grayish brown silty clay loam. In some small areas the surface layer is loam, and in some areas the middle and lower parts of the underlying material are less clayey.

Included with this soil in mapping are small areas of coarser textured Inavale soils and the somewhat poorly drained Wann soils. Inavale soils are slightly higher in the landscape, and Wann soils are in lower lying positions. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately rapid in the upper part and moderately slow in the lower part. The available water capacity is moderate. The depth of the water table ranges from 2.5 feet in most wet years to 3.5 feet in most dry years. Moisture is released readily to plants. Natural fertility is medium. Phosphorus and nitrogen generally are deficient in this soil. The content of organic matter is moderate. Runoff is slow. During periods of high rainfall or if irrigated, this soil is able to hold water in the upper part of the underlying material and in the surface layer because of the underlying clayey substratum. This water holding capacity is important in management of the soil because the additional moisture is available for use by crops. The intake rate of water is moderately high.

Most of the acreage is cultivated. This soil has good potential for dryland or irrigated crops, hay, pasture, and trees. It has good potential for habitat for openland and rangeland wildlife. It has good potential for most recreation uses but poor potential for camping areas because of the hazard of flooding. This soil has fair to poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, and small grain. Grasses and legumes can be used for hay and pasture. Row crops can be grown in consecutive years if management is at a high level. Soil blowing generally is a problem if the soil is dry farmed. A conservation tillage system that includes the use of mulch planting and conservation of crop residue helps control soil blowing, builds up the supply of organic matter, and conserves moisture for use by crops.

Under irrigation, this soil is suited to row crops such as corn, soybeans, grain sorghum, and to close sown crops such as alfalfa, tame grass pasture, and small grain. For gravity irrigation, the length of runs needs to be less on this soil because of the coarse textured surface layer and the upper part of the underlying material. Some land leveling generally is needed to provide an even distribution of irrigation water and to allow uniform drainage. Because this soil is clayey at a depth of 36 to 40 inches, fewer applications of water are needed for the soil to hold water in the upper part of the profile. The clayey layer also prevents excessive loss of water by leaching. The sprinkler system of irrigation is well suited to this soil.

This soil is suited to pasture and range. Pastures generally consist of bromegrass, a mixture of bromegrass and alfalfa, or a mixture of orchardgrass and alfalfa. Controlled grazing and rotation grazing help to keep the

grasses in good condition, and in some places response to nitrogen and phosphate fertilizers is good.

This soil is well suited to trees and shrubs in windbreaks and to plantings for wildlife habitat and recreation uses. Because of the moderately coarse textured surface layer, plantings should be carefully selected. Soil blowing is the main hazard in establishing trees; it can be controlled by maintaining strips of sod or a cover crop between the rows.

Flooding is rare; nevertheless, it is a hazard if this soil is used as septic tank absorption fields and building sites or for sewage lagoons. Special design or installation procedures are needed. The perched water table can restrict some engineering works. Dikes and levees can help prevent flooding. The clayey substratum can interfere with the successful operation of filter fields in a septic tank system unless perforated tile is installed to provide drainage. If the clayey substratum is removed in constructing a sewage lagoon, the lagoon should be lined to prevent seepage. Buildings and roads should be constructed on suitable fill material to protect them from flooding. Roads can be damaged by frost action, but installing a gravel subgrade barrier helps prevent such damage.

Capability units IIs-6 dryland and IIs-8 irrigated; Sandy Lowland range site; windbreak suitability group 3.

Ce—Cass loam, 0 to 2 percent slopes. This is a deep, nearly level, well drained soil on high bottom lands of the Platte and Elkhorn River valleys. It is rarely flooded. The areas are 10 to 100 acres in size.

Typically, the surface layer is friable, black loam about 16 inches thick. A transition layer of very friable, dark gray fine sandy loam about 9 inches thick is below the surface layer. In the upper part, the underlying material is grayish brown fine sandy loam, and in the lower part, to a depth of 60 inches, it is light brownish gray loamy fine sand. In some small areas this soil has a fine sandy loam surface layer, and in some areas it has a clayey substratum.

Included with this soil in mapping are small areas of the somewhat poorly drained Wann soil. These areas are in lower lying positions on the landscape. This included soil makes up 3 to 8 percent of this map unit.

Permeability is moderately rapid, and the available water capacity is moderate. Moisture is released readily to plants. This soil has good tilth and workability, and natural fertility is medium. Phosphorus and nitrogen generally are deficient in this soil. The content of organic matter is moderate. Runoff is slow. The intake rate of water is moderately high.

Most of the acreage is cultivated. This soil has good potential for dryland or irrigated crops, hay, pasture, and trees. It has good potential for habitat for openland and rangeland wildlife and fair potential for most recreation uses. It has fair to poor potential for most sanitary facilities and for building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, and small grain. It can also be used for grasses and legumes for hay and pasture. Row crops can be grown in consecutive years if management is at a high level. Droughtiness is a hazard due to the moderate available water capacity of this soil, and moisture is generally leached below an effective rooting depth. A cropping system that includes mulch planting and conservation of the crop residue builds up the supply of organic matter and conserves moisture for use by crops.

Under irrigation, this soil is suited to row crops such as corn, soybeans, grain sorghum, and to close sown crops such as alfalfa, tame grass pasture, and small grain. Because the underlying material is coarse textured, the length of runs needs to be short under a gravity system. If these soils are irrigated by gravity, some land leveling generally is needed for evenly distributed irrigation water and uniform drainage. A sprinkler system of irrigation is well suited to this soil.

This soil is suitable for pasture and range. Pastures generally are made up of bromegrass or a mixture of alfalfa or orchardgrass and alfalfa. Controlled grazing and rotation grazing help to keep the grasses in good condition. Pastures may respond to nitrogen and phosphate.

This soil is well suited to trees and shrubs in windbreaks and to plantings for wildlife habitat and recreational uses. Competition for moisture from grasses and weeds is a concern in establishment and management of trees on this soil. Weeds can be controlled by the careful use of herbicides in the row or by cultivation between the rows.

Flooding is rare; nevertheless, it is a hazard if this soil is used as septic tank absorption fields and building sites and for sewage lagoons. Dikes and levees can be constructed to prevent flooding, and buildings can be constructed on fill material. Bottoms of lagoons should be lined to prevent seepage. Roads can be constructed on fill material to protect them from flooding. Frost action can damage roads, but proper grading and a gravel subgrade barrier can reduce this damage.

Capability units I-1 dryland and I-8 irrigated; Sandy Lowland range site; windbreak suitability group 1.

Cf—Cass loam, clayey substratum, 0 to 2 percent slopes. This is a deep, nearly level, well drained soil on high bottom lands of the Platte and Elkhorn River valleys. It is rarely flooded. The areas are 10 to 80 acres in size.

Typically, the surface layer is friable, black loam about 14 inches thick. A transition layer of friable, dark grayish brown fine sandy loam about 26 inches thick is below the surface layer. In the upper part, the underlying material is grayish brown silty clay loam, and in the lower part, to a depth of 60 inches, it is light brownish gray fine sand. In some areas, the lower part of the underlying

material is silt loam or silty clay loam at a depth of 40 inches or below, and in places the clayey material is above a depth of 40 inches. About 35 to 40 percent of the soil has clayey material at a depth of 36 to 40 inches.

Included with this soil in mapping are small areas of Cass fine sandy loam that does not have a clayey substratum. These included areas make up 2 to 5 percent of this map unit.

Permeability is moderately rapid in the upper part of the profile and moderately slow in the lower part. The available water capacity is moderate. The perched seasonal high water table ranges from a depth of about 2.5 feet in most wet years to a depth of about 3.5 feet in most dry years. Moisture is released readily to plants. Natural fertility is medium. Phosphorus and nitrogen generally are deficient in this soil. The content of organic matter is moderate. Runoff is slow. The clayey substratum has moderate shrink-swell potential. During periods of high rainfall or if irrigated, this soil is able to hold water in the upper part of the underlying material and in the surface layer because of the clayey substratum. The intake rate of water is moderately high.

Most of the acreage is cultivated. This soil has good potential for dryland or irrigated crops, hay, pasture, and trees. It has good potential for habitat for openland wildlife and good potential for most recreation uses, but it has poor potential for camp areas. This soil has fair to poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if fertilizer is applied and weeds and insects are controlled. A cropping system that includes the use of mulch planting and the conservation of crop residue builds up the supply or organic matter and conserves moisture for use by crops. Gravity and sprinkler irrigation systems are suitable.

Under irrigation, this soil is suited to row crops such as corn, soybeans, grain sorghum, and to close sown crops such as alfalfa, tame grass pasture, and small grain. For gravity irrigation, some land leveling generally is needed for the even distribution of irrigation water and for uniform drainage. Because this soil has clayey material at a depth of 36 to 40 inches, it is able to hold water in the upper part of the underlying material and in the surface layer for a longer period than similar soils that do not have this material; hence, fewer applications of irrigation water are needed. Sprinkler irrigation is well suited to this soil.

This soil is suited to pasture and range. Pastures generally consist of bromegrass, a mixture of bromegrass and alfalfa, or orchardgrass and alfalfa. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Pastures can be fertilized for increased production.

This soil is well suited to trees and shrubs in windbreaks and to plantings for wildlife habitat and recreation use. Moisture competition from grass and weeds is a concern in establishing and managing trees on this soil. Cultivating between the rows and using herbicides can control the competition.

Flooding is rare; nevertheless, it is a hazard if this soil is used as septic tank absorption fields and for sewage lagoons and building sites. The perched water table above the clayey layer restricts some engineering works. Dikes and levees can prevent flooding. Buildings and roads should be constructed on fill material to protect them from soil wetness and flooding. If the clayey layer is removed in constructing a sewage lagoon, the lagoon should be lined to prevent seepage. Frost action can damage roads, but grading the soil properly to provide surface drainage and installing a gravel subgrade barrier help prevent such damage.

Capability units I-1 dryland and I-8 irrigated; Sandy Lowland range site; windbreak suitability group 1.

Cg—Colo silty clay loam, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys and on bottom lands of Maple Creek and its tributaries. It is on low areas adjacent to old channels. It is occasionally flooded. The areas are 10 to 50 acres in size.

Typically, the surface layer is firm, black silty clay loam about 40 inches thick. A transition layer of very dark gray silty clay loam about 12 inches thick is below the surface layer. The underlying material is very dark gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of Gibbon, Luton, and Zook soils. Typically, Gibbon soils are calcareous throughout the profile. Luton and Zook soils have a clayey subsoil and are generally slightly lower in the landscape than Colo soils. These included soils make up 3 to 8 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is released readily to plants. The water table is at a depth of about 2 feet in most wet years and at a depth of 3 feet in most dry years. The content of organic matter and natural fertility are high. This soil has only fair workability because of its firm consistence. Runoff is slow. The shrink-swell potential is high. The water intake rate is low.

Most of the acreage is cultivated. This soil has good potential for dryland and irrigated cultivated crops, good potential for pasture and range, and fair potential for trees and shrubs in windbreaks. It has poor potential for recreation areas and fair potential for openland wildlife. It has poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, small grain, and grain sorghum. Grasses or a mixture of grass and legumes can be grown for hay and

pasture. Row crops can be grown in consecutive years if a high level of management is used. Tillage operations are commonly delayed in spring because of wetness and occasional flooding. Tile drainage or surface ditches can be used to improve drainage.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and to close-sown crops such as alfalfa, tame grass pasture, and small grain. Wetness, caused mainly by a seasonal high water table, is the main limitation. This soil is subject to flooding on an average of about once every 3 to 5 years, but crop losses generally are slight. The soil is somewhat difficult to work because it is firm when moist and tends to clod if tilled when wet. Perforated tile or V-ditches can be installed to lower the water table; and thus improve drainage. In places, locating suitable outlets is a problem in installing a drainage system. Suitable methods of irrigation are gravity systems and sprinkler systems. Diversions can be used to prevent flooding by runoff from higher lying soils.

This soil is suited to pasture and range. Pastures commonly consist of bromegrass, a mixture of bromegrass and alfalfa, or a mixture of orchardgrass and alfalfa. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Applying fertilizer can increase production.

This soil is suited to plantings of trees and shrubs for windbreaks. Only those species that can tolerate a moderately high water table are suited. The herbaceous vegetation that grows on this soil is abundant and persistent. Soil cracking can be controlled by light cultivation and supplemental watering.

Because of wetness from the water table and occasional flooding, this soil is poorly suited to use as septic tank absorption fields and building sites and for sewage lagoons. Special designs or installation procedures are needed. Sewage lagoons, roads, and some buildings should be constructed on well compacted fill material to protect them from soil wetness and floodwater. Dikes and levees can also be used as protection from flooding. Roads are subject to damage by frost action unless they are designed with a gravel subgrade barrier and crowned by grading. Adequate roadside ditches help to remove floodwaters. Roads and streets should be designed so that the surface pavement is sufficiently thick to withstand the low strength of the soil material.

Capability units IIw-4 dryland and IIw-3 irrigated; Clayey Overflow range site; windbreak suitability group 2.

CrD2—Crofton silt loam, 6 to 15 percent slopes, eroded. This is a deep, strongly sloping and moderately steep, well drained soil on narrow ridgetops, rounded knolls, and short, uneven side slopes of the loess uplands. The areas are 5 to 10 acres in size.

Typically, the surface layer is friable, dark grayish brown silt loam about 6 inches thick. A transitional layer of very friable, dark brown silt loam about 8 inches thick is below the surface layer. The underlying material is brown silt loam to a depth of 60 inches. This soil is calcareous in all parts of the profile.

Included with this soil in mapping are small areas of finer textured and darker Nora soils. Nora soils are on similar landscapes as Crofton soils. They make up about 5 to 10 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is released readily to plants. Erosion by water is the main hazard. Small rills and a few gullies are common. The content of organic matter is low. Runoff is rapid. Due to the high content of free carbonates, the availability of phosphorus is low. The intake of water is moderate.

Most of the acreage is cultivated, and the rest is mainly in native grass. This soil has poor potential for cultivated crops, hay, and pasture. It has fair potential for plantings of trees and shrubs in windbreaks, good potential for most recreation areas where the slope is less than 8 percent, and fair potential for habitat for openland wildlife. This soil has good potential for most sanitary facilities and building site development where the slope is less than 8 percent and poor potential where the slope is more than 8 percent.

Under dryland management, this soil generally is used for corn and for grasses and legumes. If the soil is used for row crops, it is difficult to control erosion. Conservation tillage and grassed waterways can be used to prevent excessive soil loss. A few areas have smooth slopes that can be terraced and then cultivated on the contour. This soil is low in nitrogen. It is also low in available phosphorus because of the high content of carbonates. Returning crop residue to the soil or the regular addition of other organic matter helps to improve fertility and decrease soil erosion. Phosphorus is needed for good production of alfalfa.

Under irrigation, this soil is better suited to close sown crops such as alfalfa and tame grass pasture than to cultivated row crops. Irrigation is not practical where slopes are more than 9 percent because of excessive erosion and the difficulty in controlling water. This soil is suited only to sprinkler irrigation. Other methods of irrigation are too difficult to manage, and the cost of land preparation for them is high. Water application needs to be adjusted to prevent runoff. Terraces and grassed waterways are effective in controlling erosion. Crop residue can be used as a mulch to help reduce erosion.

This soil is suited to pasture, which is an effective way to help control erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Controlled grazing, rotation grazing, and restricted use during very wet periods help to keep grasses in good condition.

This soil is suited to trees and shrubs that can tolerate a high content of calcium. These trees and shrubs are listed in table 6. Susceptibility to water erosion is a hazard. Moisture competition from grass and weeds is the main hazard in establishing seedlings. Planting tree

rows on the contour and a cover crop between the rows can reduce erosion. Terraces help prevent runoff and water erosion.

The steepness of slopes is a problem in installing septic tank absorption fields and sewage lagoons. Liners or other special treatment should be used in sewage lagoons to prevent seepage. Buildings need to be properly designed and can be constructed to accommodate the slope. Roads are subject to moderate frost action but can be crowned by grading for good surface drainage. Erosion of ditchbanks and side slopes can be severe along roads. An adequate grass cover helps to prevent this erosion.

Capability units IVe-9 dryland and IVe-6 irrigated; Limy Upland range site; windbreak suitability group 5.

CrF—Crofton silt loam, 15 to 30 percent slopes. This is a deep, steep, somewhat excessively drained soil on short, uneven side slopes of bluffs that border the Elkhorn and Platte River valleys. The areas are 5 to 20 acres in size.

Typically, the surface layer is friable, dark brown silt loam about 6 inches thick. A transitional layer of friable, grayish brown silt loam about 6 inches thick is below the surface layer. The underlying material is brown silt loam to a depth of 60 inches. The soil is calcareous throughout the profile.

Included with this soil in mapping are small areas of finer textured and darker Nora soils on side slopes and narrow ridgetops. This included soil makes up 5 to 10 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is released readily to plants. Erosion by water is the main hazard where this soil is farmed. Gullies and small rills are common. The content of organic matter is low. Runoff is rapid.

Most of the acreage is in range. This soil has very poor potential for cultivated crops because of the steep slope. It is not suited to irrigation because of the excessive slopes, the hazard of erosion, and the difficulty in controlling the water. It generally is not suited to pasture grasses but has fair potential for range grass. This soil has very poor potential for plantings of trees and shrubs, poor potential for recreational uses, fair potential for habitat for openland wildlife, and good potential for habitat for rangeland wildlife. It has poor potential for most sanitary facilities and building site development.

This soil is suited to range. A good cover of native grasses needs to be maintained. Controlling grazing so that one-half the forage production is left for the following year allows the grass to store carbohydrates in the root system and insures a healthy stand of grass. Overgrazing reduces the protective cover and causes the native plant community to deteriorate. Controlled grazing, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil is not suited to trees and shrubs in windbreaks because of the steepness of slope and the excessive hazard of erosion. Trees and shrubs can be planted by hand for wildlife areas.

Because of steep slopes, this soil generally is not suited to use as septic tank absorption fields and building sites or for sewage lagoons. Special design and installation procedures are needed. Cutting and filling can be used to modify the slope on sites for roads and buildings. Roads are subject to water erosion along the side ditches and side slopes, but an adequate grass cover helps to minimize this hazard.

Capability unit VIe-9 dryland; Limy Upland range site; windbreak suitability group 10.

CrG—Crofton silt loam, 30 to 60 percent slopes. This is a very steep, excessively drained soil on narrow bluffs that border the Elkhorn and Platte River valleys. Short, nearly vertical slopes, or catsteps, are common. Large gullies and intermittent drainageways are characteristic of the landscape. Areas of this soil are long and narrow and are 5 to 30 acres in size.

Typically, the surface layer is friable, dark brown silt loam about 5 inches thick. A transitional layer of grayish brown silt loam about 4 inches thick is below the surface layer. The underlying material is brown silt loam to a depth of 60 inches. This soil is calcareous throughout.

Included with this soil in mapping are small areas of less sloping Crofton soils. Small areas of glacial till and sand are outcrops in this map unit. These included areas make up 3 to 6 percent of this unit.

Permeability is moderate, and the available water capacity is high. Moisture is released readily to plants. Because of the very steep slope, erosion by water is the main hazard. Gullies are common. The content of organic matter is low. Runoff is rapid or very rapid.

Most of the acreage of this map unit is in range. Scattered trees are common. This soil is not suited to cultivated crops and has very poor potential for this use because of the steepness of slope. It has poor potential for pasture grasses and very poor potential for trees and shrubs in windbreaks. This soil has poor potential for recreation use, fair potential for habitat for openland wildlife, and good potential for habitat for rangeland wildlife. It has poor potential for most sanitary facilities and building site development.

Because of the very steep slope, the soil is not suited to the mowing of grasses or legumes for hay.

This soil is suited to range. A good cover of native grasses needs to be maintained. Controlling grazing so that one-half the forage production is left for the following year allows the grass to store nutrients in the root system and insures a healthy stand of grass. Overgrazing reduces the protective cover and causes the native plant community to deteriorate. Soil erosion by water is a severe hazard unless adequate grass cover is maintained. Controlled grazing, timely deferment from grazing,

and a planned grazing system help maintain or improve the range condition.

This soil is not suited to trees in windbreaks because of the very steep slopes, excessive loss of moisture by runoff, and the very severe hazard of erosion. Trees for wildlife areas can be hand planted.

This map unit generally is not suitable for use as sanitary facilities or building sites because of the very steep slopes. Alternate sites need to be selected. Severe cutting and filling is needed if roads are constructed across these areas.

Capability unit VIIe-9 dryland; Thin Loess range site; windbreak suitability group 10.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This is a deep, poorly drained soil in broad, shallow basins or depressions of the loess uplands and stream terraces. It is occasionally flooded. The areas are 6 to 40 acres in size.

Typically, the surface layer is friable silt loam about 20 inches thick. The upper part is very dark grayish brown, and the lower part is gray. The subsoil is very firm silty clay 20 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The underlying material is dark grayish brown silty clay to a depth of 60 inches. Small stains of manganese generally are in the subsoil and underlying material. This soil in some areas has a surface layer that is more than 20 inches thick.

Included with this soil in mapping are small areas of Fillmore silt loam, ponded. These areas are in the lowest part of the depressions. This included soil makes up 3 to 8 percent of this map unit.

Permeability is very slow, and the available water capacity is high. Ponding after heavy rain is the main hazard. This soil has a perched water table above the claypan subsoil. The water table is at the surface in wet years and is at a depth of about 1 foot in dry years. Where this soil is not artificially drained, there are no outlets, and therefore little or no runoff. Because of the slow permeability of the subsoil, only a small amount of the ponded water can move through the solum. Most of the surface water is removed by evaporation or transpiration. The content of organic matter is moderate, and natural fertility is medium.

Most of the acreage is cultivated, and some is in grasses. The soil has fair potential for dryland and irrigated cultivated crops, hay, and pasture. It has poor potential for trees or shrubs in windbreaks, poor potential for most recreation uses, and fair potential for habitat for openland and rangeland wildlife. It has poor potential for sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. Planting and cultivation generally are delayed because of ponded water. Crops generally are planted early in spring but commonly need to be replanted later because they are drowned out by spring rains. Crop production, therefore, is limited unless adequate drainage can be provided by V-ditches or other acceptable means.

Under irrigation, this soil is suited to such row crops as corn and grain sorghum and to such close-sown crops as alfalfa, tame grass pasture, grasses, and small grain. Because of very slow permeability and excess moisture from flooding, wetness is the main limitation. This soil is difficult to work because it is commonly wet at tillage time. Flooding can be controlled by dikes or diversions, which prevent excess runoff from adjacent areas. Gravity and sprinkler irrigation systems are suitable. Systems that recycle excess irrigation water can be installed. If suitable outlets are available, this soil can be drained by V-ditches.

This soil can be used for pasture and range. Pastures generally are made up of reed canarygrass, switchgrass, and some bluegrass. Grazing when the soil is ponded causes surface compaction, which results in poor tilth. Controlled grazing, rotation grazing, and nitrogen fertilizer help to keep the grasses in good condition.

This soil is suited to plantings of trees and shrubs in windbreaks, but only those species that tolerate occasional flooding should be used. To establish trees, special methods of planting that keep seedlings from drowning are needed. Building up adjacent soils on the contour and using minimum tillage help decrease the flow of runoff. Planting the trees on raised or fill areas also helps prevent loss from flooding.

Because of occasional flooding, this soil is generally not suited to use as septic tank absorption fields and building sites unless special design or installation is used. Because of very slow permeability, the soil is not suited to septic tank filter fields. Roads are subject to damage by frost action. Waterproofing the surface with a gravel subgrade barrier can minimize this damage. Flooding over the roadbed can be prevented by constructing the road on fill material and providing ditches along the roadside. Because the subsoil has low strength, special design for foundations and roads is needed.

Capability units IIIw-2 dryland and IIIw-2 irrigated; Clayey Overflow range site; windbreak suitability group 2.

Fp—Fillmore silt loam, ponded, 0 to 1 percent slopes. This is a deep, very poorly drained soil in shallow basins or depressions of the loess uplands and stream terraces. It is frequently flooded. The areas are 10 to 40 acres in size.

Typically, the surface layer is friable silt loam about 19 inches thick. The upper part is very dark grayish brown, and the lower part is gray. The subsoil is very firm, mottled silty clay about 35 inches thick. The upper part is very dark grayish brown, and the lower part is dark gray. The underlying material is very firm, light brownish gray, mottled silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Fillmore silt loam, which is in slightly higher places and is occasionally flooded. This included soil makes up 5 to 8 percent of this map unit.

Permeability is very slow, and the available water capacity is high. This soil lacks natural outlets for drainage; therefore, there is little or no runoff. Because of the slow permeability of the subsoil, only a small amount of ponded water can move through the soil. The perched water table is about 0.5 feet above the surface in wet years and about 1 foot below the surface in dry years. Most of the surface water is removed by evaporation. The content of organic matter is moderate, and natural fertility is medium. The shrink-swell potential of the subsoil is high.

Most of the acreage is used for pasture or for wildlife habitat. This soil has poor potential for cultivated crops, hay, and pasture. It has very poor potential for trees and shrubs in windbreaks, poor potential for most recreation uses, and fair potential for habitat for openland and rangeland wildlife. It has poor potential for most engineering uses because of flooding and high shrink-swell characteristics.

Under dryland management, this soil is marginally suited to corn, soybeans, and grain sorghum. It can also be used for grasses and legumes for hay and pasture. Tile drains, dugouts, or large drainage ditches can be installed to remove excess water. Ponded water is the main hazard. In areas that do not have a drainage system, the vegetation consists mainly of tall sedges, prairie cordgrass, reed canarygrass, and smartweeds. This soil is not suited to irrigated crops unless surface drainage has been installed.

This soil is not suited to range or pasture because of the ponded condition that exists during much of the growing season.

This soil generally is not suited to any kind of windbreak plantings because of the frequent flooding. Some limited plantings can be made for wildlife habitat if the trees or shrubs are tolerant of flooding and if special methods of planting are used to keep the seedlings from drowning.

Because of flooding, wetness, and very slow permeability, this soil generally is not suited to use for sanitary facilities or as building sites. Special design or installation is needed. Filling and leveling can protect some sites for lagoons and roads from flooding. An alternative site may be needed. The potential is good for development of pond reservoir areas. To help control flooding, roads can be constructed on fill material, and roadside ditches that lead to a good outlet can be constructed. Because the subsoil has low strength, special design for foundations and roads is needed.

Capability unit IVw-2 dryland; no range site; windbreak suitability group 10.

Ga—Gibbon loamy sand, overwash, 0 to 2 percent slopes. This is a deep, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. It occurs in low areas where floodwaters spread a deposit of coarse textured material over the original soil. This soil is occasionally flooded. The areas are 5 to 40 acres in size.

Typically, the surface layer is about 17 inches thick. The upper part is dark brown loamy sand, the middle part is grayish brown loamy sand, and the lower part is dark grayish brown loamy very fine sand. The buried Gibbon soil is below the surface layer. The buried soil is friable loam about 28 inches thick. The upper part is black, the middle part is very dark brown, and the lower part is very dark gray. Below that there is a transition layer of very dark grayish brown loam. In the upper part, the underlying material is grayish brown loamy fine sand, and in the lower part, to a depth of 60 inches, it is light brownish gray fine sand.

Included with this soil in mapping are areas that have a loam surface layer. These included areas make up 5 to 8 percent of this map unit.

Permeability is moderate in the upper part and rapid in the lower part. The available water capacity is high. Moisture is readily released to plants. The water table is at a depth of about 2 feet in most wet years and at a depth of 4 feet in most dry years. The content of organic matter is moderate, and natural fertility is high. Runoff is slow. The intake rate of water is high.

Most of the acreage is in cultivated crops and nursery stock. This soil has fair potential for dryland and irrigated cultivated crops and pasture. It has good potential for range, fair potential for plantings of trees and shrubs in windbreaks, fair potential for recreation uses, and good potential for habitat for openland and rangeland wildlife. It has poor potential for sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Because of wetness, the soil warms up slowly in spring, and tillage is commonly delayed. Soil blowing in summer is common. The soil is droughty in summer. Use of conservation tillage helps to conserve moisture, to build up the supply of organic matter, and to lessen the hazard of soil blowing.

Under irrigation, this soil is suited to corn and grain sorghum, and it is better suited to close sown crops such as alfalfa, tame grass pasture, and small grain. Wetness, caused mainly by a seasonal high water table, is the main limitation. Soil blowing late in summer is common because of the coarse textured surface layer. Because of wetness, this soil warms up slowly in spring; hence, tillage is delayed. Installing a drainage system to lower the water table helps to improve irrigation on this soil. In places, locating suitable outlets is a problem in installing a drainage system. Sprinkler and gravity systems are suitable forms of irrigation. Land leveling gener-

ally is needed for an even distribution of water and uniform surface drainage for a gravity irrigation system. Dikes or levees help prevent occasional flooding due to ice jams on the Platte and Elkhorn Rivers.

This soil is suitable for pasture and range grasses. Pastures generally consist of bromegrass or bluegrass and, less commonly, native grasses. Overgrazing in summer can result in soil blowing. Controlled grazing and rotation grazing help to keep the grasses in good condition. Applying nitrogen increases forage production.

This soil generally is suited to trees and shrubs in windbreaks. Only those species of trees and shrubs that tolerate a seasonal high water table should be grown. Soil blowing can be prevented by planting the area with rows of larger trees and by timely irrigation. Vegetation is abundant and persistent. Weeds and soil blowing can be controlled by a cover crop grown between the rows.

Because of occasional flooding and wetness due to the seasonal high water table, this soil generally is not suited to use as septic tank absorption fields and building sites and for sewage lagoons. Special design or installation procedures are needed. Seepage into the water table is a hazard for lagoons and filter fields, and an alternate site may be needed. Gravel moisture barriers and crowning to provide good surface drainage can reduce damage to roads by frost action. Engineering works need to be protected from flooding by the use of dikes or by constructing them on good fill material.

Capability units IIIw-5 dryland and IIIw-10 irrigated; Subirrigated range site; windbreak suitability group 2.

Gc—Gibbon loam, 0 to 2 percent slopes. This is a deep, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. It is occasionally flooded. The areas are 10 to 200 acres in size.

Typically, the surface layer is friable loam about 16 inches thick. The upper part is very dark gray, and the lower part is black. A transitional layer of very dark gray loam about 7 inches thick is below the surface layer. In the upper part, the underlying material is gray loam; in the middle part, it is grayish brown fine sandy loam; and in the lower part, to a depth of 60 inches, it is light brownish gray loamy fine sand. In a few areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the coarser textured Wann fine sandy loam in about the same landscape as the Gibbon soils. This included soil makes up 5 to 8 percent of this map unit.

The permeability is moderate in the upper part and rapid in the lower part. The available water capacity is high. Moisture is readily released to plants. The water table is at a depth of about 2 feet in most wet years and at a depth of about 4 feet in most dry years. The content of organic matter is moderate, and natural fertility is high. Runoff is slow. The shrink-swell potential of the material in the upper part of the profile is moderate. The intake of water is moderate.

Most of the acreage is cultivated. This soil has good potential for dryland and irrigated cultivated crops. It has good potential for hay, pasture, and range, fair potential for planting trees and shrubs in windbreaks, fair potential for most recreation uses, and good potential for habitat for openland and rangeland wildlife. This soil has poor potential for sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Because of wetness from the high water table, this soil warms up slowly in spring; hence, tillage generally is delayed. Row crops can be grown in consecutive years if a high level of management is used. In years of excessive rainfall, the water table may be high enough to limit the production of alfalfa. Installing V-ditches or perforated tile to lower the water table helps to improve drainage.

Under irrigation, this soil is suited to corn, soybeans, and grain sorghum and to close-sown crops such as alfalfa, tame grass pasture, and small grain. Wetness, caused mainly by a seasonal high water table, is the main limitation. Tillage is commonly delayed early in spring because of wetness. Installing V-ditches or perforated tile to lower the water table helps to improve drainage. Suitable systems of irrigation are the gravity system and sprinkler system. Land leveling generally is needed for an even distribution of water and for uniform surface drainage. In places, locating suitable outlets is a problem in planning a drainage system.

This soil is suited to pasture and range grasses. Pastures generally consist of bromegrass or bluegrass and, less commonly, native grasses. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and restricted use during wet periods help keep the grasses in good condition. Fertilizing with nitrogen can increase grass production.

This soil is fairly well suited to trees and shrubs in windbreaks. Only those species that can tolerate a seasonal high water table should be used. Establishing seedlings may be a problem in wet years. Vegetation is abundant and persistent and is a concern of management.

Because of occasional flooding and wetness due to the seasonal high water table, this soil generally is not suited to use as septic tank absorption fields, sewage lagoons, and building sites. Special design or installation is needed. Seepage into the water table is a hazard, and alternate sites may be needed for sanitary facilities. Good surface drainage and a gravel moisture barrier can be used to protect roads from frost action. Side ditches that lead to a good outlet can help reduce the soil wetness and carry floodwater away. The pavement of roads and streets should be thick enough to accommodate the low soil strength. Most engineering works need to be protected from flooding by dikes or ditches.

Capability units IIw-4 dryland and IIw-6 irrigated; Subirrigated range site; windbreak suitability group 2.

Gd—Gibbon silty clay loam, 0 to 2 percent slopes. This is a deep, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. It is occasionally flooded. The areas are 10 to 400 acres in size.

Typically, the surface layer is firm, black silty clay loam about 14 inches thick. A transition layer of firm, dark gray silty clay loam about 8 inches thick is below the surface layer. In the upper part, the underlying material is light brownish gray silty clay loam; in the middle part, it is grayish brown fine sandy loam; and in the lower part, to a depth of 60 inches, it is grayish brown fine sand. In few small areas the surface layer is loam.

Included with this soil in mapping are small areas of the noncalcareous Colo silty clay loam on similar landscapes. This included soil makes up 5 to 10 percent of this map unit.

Permeability is moderately slow in the upper part and rapid in the lower part. The available water capacity is high. Moisture is readily released to plants. The water table is at a depth of about 2 feet in most wet years and at a depth of about 4 feet in most dry years. The content of organic matter is moderate, and natural fertility is high. Runoff is slow. The shrink-swell potential of the material in the upper part of the profile is moderate. The intake rate of water is moderately low.

Most of the acreage is cultivated. This soil has good potential for dryland and irrigated cultivated crops. It has good potential for hay, pasture, and range, fair potential for planting of trees and shrubs in windbreaks, fair potential for recreation uses, and good potential for habitat for openland and rangeland wildlife. It has poor potential for sanitary facilities and building site development.

Under dryland management, the soil is suited to corn, soybeans, grain sorghum, wheat, and legumes, primarily alfalfa. Because of wetness from the water table, this soil warms up slowly in spring, and tillage generally is delayed. Row crops can be grown in consecutive years if a high level of management is used and weeds and insects are controlled. In some years, the high water table limits the production of alfalfa. Installing V-ditches or perforated tile to lower the water table helps to improve drainage.

Under irrigation, this soil is suited to corn, soybeans, and grain sorghum and to close sown crops such as alfalfa, tame grass pasture, and small grain. Wetness, caused mainly by the seasonal high water table, is the main limitation. Flooding occurs on an average of once every 3 to 5 years, but crop losses generally are slight. The soil is somewhat difficult to work because it is firm when moist and tends to clod if tilled when wet. A system of V-ditches or perforated tile can be used to lower the water table. In places, locating suitable outlets is a problem in installing a drainage system. Suitable irrigation systems are the gravity system and the sprinkler system. If the gravity system is used, land leveling generally is needed for an even distribution of water and uniform surface drainage. Diversions can be used to prevent flooding of this soil by runoff from higher lying soils.

This soil is suitable for pasture and range grasses. Pastures generally consist of bromegrass or bluegrass and, less commonly, native grasses. Overgrazing and grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Fertilizing with nitrogen can increase forage production.

This soil is suited to trees and shrubs in windbreaks. Only those species that can tolerate a seasonal high water table should be used. The herbaceous vegetation is abundant and persistent and is a concern of management. Weeds and undesirable grasses can be controlled by cultivating between the rows and by careful use of herbicides in the row. In summer this soil may crack when dry and should be cultivated lightly.

Because of occasional flooding and the seasonal high water table, this soil generally is not suited to use as septic tank absorption fields and building sites or for sewage lagoons. Special design or installation is needed. Seepage into the water table is a hazard for sanitary facilities. A liner in lagoons can be used to prevent this seepage. This soil generally is not suited to basements. The pavement of roads and streets needs to be thick enough to compensate for the low strength of the soil. Use of a gravel moisture barrier and suitable grading for good surface drainage can help prevent damage to roads from frost action. Most engineering works need to be protected from flooding. They can generally be protected by dikes or construction on suitable fill material.

Capability units IIw-4 dryland and IIw-3 irrigated; Subirrigated range site; windbreak suitability group 2.

Gv—Gibbon Variant soils, 0 to 2 percent slopes. These are deep, poorly drained soils on bottom lands of the Platte and Elkhorn River valleys and their major tributaries. They are frequently flooded. The areas are 10 to 25 acres in size.

Typically, the surface layer is about 19 inches thick. The upper part is friable, very dark brown silty clay loam, and the lower part is friable, black silty clay loam. A transition layer of friable, very dark gray silty clay loam about 7 inches thick is below the surface layer. In the upper part, the underlying material is very dark gray silty clay loam; in the middle part, it is dark gray silty clay loam; and in the lower part, to a depth of 60 inches, it is black loam.

Included with these soils in mapping are small areas of the fine textured Luton silty clay and the moderately coarse textured Wann fine sandy loam. Also included are areas of Alda loam, which is moderately deep over gravelly sand, and Platte loam, which is shallow over coarse

sand and gravel. All the included soils are slightly higher in elevation than the Gibbon Variant soils. The included soils make up 10 to 20 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. The main limitation is wetness throughout most of the year. Moisture is readily released to plants. The seasonal high water table ranges from about 6 inches above the surface in most wet years to about 2 feet below the surface in most dry years. The content of organic matter is high, and natural fertility is medium. Runoff is very slow or ponded. The shrink-swell potential is moderate.

All of the acreage is in aquatic-type grasses and weeds. These soils are used for grazing but are mainly used for habitat for wetland wildlife. They have very poor potential for cultivated crops, hay, and pasture, and for trees and shrubs in windbreaks. They have good potential for range grasses and poor potential for recreation uses. These soils have poor potential for habitat for openland or rangeland wildlife but good potential for habitat for wetland wildlife. They have very poor potential for sanitary facilities and building site development.

These soils are not suited to any of the cultivated crops commonly grown in the area because of the extreme wetness. The water table should be lowered by artificial methods and the land reshaped if cultivated crops are grown.

These soils are not suitable for pasture because of the wetness. Reed canarygrass, cattails, or prairie cordgrass is the vegetation commonly grown in the area. Artificial drainage is necessary for the most tame grasses commonly used in pastures.

These soils are used for grazing, mainly during dry periods. Overgrazing reduces the protective cover. Controlled grazing and a planned grazing system help to improve the range condition. Grazing should be restricted during the wettest periods to prevent the formation of small mounds or bogs making grazing difficult.

These soils are not suited to plantings of trees or shrubs in windbreaks because of excessive soil wetness from the high water table and the frequent flooding.

Because of wetness from the high water table and frequent flooding, these soils are not suited to use for sanitary facilities and building sites. Special design and installation are needed. Alternate sites should generally be selected. Seepage into the water table is also a hazard to use for sanitary facilities. In places, roads can be constructed on fill material. Bridges and culverts are commonly needed on roads that cross these areas.

Capability unit Vw-7 dryland; Wet Land range site; windbreak suitability group 10.

Im—Inavale loamy fine sand, 0 to 2 percent slopes. This is a deep, somewhat excessively drained soil on bottom lands of the Platte and Elkhorn River valleys. It is occasionally flooded. The areas are 5 to 40 acres in size.

Typically, the surface layer is loose, grayish brown loamy fine sand about 7 inches thick. A transition layer of loose, grayish brown loamy fine sand about 21 inches thick is below the surface layer. The underlying material is pale brown fine sand and sand stratified with loamy sediment. In some small areas silty clay loam or silty clay material is below a depth of 40 inches, and in others the seasonal high water table is above a depth of 5 feet during early spring.

Included with this soil in mapping are small areas of the somewhat poorly drained Alda fine sandy loam, Boel loam, and Wann fine sandy loam, all at a slightly lower elevation. These included soils make up 5 to 10 percent of this map unit.

Permeability is rapid, and the available water capacity is low. Moisture is released readily to plants. The content of organic matter and natural fertility are low. Runoff is slow. The water intake rate is very high.

Most of the acreage is used for cultivated crops; the rest is in grasses used for grazing. This soil has poor potential for dryland cultivated crops, hay, and pasture and good potential for irrigated cultivated crops. It has good potential for trees, shrubs, and range. It has fair to poor potential for recreation uses and fair potential for habitat for openland and rangeland wildlife. This soil has poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is marginally suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Because of the low available water capacity, this soil is droughty, especially during summer; therefore, crop production under dryland conditions is limited. Conservation tillage methods help conserve moisture for use by crops, build up the supply of organic matter, and reduce soil blowing. Close-sown crops are better to grow than row crops because most of their growth is in spring, when rainfall is greatest.

Under irrigation, this soil is suited to corn and grain sorghum, but it is better suited to close-sown crops such as alfalfa, tame grass pasture, and small grain. Soil blowing and low moisture retention are the main concerns of management. Sprinkler irrigation is the only system suitable for this soil. The application rate of water can be high because the soil absorbs water rapidly. Water should be applied frequently because of the low moisture retention of the soil. Conservation tillage can help reduce soil blowing.

This soil is suited to pasture and range. Pastures generally consist of bromegrass and some areas of switchgrass or sand lovegrass. Overgrazing can lead to soil blowing. Controlled grazing and rotation grazing help to keep the grasses in good condition. Fertilizing with nitrogen increases production of forage.

This soil is well suited to trees and shrubs in windbreaks. Only those species that can tolerate coarse textured, somewhat droughty soils should be planted. Inadequate available moisture and soil blowing are the main

hazards. Soil blowing can be prevented by maintaining strips of sod or a cover crop between the rows. Seedlings may need supplemental watering when rainfall is not sufficient.

Occasional flooding is a severe limitation if this soil is used as a septic tank absorption field. The areas need dikes or other protective methods. Sewage lagoons need to be sealed or lined to hold the liquid and prevent seepage into the water table. Side ditches can help convey floodwater away from roads. Shoring can be used to prevent the caving in of shallow excavations.

Capability units IVe-5 dryland and IIe-11 irrigated; Sandy Lowland range site; windbreak suitability group 3.

Jn—Janude loam, 0 to 2 percent slopes. This is a deep, moderately well drained soil on high bottom lands of the Platte and Elkhorn River valleys. It is rarely flooded. The areas are 10 to 200 acres in size.

Typically, the surface layer is very friable, black loam about 16 inches thick. A transition layer of very friable, very dark grayish brown loam about 24 inches thick is below the surface layer. The underlying material is loam. It is dark grayish brown in the upper part and grayish brown in the lower part. In some areas a clayey substratum is at or below a depth of 40 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Gibbon loam, which is in slightly lower lying positions. This included soil makes up 5 to 10 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The water table is at a depth of about 4 feet in most wet years and 6 feet in most dry years. The content of organic matter and natural fertility are high. Runoff is slow. The water intake rate is moderate.

Most of the acreage is cultivated. This soil has good potential for the dryland and irrigated cultivated crops commonly grown in the area. It has good potential for range, pasture, and for trees and shrubs in windbreaks. It has good potential for recreation uses and for habitat for openland and rangeland wildlife. This soil has fair potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grain, and legumes, mainly alfalfa. It is one of the best soils for farming in Dodge County. Row crops can be grown yearly if a high level of management is used. Conservation of water is an important concern of management, especially during years of below average rainfall. Conservation tillage helps to conserve moisture, build up the supply of organic matter, and improve fertility.

Under irrigation, this soil is suited to corn, soybeans, and grain sorghum and to such close-sown crops as alfalfa, tame grass, and small grain. If irrigated, the soil has few limitations. Some areas are subject to slight flooding, but crop losses generally are slight. This soil is easily worked. Land leveling provides for even distribution of irrigation water and allows for uniform drainage. Sprinkler irrigation systems can be used.

This soil is suited to grasses for pasture and range. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Fertilizing with nitrogen increases grass production.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from grasses and weeds is a concern in establishing and managing windbreaks on this soil.

Flooding is rare; nevertheless, it is a moderate limitation if this soil is used as a septic tank absorption field or for sanitary landfills and roads. Special design or installation procedures are needed. Dikes are good for protection from flooding. Buildings and roads should be constructed on well compacted fill material. Lagoons need to be sealed or lined to prevent seepage. Roads are subject to slight frost action, but the surface can be waterproofed with a gravel subgrade barrier to prevent damage from this hazard. Roads need to be designed to improve the strength of the subgrade.

Capability units I-1 dryland and I-6 irrigated; Silty Lowland range site; windbreak suitability group 1.

Jo—Janude loam, clayey substratum, 0 to 2 percent slopes. This is a deep, moderately well drained soil on high bottom lands of the Platte and Elkhorn River valleys. It is rarely flooded. The areas are 10 to 160 acres in size.

Typically, the surface layer is very friable, very dark brown loam about 12 inches thick. A transition layer of very friable, black loam about 12 inches thick is below the surface layer. In the upper part, the underlying material is dark gray loam; in the middle part, it is grayish brown silty clay; and in the lower part, to a depth of 60 inches, it is very dark gray silty clay loam. In some small areas the underlying material is not clayey.

Included with this soil in mapping are small areas of the coarser textured Cass loam on similar positions on the landscape and the somewhat poorly drained Gibbon loam at a slightly lower elevation. These included soils make up about 5 to 10 percent of this map unit.

Permeability is moderate above the clayey substratum and moderately slow or slow in the substratum material. The available water capacity is high. Moisture is absorbed easily and released readily to plants. The perched water table is above the clayey substratum. Its depth ranges from 2.5 feet in most wet years to 3.5 feet in most dry years. The content of organic matter and natural fertility are high. Runoff is slow. The shrink-swell potential in the clayey substratum is high. The water intake rate is moderate.

Most of the acreage is cultivated. This soil has good potential for dryland and irrigated cultivated crops. It has good potential for pasture and range, for trees and shrubs in windbreaks, for recreation uses, and as habitat for openland and rangeland wildlife. It has fair potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grain, and legumes, mainly alfalfa. Row crops can be grown yearly if a high level of management is used. Because of the clayey underlying material, this soil holds moisture in the upper part of the profile. As a result, crops can grow during periods of low rainfall. The conservation of crop residue helps to conserve moisture, build up the supply of organic matter, and improve fertility.

Under irrigation, this soil is suited to corn, soybeans, and grain sorghum and to such close sown crops such as alfalfa, tame grasses, and small grain. This soil has few limitations if irrigated. In some areas it is subject to slight flooding, but crop losses generally are slight. This soil is easily worked. Land leveling where a gravity system of irrigation is used allows even distribution of irrigation water and uniform drainage. Because of the clayey underlying material at a depth of 40 inches, this soil is able to hold water in the upper part of the profile. As a result, fewer applications of water are needed. This soil is well suited to sprinkler irrigation. Fertility can be maintained by returning crop residue to the soil and by applying commercial fertilizer and barnyard manure. Insects and plant diseases need to be controlled.

This soil is suited to grasses for pasture and range. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Fertilizing with nitrogen increases grass production.

This soil is well suited to trees and shrubs in windbreaks. Competition for moisture from grasses and weeds is a concern in establishing and managing trees on this soil. It can be controlled by cultivating between the rows and by the use of herbicides in the rows.

Flooding is rare; nevertheless, it is a moderate hazard if the soil is used as septic tank absorption fields and building sites. Dikes or construction on well compacted fill material generally is needed as protection from flooding. Sewage lagoons need to be sealed or lined to prevent seepage. Roads can be waterproofed with a gravel subgrade barrier to protect the soil from frost action. The subgrade may need to be designed to overcome the low strength of this soil. This soil is good for use as daily cover for landfills.

Capability units I-1 dryland and I-6 irrigated; Silty Lowland range site; windbreak suitability group 1.

JuC—Judson silt loam, 2 to 6 percent slopes. This is a deep, well drained soil on colluvial-alluvial foot slopes along narrow upland drainageways and at the base of upland slopes and the adjacent bottom lands. The areas are long and narrow and are 10 to 50 acres in size.

Typically, the surface layer is friable loam about 27 inches thick. The upper part is very dark grayish brown silt loam, the middle part is very dark brown silty clay loam, and the lower part is very dark grayish brown silty clay loam. The subsoil is friable, dark brown silty clay loam about 23 inches thick. The underlying material is brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Colo and Gibbon soils and the less well developed Kennebec soils on bottom lands. Included on uplands are the weakly developed Crofton soils and the more strongly developed Moody and Nora soils. The more strongly developed Monona soils are included on stream terraces. These included soils make up 5 to 10 percent of this unit.

Permeability is moderate, and the available water capacity is high. Erosion by water is the main hazard if this soil is cultivated. Moisture is readily released to plants. The content of organic matter and natural fertility are high. Runoff is medium. The shrink-swell potential of the soil is moderate. Intake rate of water is moderate.

Most of the acreage is cultivated. This soil has good potential for dryland crops and for trees and shrubs in windbreaks. It has fair potential for cultivated crops if irrigated, fair potential for grass, and good potential for recreation uses and for habitat for openland wildlife. It has fair potential for most sanitary facilities and building site developments.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grains, and legumes. Row crops can be grown yearly if a high level of management is used. Erosion by water can cause rills. Where this soil is on alluvial fans, it is subject to occasional flooding by runoff from adjacent soils after heavy rains. Grassed waterways and terraces on the adjacent soils help prevent soil and water loss and damage by flooding. Conservation of water is an important concern of management. Conservation tillage helps to conserve moisture and build the supply of organic matter.

Under irrigation, this soil is suited to such row crops as corn, soybeans, and grain sorghum and to such close-sown crops as alfalfa, tame grass pasture, and small grain. The hazard of erosion by water is moderate. If a gravity irrigation system is used for row crops, contour furrows can be supplemented with terraces. Bench leveling can be used to shape the surface of the soil so that all types of gravity systems can be used. If erosion is controlled, this soil is best suited to sprinkler systems. Terraces and contour farming help to control erosion. Returning crop residue to the soil, keeping tillage to a minimum, and keeping residue on the surface are ways

that can be used to control erosion and increase the content of organic matter.

This soil is suited to pasture and range grasses. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction, excessive runoff, and poor tilth. Controlled grazing, rotation grazing, and restricted use during wet periods help to keep the grasses in good condition. Fertilizing with nitrogen increases grass production.

This soil is well suited to trees and shrubs in windbreaks. Competition for moisture from grasses and weeds is a concern in establishing and managing the trees on this soil.

This soil is generally well suited to use as septic tank absorption fields and area type sanitary landfills. Sewage lagoons may need to be sealed or lined to prevent seepage. The shape of the lagoon can be adjusted to accommodate the slope. Terraces and diversions on the adjacent higher soils can be constructed to keep runoff away from engineering structures. Foundations for buildings can be strengthened or designed so that they can withstand the shrinking and swelling of the soil. Roads can be waterproofed with a gravel subgrade barrier to prevent frost action. The pavement of roads and streets needs to be thick enough to compensate for the low soil strength.

Capability units IIe-1 dryland and IIIe-4 irrigated; Silty range site; windbreak suitability group 4.

Ke—Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil on flood plains. In a few places, it is in the lower parts of upland drainageways. It is occasionally flooded, generally early in spring. The areas are 10 to 200 acres in size.

Typically, the surface layer is friable silt loam about 29 inches thick. The upper part is very dark brown, and the middle and lower parts are black. A transition layer of friable, very dark grayish brown silt loam about 8 inches thick is below the surface layer. The underlying material is dark brown silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the more strongly developed Judson silt loam on foot slopes. This included soil makes up about 5 to 10 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The water table is at a depth of about 4 feet in most wet years and at a depth of 6 feet in most dry years. The content of organic matter and natural fertility are high. Runoff is slow. The intake rate of water for irrigation is moderate.

Most of the acreage is used for cultivated crops. This soil has good potential for dryland and irrigated cultivated crops, for grasses, and for trees and shrubs in windbreaks. It has poor potential for recreation uses unless protected from flooding, but good potential for habitat for openland wildlife. This soil has poor potential for sanitary facilities and building site development.

This soil is suited to dryland corn, soybeans, grain sorghum, small grains, and alfalfa. Row crops can be grown yearly if proper amounts and kinds of fertilizer are applied and weeds and insects are controlled. Diversions and terraces on the higher soils can be used to prevent flooding of this soil by runoff. Conservation of water is a main concern of management. The soil tends to dry more slowly in spring than better drained soils. Conservation tillage and proper management of crop residue help to conserve moisture for use by crops and build up the content of organic matter.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. The floodwater remains on the soil for only a short time, and damage to crops is seldom severe. Land leveling for gravity irrigation systems helps reduce wetness. Sprinkler and gravity systems are both suited to this soil. Planting of early crops generally is delayed by wetness in spring. In places, surface drains help move floodwater off the soil.

This soil is suited to pasture and range grasses. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is well suited to trees and shrubs in farmstead windbreaks. Competition for moisture from grasses and weeds is a common concern of management. It can be controlled by cultivating between the rows and by careful use of herbicides in the rows.

Septic tank absorption fields and sewage lagoons can be protected from flooding by dikes or construction on compacted fill material. Roads should be built on fill material, and side ditches should be constructed. Good surface drainage and moisture barriers of gravel in the subgrade help to prevent damage by frost action.

Capability units IIw-3 dryland and IIw-6 irrigated; Silty Overflow range site; windbreak suitability group 1.

Kf—Kennebec and Colo soils, channeled, 0 to 2 percent slopes. This map unit is an undifferentiated group that consists of Kennebec silt loam and Colo silty clay loam.These soils are on the bottom lands of creeks and their tributaries. The areas include the deeply cut channels of the streams and the adjacent streambanks and breaks. The areas are frequently flooded. They are long and narrow and range from 20 to 80 acres in size.

Both soils occur in most areas. The proportion of each varies from one area to another, however, the Kennebec soil is generally dominant. The Kennebec soil is on the higher areas adjacent to stream channels or old oxbows, and the Colo soil is in slightly lower places, generally old abandoned channels. Only one or the other soil occurs in a few areas.

Typically, the Kennebec soil has a surface layer of friable, black silt loam about 29 inches thick. Beneath this is a transition layer of very dark grayish brown silt loam about 8 inches thick. The underlying material is dark brown silt loam to a depth of 60 inches.

Typically, the Colo soil has a surface layer of firm, black silty clay loam about 40 inches thick. Beneath this is a transition layer of very dark gray silty clay loam about 12 inches thick. The underlying material is very dark gray silty clay loam to a depth of 60 inches. In a few places the profile is calcareous.

Included with these soils in mapping are small areas of Judson soils on foot slopes. These included soils make up about 2 to 8 percent of this map unit.

Permeability is moderate in Kennebec soils and moderately slow in Colo soils. The available water capacity is high for both soils. The seasonal high water table for Kennebec soils is at a depth of about 4 feet in wet years and 6 feet in dry years. In Colo soils it is at a depth of about 2 feet in wet years and 3 feet in dry years. Both soils release moisture readily to plants. They are high in organic matter content and natural fertility. Runoff is slow.

Most of the acreage of this map unit is in bromegrass, native grass, or in scattered trees that occur along the banks of the streams. The soils have very poor potential for cultivated crops or for trees and shrubs in windbreaks. They have fair potential for pasture and good potential for range. They have poor potential for recreation uses and as habitat for openland wildlife. The soils have poor potential for sanitary facilities and building site development.

This map unit is not suited to growing cultivated crops. The areas are flooded too frequently, and many areas are not readily accessible with modern machinery. Streambank erosion can occur during high stream flow.

These soils are best suited to grazing and as habitat for wildlife. Grazing usually occurs late in the season after the adjacent area of cultivated crops has been harvested and when the residue is being grazed. Maintaining a stand of the most desirable grasses is difficult, but once established, the grasses maintain themselves if protected from overgrazing. Deferred grazing and proper use are needed to help the grass remain healthy.

These soils are generally not suited to plantings of trees or shrubs because of the frequent flooding and the inaccessibility. If trees and shrubs can be hand planted where flooding is least severe, habitat for wildlife can be established.

Sanitary facilities and buildings are generally not constructed on soils of this map unit because of frequent flooding. An alternate site should be selected. Roads should be constructed on well compacted fill material. Side ditches, culverts, and bridges are generally able to handle the floodwater. Roads should be crowned by grading to provide good surface drainage for protection against frost action.

Capability unit Vlw-7; Kennebec soils in Silty Overflow range site and Colo soils in Clayey Overflow range site; windbreak suitability group 10.

LeC—Leisy fine sandy loam, 2 to 6 percent slopes. This is a deep, well drained, moderately sloping soil on uplands between the Elkhorn River and Cuming Creek. The areas are 5 to 45 acres in size.

Typically, the surface layer is friable and very dark grayish brown. It is about 20 inches thick. The upper part is fine sandy loam, and the lower part is loam. The subsoil is friable, dark brown loam about 40 inches thick. The upper part is loam, and the lower part is silty clay loam.

Included with this soil in mapping are small areas of the finer textured Moody silty clay loam and the coarser textured Thurman loamy fine sand. Both soils are on similar landscapes as the Leisy soil. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderate in the upper part and moderately slow in the lower part. The available water capacity is high. Erosion by wind and water is the main hazard where this soil is cultivated. The content of organic matter is moderate, and natural fertility is medium. Runoff is slow. The shrink-swell potential of the material in the lower part of the subsoil is moderate. Rate of water intake is moderate.

Most of the acreage is used for cultivated crops. This soil has fair potential for dryland and irrigated cultivated crops and for pasture and range. It has good potential for trees and shrubs in windbreaks and good potential for recreation uses and for habitat for openland wildlife. This soil has good or fair potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Soil blowing and water erosion are the main hazards. Row crops can be grown in consecutive years if a high level of management is used. Terracing, contour farming, stripcropping, and grassed waterways help to control erosion. Conservation tillage helps to conserve moisture for use by crops and builds up the supply of organic matter. Field windbreaks planted along field borders reduce soil blowing.

Under irrigation, this soil is suited to corn, grain sorghum, and such close-sown crops as alfalfa, tame grass, and small grain. Soil blowing and water erosion are the main hazards. Gravity irrigation systems that use contour furrows or borders on the lower slopes can be used. Water erosion can be controlled by using terraces, grassed waterways, and contour furrows. The more sloping areas of this soil are better suited to sprinkler systems. Returning crop residue to the soil and keeping tillage to a minimum help to control erosion.

This soil is suited to pasture and range. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Controlled grazing, rotation grazing, and fer-

tilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from grass and weeds and soil blowing are common concerns of management. Planting a cover crop between the rows can help control weeds and soil blowing.

Septic tank absorption fields should be large enough to accommodate the moderately slow permeability of the soil. Sewage lagoons should be shaped to accommodate the slope. Foundations for buildings should be strengthened and backfilled with coarse material to protect from the shrinking and swelling of the subsoil. The soil material can be stabilized with hydrated lime to prevent shrink-swell near foundations and in roads. Roads should be designed to account for the low strength of the subgrade.

Capability units IIIe-3 dryland and IIIe-5 irrigated; Sandy range site; windbreak suitability group 3.

Lu—Luton silty clay, 0 to 2 percent slopes. This is a deep, nearly level, poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. In places, it is in old abandoned river channels on the lowest part of the landscape. It is occasionally flooded. The areas are 10 to 600 acres in size.

Typically, the surface layer is very sticky, black silty clay about 22 inches thick. The subsoil is silty clay about 22 inches thick. The upper part is black, the middle part is very dark gray, and the lower part is dark gray. The underlying material is dark gray silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of the less clayey Gibbon silty clay loam at a slightly higher elevation, the saline-alkali Saltine soils at a similar elevation, and the less clayey, noncalcareous Zook silty clay that is on similar or slightly higher areas on the landscape. These included areas make up 5 to 12 percent of this map unit.

Permeability is very slow, and the available water capacity is moderate. Moisture is released slowly to plants. This soil has a perched seasonal high water table that ranges from a depth of about 1 foot in most wet years to a depth of 3 feet in most dry years. The content of organic matter is moderate, and natural fertility is medium. Runoff is very slow. This soil has high shrink-swell potential and low strength. The intake rate of water is very low.

Most of the acreage is used for dryland and irrigated crops. This soil has fair potential for dryland and irrigated cultivated crops, pasture grasses, and trees in windbreaks and good potential for range. It has poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizer are applied and if weeds and insects are controlled. Wetness and the extremely firm consistence of the soil influence use and management. Surface water standing in low areas for several days after rain delays tillage operations. On drying, the soil cracks, and the cracking can damage plant roots. Land leveling and surface ditches are needed for good drainage. In most areas, this soil is plowed late in fall, and soil blowing can be a hazard in winter when the soil is without adequate snow cover or other kinds of protection. Soil workability generally is poor because the soil is very sticky when wet and very hard when dry. Filling should be done when the surface layer has the proper moisture content.

Under irrigation, this soil is suited to such row crops as corn, soybeans, and grain sorghum and to such close-sown crops as alfalfa, tame grass, and small grain. Wetness, caused by the perched water table, is the main limitation. The soil is difficult to till because it is extremely firm when moist and very hard and cloddy when dry; it should be tilled at the proper moisture content. This soil generally needs land leveling if it is to be irrigated by a gravity system. A system to recycle irrigation water can be installed at the lower end of a field. Irrigation by sprinklers can be used, but because of the low intake rate of the soil, water should be applied at a slow rate. Growing legumes, such as alfalfa, tends to increase the permeability of this soil. Sprinklers that operate in sets at one location should be adjusted to provide the proper application rate.

This soil is suited to grasses for pasture and range. Pastures commonly consist of bromegrass or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilizing with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be used that adapt to soils that have a moderately high water table. Competition for moisture from grasses and weeds is a concern of management. During dry weather, the soil may crack, exposing the roots to drying. The soil may need shallow cultivation to close the cracks.

Because of occasional flooding, poor surface drainage, and a moderately high water table, this soil generally is not suited to septic tank absorption fields and building sites. An alternate site is needed. Dikes protect sewage lagoons from flooding. Roads can have good surface drainage if crowned by grading. Roads and streets should be built on adequate fill material and need adequate side ditches to carry off floodwater to an outlet. Stabilizing the soil with hydrated lime helps to prevent excessive shrink-swell. Surface pavement of roads and streets needs to be thick enough because the soil strength is low. The soil is suitable for pond reservoir areas.

Capability units IIIw-1 dryland and IIIw-1 irrigated; Clayey Overflow range site; windbreak suitability group 2.

Mn—Monona silt loam, terrace, 0 to 2 percent slopes. This is a deep, well drained soil on nearly level stream terraces of Maple Creek valley. The areas are 10 to 50 acres in size.

Typically, the surface layer is friable, very dark grayish brown silt loam about 10 inches thick. The subsoil is brown silt loam about 23 inches thick. The underlying material is brown silt loam to a depth of 60 inches. Sand and gravel are at a depth of 60 inches and below.

Included with this soil in mapping are small areas of the gently sloping Judson silt loam on foot slopes above the Monona soil, and the finer textured Moody silty clay loam that is also above the Monona soil. These included soils make up about 5 to 8 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderate, and natural fertility is high. Runoff is medium. The shrink-swell potential is moderate. The intake rate of water is moderate.

Most of the acreage is used for cultivated crops. This soil has good potential for dryland and irrigated cultivated crops and pasture grasses. It has good potential for trees and shrubs in windbreaks, fair potential for range, and good potential for recreation uses and for habitat for openland wildlife. It has good potential for most sanitary facilities and fair potential for most building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important concern of management. Conservation tillage helps to conserve moisture for use by crops and builds up the supply of organic matter. Grassed turn-rows can be used to help control weeds along field borders.

Under irrigation, this soil is suited to such row crops as corn, soybeans, and grain sorghum and to such close-sown crops as alfalfa, tame grass pasture, and small grain. Furrow and sprinkler irrigation systems generally work better on this soil than other systems. The center-pivot sprinkler system is particularly well suited. Land leveling and reuse pits can provide more efficient use of irrigation water where a gravity system of irrigation is used.

This soil is suited to grasses for pasture and range. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks (fig. 7). Competition for moisture from grasses and weeds is a common concern of management. Supplemental watering of the trees when they are small may be needed in seasons of below normal rainfall. Cultivation between the rows and use of herbicides in the rows can control undesirable weeds and grasses.

This soil is generally suited to use as septic tank absorption fields. Because sand and gravel are common below a depth of 5 feet, seepage can contaminate the underground water supply. Sewage lagoons should be lined or sealed to prevent seepage. Foundations of buildings need to be strengthened and then backfilled with coarse material as protection against the shrink-swell of the soil. Frost damage to roads can be prevented by waterproofing the surface with a gravel subgrade barrier.

Capability units I-1 dryland and I-6 irrigated; Silty range site; windbreak suitability group 1.

MnC—Monona silt loam, terrace, 2 to 6 percent slopes. This is a deep, well drained, gently sloping soil on stream terraces adjacent to Maple Creek valley. The areas are 5 to 15 acres in size.

Typically, the surface layer is friable, very dark grayish brown silt loam about 11 inches thick. The subsoil is friable silt loam 29 inches thick. The upper part is dark brown, and the lower part is brown. The underlying material is brown silt loam to a depth of 58 inches. Below this depth are mixed sand and gravel to a depth of 60 inches. A few small areas are nearly level.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderate, and natural fertility is high. Runoff is medium. The shrink-swell potential is moderate. The intake rate of water is moderate.

Most of the acreage is cultivated. This soil has good potential for dryland cultivated crops, fair potential for irrigated crops, pasture grasses, and range, and good potential for recreation uses and for habitat for openland wildlife. It has good potential for most sanitary facilities and fair potential for most building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Erosion by water is the main hazard. Conservation of water is an important concern of management. Terraces and grassed waterways can be used to conserve moisture and to help prevent further erosion. Conservation tillage and contouring help to conserve moisture for use by crops, help to prevent water erosion, and build up the supply of organic matter.

Under irrigation, this soil is suited to such row crops as corn, soybeans, and grain sorghum and to such close-sown crops as alfalfa, tame grass, and small grain. Erosion by water is a moderate hazard. A sprinkler irrigation system is generally better than other systems, and the center-pivot sprinkler system is particularly well suited. Maintaining a large amount of crop residue on the surface and contour farming can help to prevent erosion. Use of contour furrows, with or without supplemental terraces and grassed waterways, and bench leveling help to control erosion.

This soil is suited to grasses for pasture and range. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from grasses and weeds is a common concern of management. Lack of sufficient moisture caused by runoff reduces growth of the trees. Planting the trees on the contour in combination with terraces helps conserve water and prevent erosion. Cultivation between the rows and hand hoeing, roto-tilling, or use of herbicides can control weeds and undesirable grasses.

This soil is generally suited to use as septic tank absorption fields and building sites. Sewage lagoons should be lined or sealed to prevent seepage. The areas should be graded to modify the slope for buildings and lagoons. Foundations for buildings can be strengthened and backfilled with coarse material to prevent damage by the shrink-swell of the soil. Damage to roads by frost action can be prevented by providing good surface drainage by crowning with a grader and by including a gravel moisture barrier in the subgrade. The road can be designed to strengthen the subgrade.

Capability units IIe-1 dryland and IIIe-6 irrigated; Silty range site; windbreak suitability group 4.

Mo—Moody silty clay loam, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil on broad divides of uplands. The areas are 40 acres to several thousand acres in size.

Typically, the surface layer is friable silty clay loam about 13 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. The friable subsoil is silty clay loam about 33 inches thick. The upper part is very dark grayish brown, the middle part is dark grayish brown and dark brown, and the lower part is yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the more clayey Belfore soils on similar landscapes and the poorly drained, clayey Fillmore soils in shallow depressions. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderate, and natural fertility is high. Runoff is slow. The shrink-swell potential is moderate. The intake rate of water is low.

Most of the acreage is cultivated. This soil has good potential for cultivated crops, both dryland and irrigated, pasture, and for trees and shrubs in windbreaks. It has fair potential for range and good potential for recreation uses and for habitat for openland wildlife. It has fair potential for most sanitary facilities and fair or poor potential for most building site developments.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important concern of management. Mulch planting and the conservation of crop residue help to conserve moisture for use by crops, build up the supply of organic matter, and improve fertility. Lime is needed to correct soil acidity if alfalfa is to be grown.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as alfalfa, tame grass pasture, and small grain. This soil tends to clod if tilled when the moisture content is too high. Furrow and sprinkler irrigation are well suited, and borders can be used for alfalfa and close-sown crops. Land leveling and water reuse pits can increase the efficiency of water use under furrow irrigation. The center-pivot sprinkler system is particularly well suited. The application rate of water needs to be adjusted so that it does not exceed the intake rate of this moderately fine textured soil.

This soil is suited to pasture, generally bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Weeds can be controlled by cultivating between the rows, by hand hoeing within the row of trees, or by the careful use of appropriate herbicides in the row. Newly planted trees may need watering during times of insufficient rainfall.

The moderately slow permeability of this soil presents a problem for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption areas. Sewage lagoons should be lined or sealed to eliminate seepage. Foundations should be strengthened and backfilled with coarse material to overcome the shrink-swell of the soil. Roads should be designed with a gravel moisture barrier in the subgrade to help prevent frost action. They also need to be properly graded by crowning to provide good surface drainage. On hard surfaced roads, increasing the thickness of the surface pavement compensates for the low strength of the subsoil.

Capability units I-1 dryland and I-3 irrigated; Silty range site; windbreak suitability group 4.

MoC—Moody silty clay loam, 2 to 6 percent slopes. This is a deep, well drained, gently sloping soil on ridgetops. The areas are 5 to 40 acres in size.

Typically, the surface layer is friable, very dark brown silty clay loam about 9 inches thick. The subsoil is friable silty clay loam about 31 inches thick. The upper part is

very dark grayish brown, the middle part is dark grayish brown, and the lower part is dark brown. The underlying material is brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of eroded Moody silty clay loam and eroded Nora silty clay loam, both on similar landscapes. These included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is readily released to plants. Erosion by water is the main hazard. The content of organic matter is moderate, and natural fertility is high. Runoff is medium. The shrink-swell potential is moderate. The intake rate of water is low.

Most of the acreage is cultivated. This soil has good potential for dryland cultivated crops and fair potential for irrigated crops. It has fair potential for range, good potential for trees in windbreaks, and good potential for recreation uses and for habitat for openland wildlife. It has fair potential for most sanitary facilities and fair or poor potential for most building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Water erosion is the main hazard. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important management concern. Terraces can be used to prevent erosion and loss of surface water. Conservation tillage helps to conserve moisture for use by crops, builds up the supply of organic matter, and helps to stop soil erosion.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as alfalfa, tame grass pasture, and small grain. Erosion by water is the main hazard. Mulch planting, keeping tillage to a minimum, and conservation of crop residue help to slow erosion and to improve fertility. Terraces or bench leveling can conserve surface water and control erosion. Contour furrows can be used with row crops. Sprinkler irrigation can be used where erosion is controlled. The center-pivot sprinkler system is well suited to this soil if the application rate of water is controlled so that it does not exceed the intake rate of this soil.

This soil is suited to pasture, generally bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen will help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and undesirable grasses is a concern in management. Weeds can be controlled by cultivation between the rows, by hand hoeing within the row of trees, or by careful use of herbicides. Newly planted trees may need watering when moisture is insufficient. Planting on the contour in combination with terraces helps conserve water and control erosion.

The moderately slow permeability of this soil is a problem for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption area. Sewage lagoons should be lined or sealed to prevent seepage. The areas need to be shaped to modify the slope before constructing the lagoon. Foundations for buildings should be strengthened and then backfilled with coarse material to prevent damage by the shrinking and swelling of the soil. Gravel moisture barriers and adequate grading to provide good surface drainage help to prevent damage by frost action. Concrete or asphalt on roads and streets should be thick enough to compensate for the low strength of the soil material.

Capability units IIe-1 dryland and IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

MoC2—Moody silty clay loam, 2 to 6 percent slopes, eroded. This is a deep, well drained, gently sloping soil mainly on ridgetops. The areas are 5 to 20 acres in size.

Typically, the surface layer is friable, very dark brown silty clay loam about 6 inches thick. Tillage has mixed part of the upper subsoil with the remaining surface layer. The subsoil is friable silty clay loam about 25 inches thick. The upper part is dark brown, the middle part is grayish brown, and the lower part is brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the uneroded Moody silty clay loam and the eroded Nora silty clay loam. Both soils are in similar areas. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderately low, and natural fertility is medium. Runoff is medium to rapid, depending upon the vegetative cover. The shrink-swell potential is moderate. The intake rate of water is low.

Most of the acreage is cultivated. This soil has fair potential for cultivated crops, both dryland and irrigated, and for pasture and range. It has good potential for trees and shrubs in windbreaks, for recreation uses, and for habitat for openland wildlife. It has fair potential for most sanitary facilities and fair or poor potential for most building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Loss of soil and water through erosion is serious on this soil. Erosion is the main hazard. Contour farming, terraces, and grassed waterways (fig. 8) can be used to conserve surface water and to control erosion. Conservation of water is an important concern of management. Conservation tillage helps to conserve moisture for use by crops, builds up the supply of organic matter, and helps to slow erosion. Applications of fertilizer, especially phosphorus and nitrogen, are needed for good growth of crops.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as alfalfa, tame grass pasture, and small grain. Erosion by water is the main hazard. Mulch planting, keeping tillage to a minimum, and conservation of crop residue help to slow erosion and improve fertility. Terraces or bench leveling should be used to conserve surface water and to control erosion. Barnyard manure is especially helpful in improving tilth and fertility on the light colored areas. Sprinkler irrigation is a suitable system if the rate of the water applied does not exceed the water intake rate of this soil.

This soil is suited to pasture and range. Pastures generally consist of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing and grazing when the soil is too wet cause surface compaction and result in poor tilth. Controlled grazing, rotation grazing, and fertilizing with nitrogen help to keep the grasses in good condition.

This soil is suited to growing trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is a problem. Runoff and erosion can be reduced by planting trees on the contour and by using terraces. Newly planted trees may need watering when rainfall is insufficient. Undesirable weeds and grasses can be controlled by cultivation between the rows and by hand hoeing, roto-tilling, or use of herbicides in the rows.

The absorption area for septic tank filter fields should be of sufficient size to account for the moderately slow permeability of the soil. The bottom of sewage lagoons should be lined or sealed to prevent seepage. Foundations should be strengthened and backfilled with sand and gravel to prevent damage by the shrinking and swelling of the soil. Roads need good surface drainage, and a gravel moisture barrier should be used to protect against frost action. Concrete or asphalt on roads and streets should be thick enough to compensate for the low strength of the soil material.

Capability units IIIe-8 dryland and IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

MoD—Moody silty clay loam, 6 to 11 percent slopes. This is a deep, well drained, strongly sloping soil on side slopes of uplands. The areas are 5 to 30 acres in size.

Typically, the surface layer is friable, very dark brown silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part is very dark brown, and the lower part is dark grayish brown. The underlying material is grayish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the eroded Moody silty clay loam and the uneroded Nora silty clay loam. Both soils have lime nearer the surface than this Moody soil. Both soils are on similar landscapes. These included soils make up 5 to 10 percent of this unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is readily released to plants. Soil erosion is the main hazard. The content of organic matter is moderate, and natural fertility is high. Runoff is medium or rapid, depending upon the type of plant cover. The shrink-swell potential is moderate. The intake rate of water is low.

Most of the acreage is cultivated. This soil has fair potential for dryland cultivated crops, pasture, and range, good potential for trees and shrubs in windbreaks, poor potential for irrigated crops, and fair potential for recreation uses and for habitat for openland wildlife. It has fair potential for most sanitary facilities and fair or poor potential for building site development.

Under dryland management, this soil is suited to corn, grain sorghum, wheat, and alfalfa. It is best suited to close-sown crops. Conservation of water is an important concern of management. Mulch planting and the conservation of crop residue help to conserve moisture for use by crops, build up the supply of organic matter, and improve fertility. Soil erosion is another management concern. Terraces can be used to help prevent water erosion and conserve surface water. Farming on the contour and grassed waterways can help control soil erosion.

Under irrigation, this soil is suited to row crops such as corn and grain sorghum and close-sown crops such as alfalfa, tame grass pasture, and small grain. This soil tends to become cloddy if tilled when wet. Erosion by water is the main hazard. Mulch planting and the conservation of crop residue help to slow runoff, which in turn helps prevent soil erosion. Terraces and grassed waterways can be used to conserve surface water and to control erosion. The center-pivot sprinkler system generally is better than other irrigation systems for most crops. Borders can be used for pasture grasses.

This soil is suited to pasture, generally bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen will help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Weeds can be controlled by hand hoeing within the row of trees or by applying appropriate herbicides. Erosion is a hazard on this strongly sloping soil. It can be controlled by planting a cover crop between the rows of trees or by planting trees on the contour in combination with terraces. Newly planted trees may need watering during times of insufficient moisture.

Septic tank absorption fields should be increased in size to account for the moderately slow permeability. The area should be graded to modify the slope. Sewage lagoons should be lined or sealed to eliminate seepage, and the areas can be graded to modify the slope. Buildings should be designed to accommodate the slope, or the areas can be graded. Foundations should be

strengthened and backfilled with sand and gravel to overcome the hazard of shrinking and swelling. Concrete or asphalt on roads and streets should be thick enough to compensate for the low strength of the soil material. Roads should have gravel subgrade barriers for protection against frost action.

Capability units IIIe-1 dryland and IVe-3 irrigated; Silty range site; windbreak suitability group 4.

MoD2—Moody silty clay loam, 6 to 11 percent slopes, eroded. This is a deep, well drained, strongly sloping soil on side slopes of uplands. The areas are 20 to 200 acres in size.

Typically, the surface layer is friable, very dark brown silty clay loam about 5 inches thick. A part of the upper subsoil generally has been mixed with the remaining surface layer during tillage. The subsoil is friable silty clay loam about 27 inches thick. The upper part is dark yellowish brown, and the lower part is dark brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the uneroded Moody silty clay loam and the uneroded Nora silty clay loam on similar landscapes. Also included are small areas of the coarser textured Leisy and Thurman soils that occur on landscapes that are more undulating. These included soils make up 5 to 10 percent of this unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is readily released to plants. Soil erosion by water is the main hazard. The content of organic matter is moderately low, and natural fertility is medium. Runoff is medium or rapid, depending upon the type and amount of plant cover. The shrink-swell potential is moderate. The intake rate of water is low.

Most of the acreage is cultivated. This soil has fair potential for dryland cultivated crops, pasture, and range, good potential for trees in windbreaks, poor potential for irrigated crops, fair potential for recreation uses, and good potential for habitat for openland wildlife. It has fair potential for sanitary facilities and fair or good potential for building site development.

Under dryland management, this soil is suited to corn, grain sorghum, wheat, grasses, and alfalfa. It is best suited to close-growing crops. Conservation of water is an important management concern. Terraces help to conserve surface water and prevent erosion. Conservation tillage helps to conserve moisture for use by crops and builds up the supply of organic matter. Erosion by water is the main hazard. Contour farming and grassed waterways help prevent additional soil erosion. Improving fertility is important on this eroded soil. Applying commercial fertilizer and barnyard manure and conserving all crop residue can improve fertility.

Under irrigation, this soil is suited to row crops such as corn and grain sorghum, but it is better suited to close-sown crops such as alfalfa, tame grass pasture, and small grain. Soil erosion is the main hazard. Mulch planting and the conservation of crop residue help to slow erosion and improve fertility. Terraces and grassed waterways can conserve surface water and control erosion. Sprinkler irrigation generally is better suited than other systems, but borders should be used to irrigate pasture grasses. The intake rate of water needs to be carefully adjusted to prevent runoff. Phosphorus and nitrogen are particularly needed on areas where the soil is lightest in color.

This soil is suited to pasture, generally bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Weeds and undesirable grasses can be controlled by hand hoeing within the row of trees or by applying appropriate herbicides. Erosion and loss of moisture by runoff can be controlled by planting a cover crop between the rows of trees or by planting trees on the contour in combination with terraces. Newly planted trees may need watering when moisture is insufficient.

Septic tank absorption fields need to be designed so that they are large enough to compensate for the moderately slow permeability. Slope limits use of this soil for many engineering structures, but an area could be modified by grading. Sewage lagoons should be sealed to prevent seepage, and grading is commonly needed to modify the slope and to shape the lagoon. Foundations can be reinforced to prevent damage by the shrinking and swelling of the soil. The surface of pavements should be thick enough to compensate for the low strength of the soil. Good surface drainage is needed to protect against frost action, and a gravel moisture barrier can be installed.

Capability units IIIe-8 dryland, and IVe-3 irrigated; Silty range site; windbreak suitability group 4.

Mt—Moody silty clay loam, terrace, 0 to 2 percent slopes. This is a deep, well drained, nearly level soil on stream terraces that are a part of the Platte River, Elkhorn River, and Logan Creek valleys. The areas are 10 to 200 acres in size.

Typically, the surface layer is friable silty clay loam about 14 inches thick. The upper part is very dark brown, and the lower part is dark brown. The subsoil is friable silty clay loam about 26 inches thick. The upper part is dark brown, and the lower part is yellowish brown. The underlying material is brown silty clay loam to a depth of 60 inches. In this map unit there are small areas where the surface layer is darker and thicker than that of the typical profile and small areas where coarse sand and gravel are at a depth of 40 to 60 inches.

Included in mapping are small areas of the poorly drained, clayey Fillmore soils in shallow depressions. These included soils make up 0 to 5 percent of this map unit.

Permeability is moderately slow, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderate, and natural fertility is high. Runoff is slow. The shrink-swell potential is moderate. The intake rate of water is low.

Most of the acreage is cultivated. This soil has good potential for cultivated crops, both dryland and irrigated, for pasture, and for trees and shrubs in windbreaks. It has fair potential for range and good potential for recreation uses and for habitat for openland wildlife. It has fair potential for most sanitary facilities and fair or poor potential for most building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important concern of management. Conservation tillage helps to conserve moisture for use by crops and builds up the supply of organic matter. Lime generally is needed for alfalfa.

Under irrigation, this soil is suited to such row crops as corn, soybeans, and grain sorghum and to such close-sown crops as alfalfa, tame grass, and small grain. This soil can become cloddy if tilled when wet. Runoff from adjacent higher soils can be controlled by diversions and terraces on those soils. Land leveling generally is needed for the most efficient use of water if a gravity system of irrigation is used. The center-pivot sprinkler is a suitable system. The rate of water application should not exceed the intake rate of the soil.

This soil is suited to pasture. Pastures generally are bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The main problem is competition for moisture from weeds and grasses. Weeds can be controlled by cultivation between the rows, by hand hoeing within the row of trees, or by applying herbicides. Newly planted trees should be watered when moisture is insufficient.

Septic tank absorption fields should be enlarged to compensate for the moderately slow permeability. Sewage lagoons should be sealed to prevent seepage. Foundations of buildings should be strengthened and then backfilled with sand or gravel to overcome the shrinking and swelling of the soil. To help prevent frost action, roads can be graded so that the surface is drained. Moisture barriers in the subgrade can also be used. The road pavement should be thick enough to compensate for the low strength of the soil.

Capability units I-1 dryland and I-3 irrigated; Silty range site; windbreak suitability group 1.

NoC2—Nora silty clay loam, 2 to 6 percent slopes, eroded. This is a deep, well drained, gently sloping soil on ridgetops. The areas are 5 to 20 acres in size.

Typically, the surface layer is friable, dark grayish brown silty clay loam about 5 inches thick. The subsoil is friable silty silty clay loam about 20 inches thick. The upper part is dark brown, and the lower part is yellowish brown. The underlying material is light yellowish brown silt loam to a depth of 60 inches. The surface layer is thicker in less eroded places.

Included with this soil in mapping are small areas of the eroded Moody silty clay loam on similar landscape. This included soil makes up 3 to 5 percent of the unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderately low, and natural fertility is medium. Runoff is moderate or rapid, depending on the kind and amount of vegetation. The shrink-swell potential is moderate. The intake rate of water is moderate.

Most of the acreage is cultivated. This soil has fair potential for cultivated crops, both dryland and irrigated, and for pasture and range. It has good potential for trees and shrubs in windbreaks and good potential for recreation uses and for habitat for openland wildlife. It has good potential for most sanitary facilities and fair or poor potential for most building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, wheat, and legumes, mainly alfalfa. Erosion by water is the main hazard. Conservation of water is an important management concern. Terraces can be used to conserve moisture and to help prevent erosion. Mulch planting and the conservation of crop residue help to conserve moisture for use by crops, build up the supply of organic matter, control erosion, and improve fertility.

Under irrigation, this soil is suited to such row crops as corn and grain sorghum and to such close-sown crops as alfalfa, tame grasses, and small grain. Erosion by water is the main hazard. A sprinkler irrigation system generally is more suitable than other systems. The center-pivot sprinkler system is particularly well suited. Leaving a large amount of crop residue on the surface, contouring, and grassed waterways and terraces help to prevent erosion.

This soil is suited to pasture and range. Pastures generally consist of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition from weeds and grasses is a common prob-

lem. Weeds can be controlled by cultivating between rows, by hand hoeing the row of trees, or by applying appropriate herbicides. Runoff can be controlled by planting on the contour in combination with terraces. Newly planted trees may need watering when moisture is insufficient.

This soil is suited to use as septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and the land needs to be shaped. Foundations of buildings should be strengthened and then backfilled with sand and gravel to prevent damage by the shrinking and swelling of the soil. Grading improves drainage of the road surface, and a gravel moisture barrier minimizes damage from frost action. The road pavement should be thick enough to compensate for the low strength of the soil.

Capability units IIIe-8 dryland and IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

NoD—Nora silty clay loam, 6 to 11 percent slopes. This is a deep, well drained, strongly sloping soil. Generally, it is on the lower part of side slopes on loessial uplands. The areas are 5 to 25 acres in size.

Typically, the surface layer is friable, very dark brown silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 17 inches thick. The upper part of the subsoil is very dark grayish brown, and the lower part is dark brown. The underlying material is silty clay loam to a depth of 60 inches. It is dark yellowish brown in the upper part and yellowish brown and dark yellowish brown in the lower part. Small areas of this soil are appreciably eroded.

Included with this soil in mapping are small areas of the eroded Nora silty clay loam and the uneroded Moody silty clay loam, both on similar landscapes. The included soils make up 3 to 8 percent of the map unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderate, and natural fertility is high. Runoff is moderate or rapid, depending on the amount and kind of vegetation. The shrink-swell potential is moderate. The water intake rate is moderate.

Most of the acreage is cultivated. This soil has fair potential for dryland cultivated crops, poor potential for irrigated crops, fair potential for pasture and range, and good potential for trees in windbreaks. It has fair potential for recreation uses and good potential for habitat for openland wildlife. This soil has good or fair potential for sanitary facilities and fair or poor potential for most building site development.

This soil is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Because of the strong slope, the soil is better suited to close-growing crops. Conservation of water is an important management concern. Terraces can be used to help conserve surface water and control erosion. Mulch planting and conserving crop residue help to conserve moisture for use by crops and build up the supply of organic matter. Erosion by water is the main hazard. Contour farming, crop rotation, terraces, and grassed waterways help control soil erosion.

Under irrigation, this soil is better suited to close-sown crops, including alfalfa, tame grasses, and small grain, than to row crops. Erosion by water is the main hazard. A large amount of crop residue on the surface, contouring, grassed waterways, and terraces help to prevent erosion. A sprinkler irrigation system, especially a center-pivot system, generally is more suitable than other systems.

This soil is suited to pasture and range. Pastures generally consist of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes compaction of the soil and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is a problem. Runoff and erosion can be controlled by planting a cover crop between the rows of trees or planting trees on the contour in combination with terraces. Newly planted trees may need watering when rainfall is insufficient.

Areas used as septic tank absorption fields should be graded to modify the slope. Sewage lagoons should be lined or sealed to prevent seepage, and grading can modify the slope. Foundations for buildings should be strengthened to prevent damage by the shrinking and swelling of the soil. Buildings can be designed to complement the slope, or the soil can be graded to modify the slope. Roads need good surface drainage as protection against frost action, or a gravel moisture barrier can be used.

Capability units IIIe-1 dryland and IVe-3 irrigated; Silty range site; windbreak suitability group 4.

NoD2—Nora silty clay loam, 6 to 11 percent slopes, eroded. This is a deep, well drained, strongly sloping soil on convex side slopes of the loessial uplands. The areas are 20 to 600 acres in size.

Typically, the surface layer is friable, dark grayish brown silty clay loam about 8 inches thick. The subsoil is friable, dark brown silty clay loam about 22 inches thick. The underlying material is light yellowish brown silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the weakly developed, calcareous Crofton soils on similar landscapes and the more clayey, steeper Steinauer soils that formed in glacial till on glacial uplands. These included soils make up 5 to 10 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderately low, and natural fertility is medium. Runoff is moderate or rapid, depending on the amount and kind of vegetative cover. The

shrink-swell potential is moderate. The water intake rate is moderate.

Most of the acreage is cultivated. This soil has fair potential for dryland cultivated crops, poor potential for irrigated crops, fair potential for pasture and range, and good potential for trees and shrubs in windbreaks. It has fair potential for recreation uses and good potential for habitat for openland wildlife. This soil has fair potential for most sanitary facilities and fair or poor potential for building site development.

This soil is suited to corn, grain sorghum, wheat, and alfalfa. Close-sown crops are best suited, and row crops need a high level of management to prevent erosion. Erosion by water is the main hazard. Conservation of water is an important concern of management. Terraces can be used to help control erosion and conserve moisture. Mulch planting and using crop residue help to conserve moisture for use by crops and build up the supply of organic matter. Contour farming and grassed waterways can be used to help prevent further erosion.

Under irrigation, this soil is suited to row crops such as corn and grain sorghum but is better suited to close-sown crops such as alfalfa, tame grass pasture, and small grain. Erosion by water is the main hazard. Maintaining a high amount of crop residue on the surface, contouring, grassed waterways, and terraces can help to prevent further erosion. Sprinkler irrigation is generally better suited than other systems. The center-pivot sprinkler system is particularly well suited.

This soil is suited to pasture and range. Pastures generally consist of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is a problem. Weeds can be controlled by hand hoeing within the row of trees or by applying appropriate herbicides. Erosion and runoff can be controlled by planting a cover crop between the rows of trees or by terracing and planting the trees on the contour. Newly planted trees may need watering when moisture is insufficient.

This soil can be graded to modify the slope for septic tank absorption fields. Sewage lagoons can be sealed to prevent seepage, and grading can modify slope. Foundations for buildings can be strengthened and backfilled with coarse material to overcome the shrinking and swelling of the soil. Roads can be protected from frost action by crowning with a grader to give good surface drainage and by use of a gravel moisture barrier. When roads are constructed, grading may also be needed to modify the slope.

Capability units IIIe-8 dryland and IVe-3 irrigated; Silty range site; windbreak suitability group 4.

NoE2—Nora silty clay loam, 11 to 15 percent slopes, eroded. This is a deep, well drained, moderately steep soil on side slopes of loess uplands. The areas are 10 to 50 acres in size.

Typically, the surface layer is friable, dark grayish brown silty clay loam about 4 inches thick. The subsoil is friable silty clay loam about 12 inches thick. The upper part is dark brown, and the lower part is yellowish brown. The underlying material is silt loam to a depth of 60 inches. The upper part is yellowish brown, and the lower part is pale brown. In this map unit are a few small areas of soil that is not so steep. In places, the loess is reddish brown.

Included with this soil in mapping are small areas of the weakly developed, calcareous Crofton silt loam on similar landscapes. Also included are small areas where glacial till and sand outcrops are at the surface. These included areas make up 5 to 10 percent of this map unit.

Permeability is moderate, and the available water capacity is high. Moisture is readily released to plants. The content of organic matter is moderately low, and natural fertility is medium. Runoff is rapid. The shrink-swell potential is moderate.

Most of the acreage is cultivated. This soil has poor potential for cultivated crops, fair potential for pasture and range, good potential for trees and shrubs in windbreaks, and fair potential for recreation uses and for habitat for openland wildlife. It has fair potential for most sanitary facilities and fair or poor potential for most building site development.

This soil is suited to dryland corn, grain sorghum, wheat, and alfalfa. It is best suited to close-growing crops, but row crops can be grown if a high level of management adequately controls erosion. Erosion by water is a severe hazard. Conservation of water is an important concern of management. Terraces (fig. 9) are a good way to control the erosion and also conserve surface water. Mulch planting and the conservation of crop residue help to conserve moisture for use by crops and build up the supply of organic matter. Contour farming and grassed waterways help control erosion. This moderately steep soil is not suited to irrigation.

This soil is suited to pasture and range. Pastures generally consist of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the pasture grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is a common problem. It can be controlled by cultivating between the rows and roto-tilling in the rows. Erosion and runoff can be controlled by planting a cover crop between the rows of trees, or by terracing and planting the trees on the contour. Newly planted trees and shrubs may need watering when natural moisture is insufficient.

Slope needs to be modified for septic tank absorption fields. This soil may be too steep for sewage lagoons without a large amount of grading. Buildings can be designed to compensate for the slope, or the area can be graded to modify the slope. Foundations can be strengthened and enlarged to overcome low soil strength. Coarse textured soil material can be used to backfill against foundations to protect against the shrink-swell of the soil. Grading to modify the slope may also be needed for the construction of some buildings.

Capability unit IVe-8 dryland; Silty range site; windbreak suitability group 4.

Pb—Pits and dumps. This miscellaneous area consists mainly of mounds of gravel, sand, and overburden and the adjacent pits that have water in them. Also included are the roads and loading docks in the areas. The sand and gravel are stockpiled for use in construction. Areas range from 5 to 80 acres in size.

Typical material in this map unit is a mixture of fine, medium, and coarse sand and gravelly sand. There is no development of a soil profile.

Included in mapping were small areas of Platte-Inavale complex, channeled, and areas of Riverwash at a lower elevation. Inclusions make up 3 to 8 percent of the area.

Permeability of the material in this map unit is rapid or very rapid, and the available water capacity is very low. The content of organic matter is very low, and natural fertility is low. The level of the water in the pits generally is 6 to 10 feet lower than the land surface. The areas of sand generally are devoid of vegetation except where they are no longer used commercially. Runoff is very slow.

All the acreage of the map unit is used for commercial mining of sand and gravel. The areas have no potential for cultivated crops, pasture, range, or trees. The abandoned pits have good potential for recreation uses and for habitat for wetland wildlife. This map unit has poor potential for sanitary facilities and building site development.

Areas of this map unit are generally not suited to agricultural use. Where these areas are no longer mined, vegetation gradually becomes established.

Cottonwoods, willows, and pine trees are best as either individual or scattered plantings. Trees need special care after planting if they are to survive. A native grass cover or wooden barriers help to protect them from sand blowing. Newly planted trees may need supplemental watering to keep the small plants alive. Establishing grass, shrubs, and trees around summer cottages is generally difficult.

If septic tank absorption fields are installed, special care needs to be taken so that the water table does not become contaminated. The areas are not suited to sewage lagoons because of rapid seepage and unstable soil material. In some areas summer cottages and permanent homes have been built around the shoreline of the gravel pits. In digging foundations and other shallow excavations, shoring or other special care is needed to prevent the caving in of loose sand.

This map unit is suited to development for recreation uses (fig. 10). Roads to lakes and picnic areas can be built. The waste material commonly consists of nearly white fine sand that makes ideal beaches. Areas can be developed for swimming by grading part of the sand back into the pits to reduce the depth of the water, thus making the areas less hazardous. Many of the pits are 35 to 55 feet in depth. Activities in the private and public areas of this map unit are fishing, boating, water skiing, rock hunting, swimming, hiking, and picnicking.

Capability unit VIIIs-8; windbreak suitability group 10.

Pc—Platte loam, 0 to 2 percent slopes. This soil is shallow over coarse sand and gravelly sand. It is nearly level, somewhat poorly drained and on the bottom lands of the Platte and Elkhorn River valleys. This soil is occasionally flooded. The areas are 10 to 30 acres in size.

Typically, the surface layer is friable, black loam about 12 inches thick. Below this, there is a transitional layer of friable, very dark brown fine sandy loam about 4 inches thick. The underlying material, to a depth of 60 inches, is light brownish gray gravelly sand.

Included with this soil in mapping are small areas of Alda loam, which is moderately deep over gravelly sand; Boel loam, which is deep and has less gravel in the profile; and Inavale soils, which are deep, excessively drained, and have less gravel in the underlying material. Unlike this Platte soil, all these soils are slightly higher in elevation. The inclusions make up 5 to 10 percent of the map unit.

Permeability is moderately rapid in the upper part and very rapid in the underlying gravelly sand. The available water capacity is low. Moisture is released readily to plants. The seasonal high water table is at a depth of about 1.5 feet in most wet years and 3 feet in most dry years. Late in summer it recedes to a depth of about 5 feet. Root growth is limited by the coarse sand and gravelly sand in the underlying material. The content of organic matter and natural fertility are low. Runoff is slow. The intake rate of water is moderately low or moderate.

Most of the acreage of this map unit is in range. This soil has poor potential for dryland and irrigated cultivated crops. It is generally not suited to pasture grasses, but it has good potential for hay and range. It has fair potential for plantings of trees and shrubs in windbreaks, poor potential for recreation uses, and fair potential for openland wildlife habitat and good for wetland wildlife habitat. It has poor potential for sanitary facilities and building site development.

This soil is suited to dryland corn, small grains, grain sorghum, and alfalfa. Because of wetness from the water table, tillage is commonly delayed early in spring. Re-

moving excess water early in spring by surface drains is helpful if outlets are available. Late in summer, the water table recedes to a depth of about 5 feet, and the soil is droughty because no capillary action is possible in the coarse textured underlying material. A cropping system that provides maximum crop residue on the surface can protect the soil from blowing.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. Soil blowing can be reduced by leaving crop residue on the surface as a mulch. Drainage ditches or land leveling can help drain the surface. Effective lowering of the water table is difficult, but in places, tile drains are helpful. Sprinklers can be used for irrigating. Frequent applications of water are needed because the available water capacity is low. Light applications are needed to avoid excessive leaching of plant nutrients.

This soil is suited to range grasses. Overgrazing or improper haying reduces the protective cover and causes the potential plant community to deteriorate. Overgrazing when the soil is wet can cause surface compaction and small mounds, which make grazing or mowing for hay difficult. Proper grazing use, deferment of grazing, and restricted use during wet periods help to keep the grasses in good condition.

This soil is suited to plantings of trees and shrubs in windbreaks. Only species tolerant of the moderately high water table are suited. Competition for moisture from grass and weeds is a common concern of management. Cultivation between the rows and proper use of herbicides in the row can help to control weeds and undesirable grasses.

Because of occasional flooding, wetness, and seepage, this soil is poorly suited to use as septic tank absorption fields, sewage lagoons, and building sites. An alternate site should be selected where possible. Sewage lagoons need to be adequately lined or sealed. Seepage into the underground water table can contaminate the underground water supply. Roads can be constructed on compacted fill material for adequate surface drainage. Gravel moisture barriers can be used for protection against frost action. Constructing on adequate fill material or building dikes, dams, or terraces protects most engineering works from flooding.

Capability units IVw-4 dryland and IVw-13 irrigated; Subirrigated range site; windbreak suitability group 2.

PxB—Platte-Inavale complex, channeled, 0 to 3 percent slopes. This map unit consists of soils on bottom lands of the Platte and Elkhorn River valleys. The areas are mainly old abandoned channels that alternate with slightly higher, uneven ridges. Platte soils are frequently flooded, and Inavale soils are occasionally flooded. Areas of this unit range from 10 to 100 acres in size.

Platte soils make up 55 to 65 percent of each mapped area and are on the lowest part of the landscape. Inavale soils make up 40 to 50 percent of the unit and are on the highest areas.

Typically, the surface layer of the Platte soils is friable, black loam about 12 inches thick. A transition layer of friable, very dark brown fine sandy loam about 4 inches thick is below the surface layer. The underlying material, to a depth of 60 inches, is mottled, light brownish gray gravelly sand.

Typically, the surface layer of the Inavale soils is loose, grayish brown loamy fine sand about 7 inches thick. Below this is a transition layer of loose, brown loamy fine sand about 21 inches thick. The underlying material is pale brown fine sand and sand to a depth of 60 inches.

Included with these soils in mapping are small areas of the deep, somewhat poorly drained Boel soils on slightly higher parts of the landscape and the poorly drained Gibbon Variant soils at lower elevations. These soils make up about 3 to 8 percent of the map unit.

Permeability is moderately rapid in the upper part of the underlying material and very rapid in the lower part of the underlying material of the Platte soils. Permeability is rapid in the Inavale soils. The available water capacity is low for the Platte and Inavale soils. The content of organic matter and natural fertility are low for these soils. The seasonal high water table for the Platte soils is at a depth of about 0.5 feet in most wet years and 2.0 feet in most dry years. The seasonal high water table for the Inavale soil is at a depth of about 5 feet in most wet years and about 8 feet in most dry years. Both soils release moisture readily to plants. Runoff is slow.

Areas of this map unit are used mostly for grazing and hay. A few areas are in scattered native trees. These soils have very poor potential for cultivated crops and poor potential for plantings of trees or shrubs in windbreaks. They generally are not used for pasture grasses but have good potential for range. They have poor potential for recreation uses, fair potential for habitat for openland wildlife, and good potential for habitat for wetland wildlife. These soils have poor potential for sanitary facilities and building site development.

Soils in this map unit are not suited to cultivated crops, either dryland or irrigated. The combination of flooding and wetness of the Platte soils, caused by the water table, and the droughtiness of the sandy Inavale soils are the main limitations.

Soils in this map unit are suited to use as rangeland. Overgrazing or using improper haying methods reduces the protective cover, and the grasses deteriorate. Overgrazing when the soil is wet can cause surface compaction and small mounds, making grazing or harvesting for hay difficult. Controlled grazing, deferred grazing, and restricted use during wet periods help keep the grasses in good condition.

The Platte soil is not suited to plantings of trees and shrubs in windbreaks because it is frequently flooded. The Inavale soil is suited to species that can withstand

periods of drought. Cottonwood, willows, and cedars are native trees commonly grown. Onsite investigation is needed before trees and shrubs are planted.

Because of occasional flooding, wetness, and seepage, areas of this map unit are poorly suited to use as sanitary facilities and building site developments. Seepage into the underground water table is a severe hazard for all sanitary facilities. Because roads are subject to damage by flooding, they need to be constructed on adequate fill material and ditched for protection from flooding. There should be good surface and subsurface drainage.

Capability unit VIw-7 dryland; Platte soils in Subirrigated range site and Inavale soils in Sandy Lowland range site; Platte soils in windbreak suitability group 2 and Inavale soils in windbreak suitability group 3.

Ra—Riverwash. This miscellaneous area is nearly level or very gently sloping and consist of sand bars and islands adjacent to channels of the Platte and Elkhorn Rivers. These areas are poorly drained and are frequently flooded. They are commonly channeled and are nearly barren of vegetation. These areas are reworked and shifted by floodwaters each spring. Slopes range from 0 to 3 percent. The areas are 10 to 40 acres in size.

Typically, the material in areas of Riverwash is fine sand and coarse sand and generally is stratified with thin layers of silty, clayey, and loamy material. There is a small percent of gravel.

Included with this map unit in mapping are small areas of the darker and better drained Platte soil at a higher elevation. This included soil makes up 3 to 5 percent of this map unit.

Permeability is rapid, and the available water capacity is low. The seasonal high water table ranges from slightly above the surface in most wet years to about 2 feet below the surface in most dry years. In late summer, it recedes to a depth of about 5 feet. The content of organic matter is very low, and natural fertility is low. Runoff is slow.

Riverwash that has been in place for a short time has little or no vegetation. Areas that have been in place for several years generally have a sparse stand of tall grasses, shrubs, willows, and cottonwood trees. These areas have very poor potential for cultivated crops and grass and for trees or shrubs in windbreaks, poor potential for recreation uses and for habitat for openland and rangeland wildlife, fair potential for habitat for wetland wildlife, and poor potential for sanitary facilities and building site development.

This map unit is not suited to any cultivated crops or plantings of trees or shrubs in windbreaks or grass. Because of flooding and wetness from the high water table, this unit is not suitable for farming. Some areas are grazed by livestock, but because the grass cover is so sparse grazing is minimal. Soil blowing is common when the surface is dry.

Riverwash is suitable for wetland wildlife habitat. Where there is a small amount of vegetation, the areas can be used as cover, as a limited supply of food for large animals, and as nesting areas for some birds.

Because of the combined effects of frequent flooding, wetness from the high water table, and seepage, these areas are not suitable for sanitary facilities or building site development. An alternate site generally is necessary.

Capability unit VIIIw-7 dryland; not placed in a range site; windbreak suitability group 10.

Sa—Saltine-Gibbon complex, 0 to 2 percent slopes. This map unit consists of deep, somewhat poorly drained soils on bottom lands and stream terraces of the Platte River, Elkhorn River, Maple Creek, and Logan Creek. It is occasionally flooded. Areas range from 5 to 320 acres in size.

This map unit is made up of 50 to 65 percent Saltine soils and 35 to 45 percent Gibbon soils. Gibbon soils are in slightly higher areas than Saltine soils. In cultivated areas there is little difference in elevation. Saltine soils are in irregularly shaped alkali areas, and Gibbon soils are between the alkali areas.

Typically, the surface layer of the Saltine soils is friable, very dark grayish brown silty clay loam about 7 inches thick. The subsoil is firm, dark grayish brown silty clay loam about 18 inches thick. The underlying material, to a depth of 60 inches, is dark grayish brown silty clay loam in the upper part and dark gray sandy clay loam in the lower part.

Typically, the surface layer of the Gibbon soils is firm, black silty clay loam about 14 inches thick. A transition layer of firm, dark gray silty clay loam about 8 inches thick is below the surface layer. The underlying material, to a depth of 60 inches, is light brownish gray silty clay loam in the upper part and grayish brown fine sandy loam and fine sand in the lower part.

Included with these soils in mapping are small areas of the darker, more clayey, and less alkaline Luton and Zook soils at about the same elevation. These soils make up about 5 to 10 percent of this map unit.

Permeability is slow in the Saltine soils and moderately slow in the Gibbon soils. The available water capacity is moderate in the Saltine soils and high in the Gibbon soils. Saltine soils have a seasonal high water table at a depth of about 2 feet in most wet years and at a depth of 3 feet in most dry years. Gibbon soils have a seasonal high water table at a depth of about 2 feet in wet years and at 4 feet in dry years.

Saltine soils release moisture slowly to plants because of the effect of the sodium in the soil. Moisture is released more readily in the Gibbon soils. The content of organic matter is low in the Saltine soils and moderate in the Gibbon soils. Natural fertility is low in Saltine soils

and high in Gibbon soils. Runoff is slow. The Saltine soils are strongly alkaline and very strongly alkaline. Gibbon soils are mildly alkaline and moderately alkaline in the surface layer and in the upper part of the underlying material; they are strongly alkaline in the lower part of the underlying material. The shrink-swell potential is moderate or high in the Saltine soils and moderate in the upper part of the Gibbon soils.

Most of the acreage of this map unit is used for cultivated crops. These soils have poor potential for dryland or irrigated cultivated crops and for pasture. They have poor potential for trees and shrubs in windbreaks and good potential for range. Their potential is fair or poor for recreation uses, fair for habitat for wetland wildlife, and poor for habitat for openland wildlife. Their potential is poor for sanitary facilities and building site developments.

Under dryland management, the soils in this map unit are suited to small grains and grain sorghum. They are only fairly suited to corn and alfalfa. Because of the accumulation of excess salts, poor soil structure, and ponding of water in low areas, these soils are poorly suited to cultivated crops unless a high level of management is used. Adequate surface drainage is needed. Small depressions can be filled by land leveling. Barnyard manure in the alkali areas makes the soil more friable; thus the rate of water intake increases. Phosphate fertilizer generally helps to increase production.

If irrigated, these soils are suited to corn, alfalfa hay, and grain sorghum. Furrows, borders, and sprinklers can be used. Land leveling is needed for efficient irrigation and drainage. It should cover the areas of Saltine soils with more fertile soil material. Barnyard manure can be applied to the saline-alkali areas to improve intake of water and to make the soil more friable. Chemical amendments can be tried on an experimental basis to help neutralize the salinity and alkalinity. Large quantities of irrigation water can leach the alkali to lower levels.

These soils are suited to pasture grasses. They are best suited to species that tolerate a high salt content, for example, tall wheatgrass, western wheatgrass, and switchgrass. Grazing when the soils are too wet can cause surface compaction and poor tilth. Proper degree of use, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

If these soils are used for farmstead windbreaks, only those trees and shrubs that tolerate a moderately high water table, occasional flooding, and a saline-alkali condition should be used. These hazards can be partly overcome by selecting species given for the Gibbon soil in table 6. Establishing trees is difficult in wet weather. The abundant vegetation that grows on these soils is difficult to control. Clean cultivation between the rows and hand hoeing between the trees in the row help control undesirable weeds and grasses.

Special design or installation procedures are needed if these soils are used as septic tank absorption fields and building sites or for sewage lagoons and other sanitary facilities. Roads constructed on fill material need adequate side ditches and culverts. Gravel moisture barriers help to protect the roadbed from frost action. Road pavement should be thick enough to compensate for the low soil strength.

Capability units IVs-1 dryland and IVs-6 irrigated; Saltine soils in Saline Subirrigated range site, Gibbon soils in Subirrigated range site; Saltine soils in windbreak suitability group 10, Gibbon soils in windbreak suitability group 2.

StF2—Steinauer clay loam, 11 to 30 percent slopes, eroded. This is a deep, well drained, moderately steep and steep soil on side slopes of uplands, generally in a band along the middle part of the slope, and on narrow ridgetops and points of ridges. The areas are 10 to 30 acres in size.

Typically, the surface layer is friable, dark grayish brown clay loam about 6 inches thick. A transition layer of friable, yellowish brown clay loam about 12 inches thick is below the surface layer. The underlying material is clay loam. It is mixed yellowish brown and gray in the upper part and yellowish brown in the lower part. In a few places, the surface layer is 7 to 11 inches thick.

Included with this soil in mapping are small areas where unweathered glacial till crops out at the surface. In some places, reddish brown loess of the Loveland formation is on the surface. Also included is an area of Steinauer soils that have slopes of 30 to 60 percent. These soils are on side slopes along the Elkhorn River. The area is about 3 miles northeast of the town of Nickerson and is about 110 acres in size. These included areas make up about 3 to 8 percent of the map unit.

Permeability is moderately slow, and the available water capacity is moderate. Soil workability is poor because of scattered stones and pebbles. Moisture is released slowly to plants. The content of organic matter and natural fertility are low. Runoff is medium or rapid, depending on the steepness of slope and the amount of vegetation. The shrink-swell potential is moderate.

Most of the acreage is used for range and for habitat for wildlife. This soil has very poor potential for cultivated crops. It is generally not used for pasture grasses but has fair potential for range grasses. It has very poor potential for plantings of trees or shrubs in windbreaks, poor potential for recreation uses, good potential for habitat for openland wildlife, and fair potential for habitat for rangeland wildlife. This soil has poor potential for sanitary facilities and building site development.

This soil is not suited to cultivated crops because of the steep slopes and the very severe hazard of erosion by water.

This soil is suited to range. A good cover of native grasses should be maintained. Only half of the forage should be grazed, and half should be left for the following year so that the grass can store carbohydrates in the

root system to insure a healthy stand of grass. Overgrazing reduces the protective cover and deteriorates the native plant community. Controlled grazing, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil is not suited to plantings of trees and shrubs in windbreaks. The areas are generally too droughty, erodible, and steep for planting trees with machinery, but some areas can be hand planted to help establish habitat for wildlife.

This soil is generally not suited to use as septic tank absorption fields because of the excessive slope and moderately slow permeability. Sewage lagoons should be specially designed to compensate for the slope. Buildings can be designed to compensate for the slope, or the area can be graded to modify the slope. In road construction, extensive cutting and filling is necessary because of the slope. Hydrated lime can be mixed with the soil to help stabilize it against excessive shrink-swell. The surface pavement needs to be of sufficient thickness to compensate for the low soil strength.

Capability unit VIe-9 dryland; Limy Upland range site; windbreak suitability group 10.

ThC—Thurman loamy fine sand, 2 to 6 percent slopes. This is a deep, somewhat excessively drained, gently sloping soil on ridgetops of uplands between the Elkhorn River and Cuming Creek. The areas are 5 to 80 acres in size.

Typically, the surface layer is loose, very dark grayish brown loamy fine sand about 12 inches thick. A transition layer of loose, dark yellowish brown loamy fine sand about 8 inches thick is below the surface layer. The underlying material is fine sand. The upper part is yellowish brown, and the lower part is light yellowish brown.

Included with this soil in mapping are small areas of the finer textured Moody silty clay loam and Leisy fine sandy loam. Both soils generally are at a slightly lower elevation than Thurman soils. These included soils make up 5 to 10 percent of this map unit.

Permeability is rapid, and the available water capacity is low. Moisture is readily released to plants. The content of organic matter is moderately low, and natural fertility is medium. Runoff is slow. The intake rate of water for irrigation is very high.

Most of the acreage is used for cultivated crops. This soil has potential for cultivated crops, both dryland and irrigated, and for pasture. It has fair potential for range, good potential for trees and shrubs in windbreaks, and fair potential for recreation uses and for habitat for openland wildlife. It has poor potential for most sanitary facilities and good potential for building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grains, and alfalfa. Row crops can be grown yearly in places where proper amounts and kinds of fertilizer are applied and where weeds and insects are controlled. Soil blowing and conservation of water are important concerns of management during most years. Where corn is planted, narrow strips or fields can be alternated with strips of rye or vetch. Close-sown crops should be grown because most growth is in spring when rainfall is greatest, and because soil blowing is not so severe on these fields as on those where row crops are grown. Minimum tillage and the conservation of crop residue help to conserve moisture for use by crops, build up the supply of organic matter, lessen soil blowing, and improve fertility. Narrow plantings of trees in windbreaks help to reduce soil blowing.

Under irrigation, these soils are suited to row crops such as corn and grain sorghum and to close-sown crops such as alfalfa, tame grass pasture, and small grain. Soil blowing is moderate or severe. Low fertility is a concern of management. In places, the soils are too loose for easy workability. Sprinkler irrigation is generally better suited than other systems. Water should be applied frequently. The center-pivot sprinkler system is particularly well suited. Maintaining a high amount of crop residue on the surface, stripcropping, using field windbreaks, keeping tillage to a minimum, and applying fertilizer help to control soil blowing.

This soil is suited to pasture and range. Pastures commonly consist of bromegrass or bromegrass and alfalfa. Overgrazing by livestock reduces the protective cover and deteriorates the plant cover. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The species of trees and shrubs selected should be adaptable to the climate. Competition for moisture from grass and weeds and soil blowing are common concerns of management. Planting a cover crop between the rows helps control weeds and soil blowing.

This soil is suited to use as septic tank absorption fields, but care needs to be taken to avoid contaminating the underground water supply. Sewage lagoons can be sealed to prevent seepage. Shallow excavations may need shoring to prevent loose material from caving in. This soil is suited to use as building sites and for roads. Disturbed areas need to be revegetated with adapted species to prevent soil blowing.

Capability units IVe-5 dryland and IVe-11 irrigated; Sandy range site; windbreak suitability group 3.

ThD—Thurman loamy fine sand, 6 to 11 percent slopes. This is a deep, somewhat excessively drained, strongly sloping soil on uplands between the Elkhorn River and Cuming Creek. The areas are 5 to 60 acres in size.

Typically, the surface layer is loose, very dark grayish brown loamy fine sand about 8 inches thick. A transition layer of loose, dark brown loamy fine sand about 8 inches thick is below the surface layer. The underlying material is brown loamy fine sand to a depth of 60 inches.

Included with this soil in mapping are small areas of finer textured Moody silty clay loam and Leisy fine sandy loam. Both soils are slightly lower in elevation than the Thurman soils. These included soils make up 5 to 10 percent of this map unit.

Permeability is rapid, and the available water capacity is low. Moisture is readily absorbed and released to plants. The content of organic matter is moderately low, and natural fertility is medium. Runoff is slow. The rate of water intake for irrigation is very high.

Most of the acreage is used for cultivated crops. This soil has very poor potential for dryland crops and poor potential for irrigated crops. It has poor potential for pasture, fair potential for range and for trees and shrubs in windbreaks, and fair potential for recreation uses and for habitat for openland wildlife. It has fair or poor potential for sanitary facilities and for building site development.

Because this soil is too droughty and soil blowing is too severe, cultivated crops cannot be grown under dryland management. This soil is suited to alfalfa and small grain if a sprinkler irrigation system is used. Water should be applied frequently. Keeping a cover of crop residue on the surface, stripcropping, and keeping tillage to a minimum help to control soil blowing. These management practices also help to conserve moisture for use by crops, build up the supply of organic matter, and improve fertility.

This soil is suited to both pasture and range. Pastures commonly consist of bromegrass or bromegrass and alfalfa. Overgrazing by livestock reduces the protective cover and deteriorates the plant cover. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to windbreaks. Competition for moisture from grasses and weeds and soil blowing are the common concerns of management. Because the soil is loose, trees should be planted in shallow furrows, and the soil should not be cultivated. Young seedlings may need temporary protection from sand blasting during high winds. Irrigation can provide supplemental moisture when natural moisture is insufficient.

Septic tank absorption fields need to be modified to accommodate the slope. Seepage can be controlled by sealing sewage lagoons. These lagoons need to be designed to accommodate the slope, and some grading is generally needed to reshape the area. This soil is suited to building sites and roads, but some grading may be needed. Disturbed areas need to be revegetated with adapted species to control soil blowing.

Capability units VIe-5 dryland and IVe-11 irrigated; Sandy range site; windbreak suitability group 7.

TmD2—Thurman-Moody complex, 6 to 11 percent slopes, eroded. This map unit consists of deep, somewhat excessively drained and well drained, strongly sloping soils about midway on the side slopes of uplands. Areas range from 5 to 20 acres in size.

This map unit is made up of about 65 to 85 percent Thurman loamy fine sand and about 15 to 35 percent Moody silty clay loam. The two soils are so intricately mixed that they cannot be separated on the soil map.

Typically, the surface layer of the Thurman soils is loose, very dark grayish brown loamy fine sand about 6 inches thick. A transition layer of dark brown loamy fine sand 8 inches thick is below the surface layer. The underlying material, to a depth of 60 inches, is brown loamy fine sand.

Typically, the surface layer of the Moody soils is friable, very dark brown silty clay loam about 5 inches thick. A part of the upper subsoil commonly has been mixed with the surface layer during tillage. The subsoil is friable silty clay loam about 27 inches thick. The upper part is dark yellowish brown, and the lower part is dark brown. The underlying material, to a depth of 60 inches, is yellowish brown silty clay loam.

Included with these soils in mapping are small areas of eroded Nora silty clay loam on similar landscapes. This soil makes up 3 to 6 percent of this map unit.

Permeability is rapid in the Thurman soils and moderately slow in the Moody soils. The available water capacity is low in the Thurman soils and high in the Moody soils. Moisture is readily released to plants. The content of organic matter is low in the Thurman soils and moderately low in the Moody soils. Natural fertility is low for Thurman soils and medium for Moody soils. Runoff is slow in the coarse textured Thurman soils and medium or rapid in the silty Moody soils. The shrink-swell potential is moderate in the Moody soils and low in the Thurman soils. The intake rate of water for irrigation is very high for Thurman soils and low for Moody soils.

Most of the acreage of this map unit is cultivated. These soils have poor potential for dryland and irrigated cultivated crops and pasture. They have fair potential for range and fair to good potential for trees and shrubs in windbreaks. Their potential is fair for recreation uses and for habitat for openland wildlife. Their potential is fair or poor for most sanitary facilities and building site development.

Under dryland management, the soils in this map unit are suited to close-sown cultivated crops such as alfalfa, pasture grasses, and small grain. Use for row crops is marginal, and in a good cropping system these crops are grown infrequently. Conservation of water is an important concern of management. Mulch planting and keeping a cover of crop residue on the surface conserve soil and water. Narrow plantings of trees in windbreaks help to reduce soil blowing. A conservation tillage system keeps residue on the surface to help reduce soil blowing and to increase the intake of water.

Because of strong slopes and the hazard of further erosion, these soils are better suited to close-sown irrigated crops. Sprinkler irrigation is better suited than

other methods of irrigation. Water should be applied frequently. The center-pivot sprinkler system is particularly well suited. Maintaining a high amount of crop residue on the surface, stripcropping, keeping tillage to a minimum, and applying fertilizer help to control soil blowing.

These soils are suited to pasture and range. Pastures commonly consist of bromegrass or a mixture of bromegrass and alfalfa or orchardgrass and alfalfa. Overgrazing by livestock reduces the protective cover and deteriorates the plant cover. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

These soils are suited to trees and shrubs in windbreaks. Soil blowing is a hazard in the areas of Thurman soils. In these areas, the trees can be planted in a shallow furrow, and the soil should not be cultivated. Weeds and grasses can be controlled by using herbicides. Erosion by water is a hazard in areas of Moody soils. Newly planted trees may need supplemental watering when moisture is insufficient.

In areas of this map unit, onsite investigation is particularly needed before engineering works can be constructed. Septic tank absorption fields work well in areas of Thurman soils but need to be modified on Moody soils. Sewage lagoons can be sealed to eliminate seepage in areas of Thurman soils. The shape of lagoons generally needs to be modified to accommodate the slopes. The Thurman soils are suited to building sites and roads, but disturbed areas need to be revegetated to eliminate soil blowing. Foundations on Moody soils need reinforcing because the soils shrink and swell. Basements may become wet if constructed in areas where sandy material lies over silty material. Tile can be used to carry water away from the foundation. Road surfaces should be strengthened to resist damage in the low strength areas of Moody soils. Good surface drainage and a gravel moisture barrier can be used to protect against frost action in the Moody soils.

Capability units IVe-5 dryland and IVe-11 irrigated; Thurman soils in Sandy range site, Moody soils in Silty range site; Thurman soils in windbreak suitability group 7, Moody soils in windbreak suitability group 4.

TmF2—Thurman-Moody complex, 11 to 30 percent slopes, eroded. This map unit consists of deep, somewhat excessively drained and well drained, moderately steep or steep soils about midway on the side slope of uplands. Areas range from 5 to 75 acres in size.

This map unit is made up of about 60 to 80 percent Thurman loamy fine sand on the highest elevations and 20 to 40 percent Moody silty clay loam on the lowest elevations.

Typically, the surface layer of the Thurman soils is loose, very dark grayish brown loamy fine sand about 5 inches thick. A transition layer of loose, dark brown loamy fine sand about 7 inches thick is below the surface layer. The underlying material, to a depth of 60 inches, is brown loamy fine sand.

Typically, the surface layer of the Moody soils is friable, very dark brown silty clay loam about 5 inches thick. A part of the upper subsoil commonly has been mixed with the remaining surface layer during tillage. The subsoil is friable silty clay loam about 27 inches thick. The upper part is dark yellowish brown, and the lower part is dark brown. The underlying material, to a depth of 60 inches, is yellowish brown silty clay loam. In places, the surface layer is 5 to 12 inches thick.

Included with these soils in mapping are small areas of eroded Nora silty clay loam on similar landscapes. This soil makes up 2 to 6 percent of this map unit.

Permeability is rapid in the Thurman soils and moderately slow in the Moody soils. The available water capacity is low in the Thurman soils and high in the Moody soils. Moisture is readily released to plants. The content of organic matter is low in the Thurman soils and moderately low in the Moody soils. Natural fertility is low for Thurman soils and medium for Moody soils. Runoff is slow for the coarse textured Thurman soils and medium or rapid for Moody soils. The shrink-swell potential is low for the Thurman soils and medium for the Moody soils.

Most of the acreage of this map unit is in native grass. These soils have very poor potential for cultivated crops, pasture, and for plantings of trees and shrubs in windbreaks. Their potential is fair for range, poor for recreation uses, and fair for habitat for openland wildlife. Their potential is poor for most sanitary facilities and building site development.

These soils are not suited to cultivated crops because of the steepness of slope and the accompanying hazard of erosion.

These soils are suited to range. They are not suited to pasture grasses. Overgrazing by livestock reduces the protective cover and deteriorates the plant cover. Controlled grazing, timely deferment of grazing, and a planned grazing system help to improve the range condition.

The soils in this map unit are not suited to trees and shrubs in windbreaks because most areas are too steep for tree planting machinery and because the soils are too erodible. In places, scattered stands of adapted species can be hand planted for wildlife habitat.

Onsite investigation is needed before construction of engineering works in all areas of this map unit begins. Areas of Thurman soils generally need to be shaped for septic tank absorption fields. Lagoons in Thurman soil areas need to be sealed to eliminate seepage, and grading is needed to modify the slope. Basements are subject to wetness if constructed in areas where the sand contacts the silt at a level above the basement floor, unless protected by perforated tile. Building sites and roads need grading to modify slope. Disturbed areas of both Thurman and Moody soils need to be revegetated with adapted species to prevent erosion by wind and

water. Road surfaces can be strengthened to withstand the low strength of Moody soils. Good surface drainage and a gravel moisture barrier can be used to protect roads against frost action in areas of Moody soils.

Capability unit VIe-5 dryland; Thurman soils in Sandy range site, Moody soils in Silty range site; windbreak suitability group 10.

Wm—Wann fine sandy loam, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. It is occasionally flooded. The areas are 10 to 50 acres in size.

Typically, the surface layer is friable fine sandy loam about 15 inches thick. The upper part is very dark brown, and the lower part is very dark grayish brown. A transition layer of friable, very dark grayish brown loam 4 inches thick is below the surface layer. In the upper part, the underlying material is grayish brown, mottled fine sandy loam, and in the lower part, to a depth of 60 inches, it is dark gray, mottled sandy loam.

Included with this soil in mapping are small areas of Gibbon loam and Wann loam. These soils are on the same landscape as the Wann fine sandy loam soil. These included soils make up 3 to 8 percent of this map unit.

Permeability is moderately rapid, and the available water capacity is high. Moisture is readily released to plants. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 4 feet in most dry years. The content of the organic matter is moderate, and natural fertility is high. Runoff is slow. The intake rate of water is moderately high.

Most of the acreage is in cultivated crops. This soil has good potential for dryland or irrigated crops and for both tame and native grasses. It has fair potential for trees and shrubs in windbreaks, fair potential for habitat for wetland wildlife, and good potential for habitat for openland wildlife. It has fair potential for recreation uses, mainly because of the moderately high water table. This soil has poor potential for sanitary facilities and building site development.

This soil is suited to dryland corn, grain sorghum, small grain, alfalfa, and mixtures of grasses and legumes. The main limitation is soil wetness, and tillage generally is delayed early in spring. Conservation tillage such as minimum tillage, stripcropping, and stubble mulching help prevent soil blowing, build up the supply of organic matter, and improve fertility. Use of commercial fertilizer and barnyard manure help maintain high fertility.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as alfalfa, tame grass pasture, and small grain. Furrows and sprinklers can be used. Land leveling is generally needed for an efficient gravity irrigation system. A cover crop helps to prevent soil blowing.

This soil is suited to pasture and range. Pastures are generally made up of bromegrass or a mixture of bromegrass and a legume. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses can be a problem. Weeds can be controlled by cultivating between the rows and by hand hoeing or using herbicides within the row of trees. Species should be used that tolerate a moderately high water table.

To avoid contaminating underground water, alternate sites should be used for sanitary facilities. Sewage lagoons need to be sealed to prevent seepage, and dikes help to prevent flooding. Drainage ditches along roads and crowning help improve surface drainage. Moisture barriers of gravel can be used to protect roads from frost action. Roads should be constructed on fill material and supplied with good ditches for protection from flooding.

Capability units IIw-6 dryland and IIw-8 irrigated; Subirrigated range site; windbreak suitability group 2.

Wn—Wann loam, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained soil on bottom lands of the Platte and Elkhorn River valleys. It is occasionally flooded. The areas are 10 to 60 acres in size.

Typically, the surface layer is friable and is 19 inches thick. The upper part is black loam, and the lower part is very dark grayish brown fine sandy loam. In the upper part, the underlying material is mottled, dark grayish brown fine sandy loam; in the middle part, it is grayish brown fine sandy loam; and in the lower part, to a depth of 60 inches, it is gray sandy loam. The lower part has a 2- or 3-inch stratum of loam.

Included with this soil in mapping are small areas of the coarser textured Boel loam and areas of Wann fine sandy loam. These included soils are on about the same landscape as the Wann loam. They make up 3 to 8 percent of this unit.

Permeability is moderately rapid, and the available water capacity is high. Moisture is readily released to plants. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 4 feet in most dry years. The content of organic matter is moderate, and natural fertility is high. Runoff is slow. The intake rate of water is moderately high.

Most of the acreage is in cultivated crops. This soil has good potential for dryland and irrigated crops, pasture, and range. It has fair potential for trees in windbreaks and for recreation uses, good potential for habitat for wildlife, and poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, grain sorghum, small grain, and mixtures of grasses and legumes. Wetness related to the moderately high water table delays tilling and planting in spring. It is the main

limitation. Open drains or tile drains help to provide improved drainage. This soil does not warm up so readily in spring as soils that are better drained. Minimum tillage and the conservation of crop residue build up the supply of organic matter and improve fertility.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as alfalfa, tame grass pastures, and small grain. Where outlets are available, open drains or tile drains help provide drainage. Land leveling helps to improve gravity irrigation and surface drainage, and it increases the efficiency of irrigation. In some years, wetness in spring delays the preparation of the seedbed.

This soil is suited to pasture and range. Pastures are generally composed of bromegrass or a mixture of bromegrass and a legume. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is a common problem. Weeds can be controlled by cultivating between rows and by hand hoeing or using herbicides within the row of trees. Species should be selected that can tolerate a moderately high water table.

To avoid contamination of underground water, alternate sites should be used for sanitary facilities. Roads can be constructed on compacted fill material and supplied with ditches for protection from flooding. A moisture barrier of gravel can be installed in the subgrade to prevent damage by frost action.

Capability units IIw-4 dryland and IIw-8 irrigated; Subirrigated range site; windbreak suitability group 2.

Zn—Zook silt loam, overwash, 0 to 2 percent slopes. This is a deep, nearly level, poorly drained soil on bottom lands of Maple and Logan Creeks and the Platte and Elkhorn River valleys. In places, it is adjacent to old abandoned river channels or on the lower part of a broad landscape. It is occasionally flooded. The areas are 10 to 80 acres in size.

Typically, the surface layer is friable, black, and about 15 inches thick. It is silt loam in the upper part and silty clay loam in the lower part. The subsoil is firm silty clay about 25 inches thick. It is black in the upper part and dark gray in the lower part. The underlying material is gray silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of the less clayey and somewhat poorly drained Gibbon silt loam at a slightly higher elevation and the more clayey, calcareous Luton silty clay that is on similar or slightly lower areas on the landscape. These included areas make up 3 to 10 percent of this map unit.

Permeability is slow, and the available water capacity is moderate. Moisture is released slowly to plants. The perched seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. The content of organic matter is high, and natural fertility is medium. Runoff is slow. The shrink-swell potential is moderate in the surface layer and high in the underlying material. The intake rate of water is low.

Most of the acreage is cultivated. This soil has good potential for both dryland or irrigated crops, pasture, and range. It has fair potential for trees and shrubs in windbreaks, poor potential for recreation uses, and fair potential for habitat for openland wildlife. It has poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Soil wetness early in spring when rainfall is highest is the main hazard. Row crops can be grown yearly if proper amounts and kinds of fertilizer are applied and if weeds, diseases, and insects are controlled. Water stands on the surface in low areas for several days after heavy rains, delaying tillage. Land leveling and surface ditches are needed for good drainage. This soil generally is plowed late in fall. Without snow cover or other kinds of protection, soil blowing can be a hazard, particularly during winter. Workability is fair because the surface layer is friable silt loam.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as tame grass and alfalfa. Soil wetness is the main limitation. Tillage is delayed early in spring. The soil is occasionally flooded, but the crops generally are not seriously damaged. Land leveling helps improve surface drainage and increases efficiency of irrigation. Surface ditches can be installed where a suitable outlet is available. Furrow, border, and sprinkler irrigation are generally suitable systems.

This soil is suited to pasture and range. Pastures commonly consist of bromegrass or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet can cause surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high water table and occasional flooding. Competition for moisture from grasses and weeds is a concern of management. Because these soils shrink when dry, cracks form, allowing air to enter the soil. The air dries out the roots of newly established plants. Shallow cultivation with a disc or harrow can help to close these cracks.

Because of occasional flooding, slow permeability, and a moderately high water table, this soil generally is not suited to use as septic tank absorption fields and building sites. Sewage lagoons can be protected from flooding by dikes. Roads need side ditches and crowning by grading to carry off floodwaters and improve drainage.

Capability units IIw-2 dryland and IIW-2 irrigated; Silty Overflow range site; windbreak suitability group 2.

Zo—Zook silty clay loam, 0 to 2 percent slopes. This is a deep, nearly level, poorly drained soil on bottom lands of Maple and Logan Creek and the Platte and Elkhorn River Valleys. In places, it is in old abandoned river channels or on the lowest part of broad landscapes. It is occasionally flooded. The areas are 10 to 300 acres in size.

Typically, the surface layer is friable silty clay loam about 18 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is firm, black silty clay about 25 inches thick. The underlying material is dark gray silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of the less clayey, slightly better drained Colo soils at a slightly higher elevation and the more clayey, calcareous Luton silty clay loam at a similar or slightly lower elevation. Also included are small areas of Zook silt loam, overwash, on similar or only slightly higher areas of the landscape. These included soils make up 3 to 8 percent of this unit.

Permeability is slow, and the available water capacity is moderate. Moisture is released slowly to plants. The perched seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. The organic matter content is high, and natural fertility is medium. Runoff is slow. The shrink-swell potential is high. The intake rate of water is very low.

Most of the acreage is cultivated. This soil has good potential for both dryland or irrigated crops, pastures, and range. It has fair potential for trees and shrubs in windbreaks, poor potential for recreation uses, and fair potential for habitat for openland wildlife. It has poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Soil wetness and flooding early in spring when rainfall is highest are the main hazards. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizer are applied and if weeds, diseases, and insects are controlled. Surface water stands in low areas for several days after rains, delaying tillage. Land leveling and shallow surface ditches help improve surface drainage. In places, tile drains can lower the water table and control wetness. Most areas of this soil are plowed late in fall. Without snow cover or other kinds of protection, soil blowing can be a hazard during winter. Diversions and land treatment of the drainage area above this soil helps reduce flood damage.

Under irrigation, this soil is suited to row crops such as corn, soybeans, and grain sorghum and to close-sown crops such as tame grass and alfalfa. Soil wetness from the water table is the main limitation. Flooding is common. Land leveling can improve surface drainage and increase efficiency of the irrigation system. Shallow surface ditches can be installed if a suitable outlet is available. Furrow or sprinkler irrigation systems generally are suitable.

This soil is suited to pasture and range. Pastures commonly consist of bromegrass or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is too wet can cause compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high water table and occasional flooding. Competition for moisture from grasses and weeds is a concern of management. Cultivation between the rows and use of herbicides in the row help to control grasses and weeds. When the soils crack in dry weather, shallow cultivation should be used to close the cracks so that roots do not dry out.

Sanitary facilities should be carefully considered before construction because the water supply can become contaminated. Because of occasional flooding, poor surface drainage, slow permeability, and a moderately high water table, this soil generally is not suited to use as septic tank absorption fields and building sites. Sewage lagoons can be constructed on well compacted fill material to increase the depth to the water table and as protection from flooding. Roads need side ditches and crowning by grading to carry away floodwaters. The road pavement should be thick enough and, if necessary, the subsoil should be replaced to compensate for low soil strength.

Capability units IIw-4 dryland and IIw-1 irrigated; Clayey Overflow range site; windbreak suitability group 2.

Zw—Zook silty clay, 0 to 2 percent slopes. This is a deep, nearly level, poorly drained soil on bottom lands of Maple and Logan Creeks and the Elkhorn River valley. It is occasionally flooded. The areas are 10 to 100 acres in size.

Typically, the surface layer is a very firm silty clay about 15 inches thick. The upper part is very dark brown, and the lower part is black. The subsoil is a very firm silty clay about 37 inches thick. The upper part is black, the middle part is very dark gray, and the lower part is dark gray. The underlying material is gray silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the less clayey, somewhat poorly drained Colo soils at a slightly higher elevation and Zook silty clay loam on similar or slightly higher areas of the landscape. These included soils make up 3 to 8 percent of this map unit.

Permeability is slow, and the available water capacity is moderate. Moisture is absorbed slowly and released slowly to plants. The perched seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. The organic matter content is high, and natural fertility is medium.

Runoff is slow. The shrink-swell potential is high. The intake rate of water is very low.

Most of the acreage is cultivated. This soil has fair potential for both dryland and irrigated crops, for pasture, and for trees and shrubs in windbreaks. It has good potential for range, poor potential for recreation uses, and fair potential for habitat for openland wildlife. It has poor potential for most sanitary facilities and building site development.

Under dryland management, this soil is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Soil wetness early in spring when rainfall is highest is the main hazard. The soil is flooded occasionally, but damage to crops is seldom severe. Surface water stands in low areas for several days after rain, delaying tillage. Row crops can be grown in consecutive years if a high level of management is used. Land leveling, tile drains, and shallow surface ditches are effective in providing improved drainage. Most areas of this soil are plowed late in fall when moisture conditions are most favorable. Without snow cover or other kinds of protection, soil blowing can be a hazard in winter. If machinery is not used in wet periods, this soil will be less compacted. Workability is poor, and the soil should be tilled only at the proper moisture content.

Under irrigation, this soil is suited to corn, soybeans, and grain sorghum and to close-sown crops such as tame grass and alfalfa. Soil wetness is the main hazard. Tillage is delayed early in spring. Land leveling, tile drains, and shallow ditches help improve drainage. Surface ditches and tile drains need a suitable outlet. Furrow, border, corrugation, and sprinkler systems are suitable forms of irrigation. Returning crop residue and barnyard manure to the soil helps to make the soil more friable and easy to work. A high level of management is needed for irrigating this soil.

This soil is suited to pasture and range. Pastures commonly consist of bromegrass or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Controlled grazing, rotation grazing, and fertilization with nitrogen help to keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be used that are suited to soils that have a moderately high water table and are occasionally flooded. Competition for moisture from grasses and weeds is a concern of management. Establishing seedlings can be a concern in wet years because the soil is sticky when wet. During summer, when the weather is dry, the soil shrinks, causing cracks that can be filled by shallow cultivation. Supplemental watering also helps.

Because of occasional flooding, poor surface drainage, and a moderately high water table, this soil generally is not suited to use as septic tank absorption fields and building sites. Sewage lagoons can be constructed on compacted fill material to increase depth to the water table. They also need diking or other protection from flooding. Roads can be provided with side ditches and constructed on fill material for protection from floodwaters. The road pavement needs to be thickened and strengthened to compensate for the low soil strength. The soil can be mixed with an additive such as hydrated lime to help lower the shrink-swell potential of the soil.

Capability units IIIw-1 dryland and IIIw-1 irrigated; Clayey Overflow range site; windbreak suitability group 2.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and windbreaks, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements,

sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

By William E. Reinsch, conservation agronomist, Soil Conservation Service.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

Dryland management

Most of the land used for agriculture in Dodge County is in cultivated crops. According to the Conservation Needs Inventory of 1967, 85 percent of the total acreage in the county is cropland. The largest acreage is in corn and soybeans, and other acreage is in alfalfa, wheat, and grain sorghum. Other crops are forage sorghum, oats, tame hay, and rye. About 33 percent of the corn is dryfarmed.

The soils of Dodge County are well suited to cultivated crops if they are well managed. The main hazard on upland soils is erosion by water. Flooding is a potential hazard in stream valleys. Loss of fertility by excessive removal of topsoil is an important concern of management. Most of the soils are suited to cropping if these hazards and limitations are reduced or corrected by suitable management practices.

Keeping crop residue on the surface or growing a protective plant cover reduces sealing and crusting of the soils during and after heavy rains. In winter, tall stubble catches drifting snow, which provides additional moisture. Soil blowing in Dodge County is a minor hazard, but the same management practices that control water erosion can control soil blowing. Stubble mulching, conservation tillage, crop residue management, wind stripcropping, and narrow field windbreaks are effective. The overall hazard of erosion can be reduced if areas of the more productive soils are used for row crops and the steeper more erodible soils are used for close-growing crops such as wheat, alfalfa, and rye or for hay and pasture. Proper use of the land can reduce the hazard of erosion in many places.

Using minimum tillage in preparing a seedbed and leaving the maximum amount of crop residue on the surface improve soil tilth, reduce erosion, and lessen compaction.

All soils that are used for cultivated crops or for pasture should be tested to determine their need for additional nutrients. Under dryland management, the kind and amount of fertilizer to be applied should be based on the results of soil tests and on the moisture content of the soil at the time when fertilizer is applied. If the subsoil is dry and rainfall is low, the amount of fertilizer applied should be slightly less than that needed where the soil is moist. Nitrogen fertilizer benefits nonlegume crops on all the soils. Phosphorous and zinc are needed on the more eroded soils and in cut areas after construction of terraces or contour benches. Dryfarmed soils need smaller amounts of fertilizer than irrigated soils because there is generally a lower plant population.

Areas in hay and tame pasture should be managed for maximum production. Once pastures are established, grasses need to remain vigorous and productive. A system of rotation grazing that meets the needs of the plants and promotes uniform use of forage is important for high returns. Many forages are a good source of minerals, vitamins, and protein; therefore, well managed pasture can provide a balanced ration during the growing season. The grasses and legumes used should be adapted to both soil and climate.

Irrigation management

About 25 percent of all cropland in Dodge County is irrigated. The largest acreage is in corn and soybeans, and a smaller acreage is in alfalfa hay and grain sorghum.

The irrigated soils in Dodge County are mainly in the Platte and Elkhorn River valleys and in a smaller area on the uplands. The irrigation water is drawn almost entirely from wells.

Corn and sorghum are grown in rows spaced 30 to 40 inches apart and soybeans in rows about 22 inches apart. Either furrow or sprinkler systems of irrigation are suited to corn, soybeans, and sorghum. Border, contour ditch, corrugation, or sprinkler systems can be used for alfalfa.

The cropping system for soils that are well suited to irrigation consists mostly of row crops. A change from corn to grain sorghum and alfalfa or grass helps to control the plant diseases and insects that are common if the same crop is grown year after year. Gently sloping soils, such as Nora silt loam, 2 to 6 percent slopes, eroded, are subject to erosion by water if they are irrigated. These soils are better suited to a cropping system that includes several years of row crops followed by 3 to

5 years of hay, mostly alfalfa or a mixture of alfalfa and grass. Moderately sloping soils, for example, Moody silty clay loam, 6 to 11 percent slopes, eroded, are better suited to irrigated hay and pasture than to irrigated row crops.

Land leveling increases the efficiency of irrigation because water is evenly distributed. The efficiency of a furrow system of irrigation can be improved if a tail-water recovery system is added. If an adequate amount of water is available, sprinkler irrigation is most satisfactory on coarser textured soils. Terraces, contour farming, and contour bench leveling, in addition to contour furrows with terraces, can be used on irrigated land. Either grassed waterways and conservation tillage systems that keep crop residue on the surface or sprinkler irrigation systems help control water erosion on dryland soils.

Conservation practices that control runoff and prevent erosion are needed on finer textured soils, for example, Moody silty clay loam, 2 to 6 percent slopes, eroded, and where a sprinkler irrigation system is used. Terraces, contour farming, and conservation tillage practices that leave a protective cover of crop residue on the soil after the row crop is planted help conserve the supply of surface water and protect soil from erosion.

If the sprinkler irrigation method is used, water should be applied at a rate that allows the soil to absorb the water and that will not produce runoff. Sprinklers can be used on the more sloping soils as well as on the nearly level ones. Some soils, such as Nora silt loam, 2 to 6 percent slopes, eroded, are suited to sprinkler irrigation. Because the water can be controlled, sprinklers have special use in conservation, for example, establishing new pasture on moderately steep slopes. In summer, much water is lost through evaporation. Because of wind drift, water can be applied unevenly under some sprinkler irrigation systems.

There are two general kinds of sprinkler systems. One kind is set up at a certain location and left there until a specified amount of water is applied; the second kind is a moving system and has sprinklers that revolve on a central pivot.

Because soil holds a limited amount of water, irrigation water is applied at regular intervals to keep the soil constantly moist. The interval varies according to the crop and the time of year. The water should be applied as fast as the soil can absorb it.

Irrigated silty soils in Dodge County hold about 2 inches of available water per foot of soil depth. A soil that is 4 feet deep and planted to a crop that sends its roots to a depth of 4 feet can hold about 8 inches of available water for that crop.

For maximum efficiency, irrigation should be started when about one-half of the stored water has been used by the plants. If a soil holds 8 inches of available water, irrigation should be started when about 4 inches have been removed by the crop. An irrigation system should be planned to replace the water that is used by the crop.

The application of irrigation water should be regulated to allow good crop growth without wasting water or soil. In a furrow system, water can be applied most efficiently by releasing a fairly large stream down the row until the water nearly reaches the lower end. Then the size of the stream can be reduced by about one-half and the water allowed to flow until the soil is irrigated. With furrow and border irrigation, a reuse system can help to reduce the loss of water at the end of the furrow or field. A reuse system recycles runoff irrigation water to reirrigate the same field or other fields nearby.

Irrigated soils generally produce higher yields than dryfarmed soils. Consequently, more plant nutrients, particularly nitrogen and phosphorus, are removed in harvesting crops. Returning all crop residue to the soil and adding barnyard manure and commercial fertilizer help to supply the needed plant nutrients. Most grain crops in Dodge County respond to nitrogen fertilizer. Soils disturbed during land leveling, particularly if the topsoil has been removed, respond to phosphorus, zinc, and iron. The kinds and amounts of fertilizer needed for specific crops should be determined by soil tests.

Irrigated pastures need a high level of management for maximum returns. A mixture of adapted grasses and legumes can be grown on many kinds of soil, and if properly managed, the soils can return a fair profit. Grasses and legumes are comparable to grain crops in a crop rotation and have beneficial effects on soil building. Because grasses and legumes help to improve soil tilth, add organic matter, and reduce erosion, they are ideal crops for use in a conservation cropping system. Using species that are suited to each soil and to the climate is important.

All of the soils in Nebraska are placed in irrigation design groups, which are described in the Nebraska Irrigation Guide (*6*). Arabic numbers designate the irrigation design group to which a soil belongs.

Assistance in planning and designing an irrigation system is available through the local office of the Soil Conservation Service or the county agricultural agent.

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 4. 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. Absence of an estimated yield indicates that the soil is not suited to the crop or the crop is not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 4.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils 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 4 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

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 landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry. There are no soils assigned to the subclass *c* in Dodge County.

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, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is indicated in table 5. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

The capability unit is identified in the description of each soil map unit in the section "Soil maps for detailed planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar produc-

tivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIw-4 or IIIe-5.

Rangeland

By Peter N. Jensen, range conservationist, Soil Conservation Service.

The acreage of rangeland or native grass pasture in Dodge County is very small. Most of it is near the Platte River and is generally on soils that are not suitable for cultivation. If livestock farmers manage their grass and feed reserves properly, the rangeland program can be a success.

Raising livestock, mainly cow-calf herds, is the main livestock program in the county. The range is grazed in the summer, and the calves are sold in the fall as feeders. The rest of the herd spends the remainder of the growing season grazing pastures of smooth bromegrass. In the fall and early in winter, the herd grazes what remains of the corn or grain sorghum. The cattle are fed alfalfa hay or silage, or both, for the remainder of the winter.

Because of overuse, rangeland in Dodge County has generally been severely depleted. These overgrazed pastures support Kentucky bluegrass and other grasses and weeds that produce low amounts of forage. The production of the range can be increased by such good range management practices as proper grazing use and timely deferments.

A range site, based on the kind and amount of vegetation on the soil when the site is in climax condition, is listed at the end of each map unit description. Interpretations for each range site in the county can be obtained from the local office of the Soil Conservation Service. Farmers who want technical help in reseeding cropped land to grass or in setting up a planned grazing system can receive that help from the local office of the Soil Conservation Service.

Windbreaks and environmental plantings

By James W. Carr, Jr., forester, Soil Conservation Service.

Native woodland in Dodge County is limited to the bluffs and bottom lands along the Platte and Elkhorn Rivers and the main tributaries of these rivers. Many areas are capable of producing wood for commercial use, but the value of these areas for wildlife habitat and watershed protection is greater.

Cottonwood, elm, willow, and other trees that can tolerate wetness grow well on the bottom lands. These areas have a greater potential for growing trees than the drier, steeper slopes on the uplands, but the commercial value of the trees is much less. On the upper slopes and crests of hills, the woodland is made up mainly of scrubby bur oak and sumac. On the lower slopes and in the draws, the trees are mainly American elm, green ash, boxelder, hackberry, basswood, and black walnut.

Early settlers in Dodge County planted trees for protection from wind and snow and for shade and for use as fenceposts. Through the years, land owners have continued to plant trees to protect their buildings and livestock.

A windbreak should be designed specifically for the soil on which it is to grow, and the purpose of the windbreak needs to be considered. Trees and shrubs are not easily established every year in Dodge County, but good tree culture can result in a high degree of survival.

The rate of growth of a windbreak varies widely with soil moisture conditions and soil fertility. Exposure and arrangement of trees within the planting also have a marked effect on tree growth. Some trees grow faster than others. Some trees have an early fast growth but tend to die young, for example, eastern cottonwood. Siberian elm and Russian-olive are vigorous growers, but they can spread where they are not wanted and can be short lived. Boxelder and Russian mulberry commonly freeze back in severe winters, and green ash is susceptible to damage by borers.

The conifers, cedar, and pine are better suited to windbreaks than other trees because they have a high survival rate and are vigorous. They hold their leaves through the winter, thus giving maximum protection when it is most needed.

On all soils except those that have a surface layer that is loamy fine sand or coarse sand, weeds and undesirable grasses can be controlled by cultivating between the rows using conventional equipment such as a disc. Soils that have a surface layer that is loamy fine sand or coarser sand should not be cultivated because the hazard of soil blowing is too severe. Hand hoeing or the use of herbicides can be used in the area within the row.

Newly planted trees and seedlings may need watering if they are to become well established. Even when the trees are larger, they may need supplemental water during seasons when natural rainfall is insufficient, especially on soils that are droughty, such as the Inavale and Thurman soils.

Soils in windbreak suitability group 10 are not suited to the planting of trees and shrubs in windbreaks because the soils have unfavorable characteristics. Some areas can be used, however, as recreation woodland or wildlife areas if tolerant species of trees and shrubs are hand planted or if special practices are used.

A windbreak suitability group, based mainly on adaptability of the species as indicated by tree growth and vigor, is given for each soil at the end of each map unit description.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of

the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

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

Table 6 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 6, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. If pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the large scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil are included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 7 shows, for each kind of soil, the degree and kind of limitations for building site development; table 8, for sanitary facilities; and table 10, for water management. Table 9 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

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

Building site development

The degree and kind of soil limitation that affects shallow excavations, dwellings with and without a basement, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties generally are favorable for the specified use; and that limitations are minor and easily overcome. A *moderate* limitation indicates that soil properties and

site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils that are rated severe, costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 8 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, and *poor*, which mean about the same as *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and

cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard if the seasonal high water table is above the level of the lagoon floor. If the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 8 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

If it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the site should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 9 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction material. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 13 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low frost action potential, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 13.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can restrict plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils or very firm clayey soils; soils that have suitable layers less than 8 inches thick; soils that have large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 10 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of the soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation (*6*) is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

By Robert O. Koerner, biologist, Soil Conservation Service.

Dodge County has two excellent recreation areas that are extensively used. Dead Timber State Recreation Area is in the north-central part of Dodge County. It takes in about 150 acres of land and 50 acres of open water. The area is excellent for fishing, picnicking, camping, hiking, bird watching, and nonpower boating and as habitat for wildlife.

Fremont State Recreation Area has 401 acres of land and 270 acres of water. Land and water recreation activities include picnicking, camping, swimming, boating, water skiing, fishing, bird watching, and hiking.

Hormel Park and Wildwood Park in Fremont also provide recreation opportunities for residents of Dodge and nearby counties.

The best fishing in Dodge County is in the Elkhorn River, but access is limited, and such features as bank characteristics, wide seasonal fluctuation, and turbid

water limit the use of the river. Stream fishing is mostly for bullheads, carp, and catfish.

Sandpit lakes, including 270 acres of open water at the Fremont State Recreation Area, provide the bulk of the better fishing for bass, bluegill, and catfish. Oxbow lakes and farm ponds provide limited fishing opportunities.

Technical assistance is available from the Soil Conservation Service in designing installations to improve the habitat for wildlife as well as facilities for recreation within Dodge County.

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

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

The information in table 11 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 8, and interpretations for dwellings without basements and for local roads and streets, given in table 7.

Camp areas require such site preparation as shaping and leveling for 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 for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

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

Wildlife habitat

By Robert O. Koerner, biologist, Soil Conservation Service.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of

wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of habitat are very severe and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are orchardgrass, intermediate wheatgrass, bromegrass, clover, and alfalfa.

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

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of hardwood plants are oak, poplar, honeylocust, willow, eastern cottonwood, hickory, and ash. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are sumac, autumn-olive, buckbrush, coralberry, and wild plum.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are cotoneaster, sumac, honeysuckle, autumn-olive, coralberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, and cordgrass and rushes, sedges, and reedgrass.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

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

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include cottontail rabbit, thrushes, woodpeckers, squirrels, raccoon, deer, and oppossum.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include white-tailed deer, badger, and meadowlark.

The seven soil associations in Dodge County are discussed in relation to wildlife in the following paragraphs.

The Moody-Nora-Belfore association is nearly level to rolling uplands. The vegetation is mainly cultivated cropland that has scattered clumps of trees and shrubs and herbaceous vegetation in the drainageways. This vegetation provides good areas of food and cover for pheasant and bobwhite quail. Trees and shrubs around farmsteads provide protection for pheasant and quail and for cottontail rabbit, eastern fox, squirrel, and songbirds.

The Zook-Kennebec-Judson association and the Inavale-Cass-Wann association include some permanent

streams and the associated wooded areas along Silver Creek, Maple Creek, Logan Creek, Rawhide Creek, and other tributary streams flowing to the Elkhorn and Platte Rivers. These two associations have riparian habitat along these rivers. These associations have stands of mixed hardwood trees and shrubs, including oak, ash, elm, willow, eastern cottonwood, chokecherry, and native plum. Wildlife, in these associations, includes white-tailed deer, bobwhite quail, eastern fox, squirrel, raccoon, opossum, cottontail rabbit, and many species of songbirds.

The Moody-Thurman-Leisy association has a good diversity of cover plants for wildlife habitat. Many small, odd shaped areas occur adjacent to larger areas of trees. Dead Timber State Recreation Area provides excellent habitat for openland and wetland types of wildlife. Because the rolling hills that have brushy draws adjacent to the Elkhorn River provide food, cover, and water, this association is particularly well suited to most forms of wildlife (fig. 11).

The Moody-Fillmore association consists mainly of cultivated cropland. A few drainageways have mixed hardwoods of ash, hackberry, mulberry, boxelder, native plum, catalpa, and osageorange. A few redcedar are also in these areas. Farmstead windbreaks, as well as native plum and osageorange along roadsides, provide cover for pheasants and bobwhite quail. Grass for nesting cover is needed to increase and improve wildlife. Habitat for pheasant and bobwhite quail is sparse.

The Nora-Moody-Judson association is mainly cultivated cropland, but it also includes a long, narrow area adjacent to Silver Creek that is mainly rangeland and pasture. A few other intermittent drainageways have woody and herbaceous plants that provide escape cover and nesting cover for pheasants and bobwhite quail.

The Gibbon-Luton-Janude association consists of high bottom lands north of the Platte River. Interceptor drains provide areas of water for waterfowl, mink, muskrat, and raccoon. The ditchbanks of these drains also provide travel lanes and nesting areas for pheasant and bobwhite quail.

Coyotes find habitat in all soil associations of the county, but they are particularly common in the more rolling and wooded areas. There are songbirds and mourning doves throughout the county.

Technical assistance in designing and installing measures to improve wildlife habitat in Dodge County is available from the Soil Conservation Service and other State and Federal agencies.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 13 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 13 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 13 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (*2*) and the system adopted by the American

Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 16. The estimated classification, without group index numbers, is given in table 13. Also in table 13 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and in plasticity index is estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 14 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 14. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on mea-

surements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 15 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information

about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Bedrock depth is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. No soils in Dodge County have bedrock within a depth of 60 inches.

Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 16.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The soil samples were analyzed by The Nebraska Department of Roads.

The methods used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods assigned by the American Association of State Highway and Transportation Officials. The codes for the Unified classification are assigned by the American Society for Testing and Materials.

The methods and codes are AASHTO classification (M-145-73); Unified classification (D-2487-69); mechanical analysis (T88-76I); liquid limit (T89-76I); plasticity index (T90-70); particle density (T-100-75I).

The group index number that is a part of the AASHTO classification was computed by using the Nebraska modified system.

Physical and chemical analysis of the soils

Samples from soil profiles were collected for physical and chemical analysis by the Soil Conservation Service, Soil Survey Laboratory in Lincoln, Nebraska. Soils of the Belfore, Cass, Crofton, Fillmore, Luton, Monona, Moody, Nora, Thurman, and Wann series were sampled in nearby counties. These data are recorded in Soil Survey Investigations Report Number 5 (*5*).

This information helps soil scientists in classifying soils and developing concepts of soil genesis. It is also helpful in estimating available water capacity, susceptibility to soil blowing, fertility, tilth, and other practical aspects of soil management.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 17, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder

and a prefix that suggests something about the properties of the soil. An example is Hapludolls (*Hapl*, meaning simple horizons, plus *udoll*, the suborder of Mollisols that have a humid moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups 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 is thought to typify the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-silty, mixed, mesic, Typic Hapludolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*4*). Unless otherwise noted, colors described are for moist soil. Chroma, given in the range of characteristics, is for both dry and moist soils.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Alda series

The Alda series consists of somewhat poorly drained soils that are moderately deep over coarse sand and gravelly sand. These soils are on bottom lands. Permeability is rapid or very rapid. These soils formed in calcareous stratified alluvium. Slopes range from 0 to 2 percent.

Alda soils are near Boel, Gibbon, Platte, and Wann soils. Boel soils are deep, have more sand in the upper part of the control section, and are at a slightly higher elevation than the Alda soils. Gibbon soils are deep, have more clay and less sand in the control section, and are at a slightly higher elevation than the Alda soils. Platte soils have coarse sand or sand and gravel at a depth of 10 to 20 inches and are at a lower elevation than Alda soils. Wann soils are deep and do not have a large amount of gravel in the control section.

Typical pedon of Alda fine sandy loam, 0 to 2 percent slopes, 2,112 feet south and 100 feet east of the northwest corner of sec. 10, T. 17 N., R. 5 E.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—12 to 20 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/1) dry; few fine distinct reddish brown (5YR 4/3) mottles; weak fine granular structure; loose; violent effervescence; moderately alkaline; clear wavy boundary.

C1—20 to 29 inches; light brownish gray (10YR 6/2) fine sandy loam, pale brown (10YR 6/3) dry; many medium prominent reddish brown (5YR 4/3) mottles; massive; soft, very friable; moderately alkaline; abrupt smooth boundary.

IIC2—29 to 48 inches; very pale brown (10YR 7/3) stratified coarse sand and gravelly sand, very pale brown (10YR 8/3) dry; few fine distinct reddish brown (5YR 4/3) mottles; single grained; loose; moderately alkaline; abrupt smooth boundary.

IIC3—48 to 60 inches; pale brown (10YR 6/3) stratified coarse sand and gravelly sand, very pale brown (10YR 7/3) dry; single grained; loose; moderately alkaline.

The solum is 15 to 25 inches thick. The mollic epipedon is 10 to 20 inches thick. The soil is calcareous between a depth of 0 and 15 inches.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. It is dominantly fine sandy loam or loam. This horizon ranges from slightly acid to moderate-

ly alkaline. The C1 horizon has value of 3 through 6 moist and 4 through 8 dry and chroma of 1 through 3. It is typically fine sandy loam with strata of finer and coarser textured material throughout. Stratified coarse sand and gravelly sand is below a depth of 20 to 40 inches.

Belfore series

The Belfore series consists of deep, well drained soils on loess covered uplands. Permeability is moderately slow. These soils formed in silty calcareous loess. Slopes range from 0 to 2 percent.

Belfore soils are near Fillmore, Judson, Moody, and Nora soils. Fillmore soils have an A2 horizon and are in shallow depressions. Judson soils have a thicker A horizon, a less clayey B horizon, and are on slightly concave foot slopes and colluvial fans. Moody and Nora soils have steeper slopes and less clay in the B horizon than the Belfore soils.

Typical pedon of Belfore silty clay loam, 0 to 2 percent slopes, 2,112 feet south and 528 feet west of the northeast corner of sec. 14, T. 20 N., R. 5 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A12—7 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium and subangular blocky structure; hard, friable; slightly acid; abrupt smooth boundary.

B21t—14 to 18 inches; dark grayish brown (10YR 4/2) heavy silty clay loam, grayish brown (10YR 5/2) dry; strong coarse and medium subangular blocky structure; hard, friable; slightly acid; clear wavy boundary.

B22t—18 to 26 inches; dark grayish brown (10YR 4/2) heavy silty clay loam, yellowish brown (10YR 5/4) dry; moderate medium blocky structure; hard, friable; slightly acid; clear wavy boundary.

B23—26 to 37 inches; dark brown (10YR 4/3) silty clay loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; hard, friable; slightly acid; clear wavy boundary.

B3—37 to 45 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; weak medium and fine subangular blocky structure; hard, friable; neutral; clear wavy boundary.

C—45 to 60 inches; yellowish brown (10YR 5/4) silty clay loam, pale brown (10YR 6/3) dry; few medium distinct light yellowish brown (10YR 6/4) mottles; massive; hard, friable; neutral.

The A horizon ranges from 9 to 18 inches in thickness. Free carbonates are leached to a depth of more than 50 inches.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. The B2t horizons have value of 3 through 5 moist and 4 through 6 dry and chroma of 2 or 3. They are heavy silty clay loam or silty clay and have between 35 and 43 percent clay. The B23 and B3 horizons have value of 3 through 5 moist and 4 through 6 dry and chroma of 3 or 4. The C horizon has value of 5 or 6 moist and 6 or 7 dry and chroma of 2 through 4. Some pedons have mottles below a depth of 25 inches and small very dark brown or black concretions.

Boel series

The Boel series consists of deep, rapidly permeable, somewhat poorly drained soils on bottom lands. These soils formed in loamy and sandy alluvium. Slopes range from 0 to 2 percent.

Boel soils are near Alda, Inavale, Platte, and Wann soils. Alda soils have more gravel between a depth of 20 and 40 inches and are on slightly lower lying areas than the Boel soils. Inavale soils do not have a mollic epipedon, are excessively drained, and are at a higher elevation than the Boel soils. Platte soils are stratified, have coarse sand or gravelly sand between a depth of 10 and 20 inches, and are at a lower elevation than the Boel soils. Wann soils have less sand in the control section.

Typical pedon of Boel loam, 0 to 2 percent slopes, 528 feet north of the center of sec. 11, T. 17 N., R. 5 E.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; slightly hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—10 to 20 inches; pale brown (10YR 6/3) loamy very fine sand, light gray (10YR 7/2) dry; few fine faint reddish brown (5YR 5/4) mottles; single grained; loose; thinly stratified with loamy fine sand and loamy sand; moderately alkaline; abrupt smooth boundary.

C2—20 to 26 inches; light gray (10YR 7/1) loamy very fine sand, white (10YR 8/2) dry; few fine faint reddish brown (5YR 5/4) mottles; single grained; loose; moderately alkaline; clear wavy boundary.

C3—26 to 60 inches; white (10YR 8/2) fine sand, very pale brown (10YR 8/3) dry; few fine faint reddish brown (5YR 5/4) mottles; single grained; loose; moderately alkaline.

The solum is 10 to 20 inches thick. Carbonates are typically in the A horizon. They are not in some of the lower horizons, but some pedons have free carbonates throughout.

The A horizon has value of 2 or 3 moist and 3 through 5 dry and chroma of 1 or 2. The C horizon has value of 5 through 7 moist and 6 through 8 dry and chroma of 2 or 3. It is fine sand, loamy fine sand, or coarse sand. The C horizon is stratified with lenses of material that is

lighter or darker and coarser or finer textured than the dominant material.

Calco series

The Calco series consists of deep, somewhat poorly drained and poorly drained soils on bottom lands of upland drainageways and major stream valleys. Permeability is moderately slow. These soils formed in calcareous silty alluvium. Slopes range from 0 to 2 percent.

Calco soils are near Colo, Kennebec, Luton, and Zook soils. Colo soils are noncalcareous. Kennebec soils are well drained, have less clay in the control section, and are at a slightly higher elevation than the Calco soils. Luton and Zook soils have more clay in the control section and are at a slightly lower elevation than the Calco soils.

Typical pedon of Calco silty clay loam, 0 to 2 percent slopes, 720 feet west and 1,056 feet south of the northeast corner of sec. 19, T. 20 N., R. 9 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium and fine prismatic structure parting to strong medium and fine subangular blocky; hard, friable; slight effervescence; moderately alkaline; clear wavy boundary.

A13—17 to 26 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; strong medium and coarse prismatic structure parting to strong medium and fine subangular blocky; hard, friable; strong effervescence; moderately alkaline; clear wavy boundary.

A14—26 to 39 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium and fine prismatic structure parting to strong medium and fine subangular blocky; hard, friable; violent effervescence; moderately alkaline; clear wavy boundary.

AC—39 to 46 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium and fine prismatic structure parting to moderate medium and fine subangular blocky; hard, friable; violent effervescence; moderately alkaline; clear wavy boundary.

Cg—46 to 60 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, friable; violent effervescence; moderately alkaline.

The mollic epipedon is dominantly 30 to 40 inches thick, but in some areas it is as much as 50 inches thick. The clay content of the control section ranges from 30 to 35 percent, but in some layers the content is slightly outside of this range.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 0 or 1. It is dominantly silty clay loam, but the range includes silt loam. The AC horizon has value of 3 or 4 moist and 3 or 4 dry and chroma of 0 or 1. The C horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 0 or 1.

Cass series

The Cass series consists of deep, well drained soils on bottom lands. Permeability is moderately rapid, but some areas have moderately slow permeability in the lower part of the pedon. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Cass soils are commonly adjacent to Gibbon, Inavale, and Wann soils. Gibbon soils are more poorly drained, have more clay and less sand in the control section, and are at a slightly lower elevation than the Cass soils. Inavale soils have more sand in the control section and are at a slightly higher elevation than the Cass soils. Wann soils have a higher water table and are in lower lying areas than the Cass soils.

Typical pedon of Cass fine sandy loam, 0 to 2 percent slopes, 1,584 feet south and 150 feet west of the northeast corner of sec. 23, T. 19 N., R. 8 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; slightly hard, very friable; medium acid; clear wavy boundary.

A12—8 to 20 inches; very dark brown (10YR 2/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

AC—20 to 38 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable; neutral; clear wavy boundary.

C1—38 to 48 inches; brown (10YR 5/3) loamy very fine sand, pale brown (10YR 6/3) dry; single grained; loose; neutral; clear wavy boundary.

C2—48 to 60 inches; brown (10YR 5/3) fine sand, very pale brown (10YR 7/3) dry; single grained; loose; neutral.

The mollic epipedon is 10 to 20 inches thick. Cass soils typically are noncalcareous to a depth of 60 inches; however, some pedons have carbonates between a depth of 25 and 60 inches.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. It is dominantly fine sandy loam or loam, but the range includes small areas of silt loam and very fine sandy loam. The A horizon ranges from medium acid to neutral. The C horizon has value of 4 or 5 moist and 5 through 7 dry and chroma of 2 or 3. It is

typically fine sandy loam or sandy loam, but strata of coarser or finer textured material are common. This horizon ranges from slightly acid to mildly alkaline.

Colo series

The Colo series consists of deep, somewhat poorly drained soils. Permeability is moderately slow. These soils formed in noncalcareous silty sediment on bottom lands. Slopes range from 0 to 2 percent.

Colo soils are near Gibbon, Kennebec, Luton, and Zook soils. Gibbon soils are calcareous and are not so dark in the upper part of the control section. Kennebec soils have less clay in the control section, are better drained, and are in slightly higher areas than the Colo soils. Luton and Zook soils have more clay in the control section and are generally at a lower elevation than the Colo soils.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, 150 feet west and 2,112 feet north of the southeast corner of sec. 31, T. 19 N., R. 6 E.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, firm; neutral; abrupt smooth boundary.

A12—10 to 22 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; slightly hard, firm; neutral; clear wavy boundary.

A13—22 to 40 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium fine and very fine subangular blocky structure; slightly hard, firm; neutral; clear wavy boundary.

AC—40 to 52 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine prismatic structure parting to moderate medium and fine blocky; slightly hard, firm; neutral; clear wavy boundary.

C1—52 to 60 inches; very dark gray (10YR 3/1) light silty clay loam, light brownish gray (10YR 6/2) dry; few fine faint reddish brown (5YR 5/4) mottles; moderate medium and fine prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; neutral.

The solum is about 36 to 54 inches thick. The mollic epipedon is 36 to 60 inches thick. Carbonates are not in the solum and are commonly not present to a depth of 60 inches or more. Some pedons have stratified dark gray, dark grayish brown, or grayish brown silty overwash sediment 6 to 18 inches thick above the dark A horizon. Reaction is slightly acid or neutral throughout the profile.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 0 or 1. Value of 2 or 3 extend to a depth of 36 inches or more; however, value of 4 and chroma of 0 or 1 are common in horizons below the dark A horizon.

Crofton series

The Crofton series consists of deep, well drained to excessively drained soils on uplands. Permeability is moderate. These soils formed in silty calcareous loess and have a weakly developed pedon. Slopes range from 6 to 60 percent.

Crofton soils are near Judson, Moody, and Nora soils. These soils have a mollic epipedon, are better developed than the Crofton soils, and have carbonates that are lower in the profile. Judson soils are on concave foot slopes and colluvial fans, Moody soils generally are at a higher elevation than the Crofton soils, and Nora soils are in about the same positions as the Crofton soils.

Typical pedon of Crofton silt loam, 6 to 15 percent slopes, eroded, 1,584 feet west and 792 feet north of the southeast corner of sec. 21, T. 19 N., R. 5 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—6 to 14 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; slightly hard, very friable; violent effervescence; moderately alkaline; clear wavy boundary.

C1—14 to 29 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; slightly hard, very friable; violent effervescence; moderately alkaline; clear wavy boundary.

C2—29 to 60 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; slightly hard, very friable; few small lime concretions; strong effervescence; moderately alkaline.

The solum is 6 to 14 inches thick. Depth to free carbonates ranges from 0 to 8 inches.

The A horizon has value of 3 or 4 moist and 4 through 6 dry and chroma of 2 or 3. It is dominantly silt loam, but the range includes light silty clay loam. The C horizon has value of 4 through 6 moist and 5 through 7 dry and chroma of 2 through 4. In many pedons, the AC and C horizons have few to many, small to medium lime concretions.

Fillmore series

The Fillmore series consists of deep, poorly drained and very poorly drained soils in shallow depressions on loess uplands and stream terraces. Permeability is very slow. Slopes range from 0 to 1 percent.

Fillmore soils are near Belfore and Moody soils. Belfore and Moody soils do not have an A2 horizon, and

they have less clay in the control section. They are at a higher elevation than the Fillmore soils.

Typical pedon of Fillmore silt loam, 0 to 1 percent slopes, 1,848 feet east and 300 feet south of the northwest corner of sec. 23, T. 18 N., R. 8 E.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

A2—9 to 20 inches; gray (10YR 5/1) silt loam, light gray (10YR 7/1) dry; weak subangular blocky structure parting to weak fine granular; slightly hard, very friable; medium acid; abrupt smooth boundary.

B22t—20 to 32 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; strong coarse blocky structure parting to moderate medium and fine blocky; hard, very firm, very sticky; medium acid; clear wavy boundary.

B3—32 to 40 inches; very dark grayish brown (10YR 3/2) silty clay, dark gray (10YR 4/1) dry; many medium prominent yellowish brown (10YR 5/6) mottles; weak medium blocky structure parting to weak fine blocky; hard, very firm, very sticky; few fine faint manganese stains; neutral; clear wavy boundary.

C—40 to 60 inches; dark grayish brown (10YR 4/2) silty clay; grayish brown (10YR 5/2) dry; many medium prominent yellowish brown (10YR 5/6) mottles; massive; hard, very sticky; few fine faint manganese stains; neutral.

The solum is 30 to 65 inches thick. Depth to free carbonates ranges from 44 to more than 60 inches.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. The A2 horizon has value of 3 to 5 moist and 5 through 7 dry and chroma of 1. The A horizon is commonly silt loam, but the A2 horizon is silt in some pedons. The B2t horizon has value of 2 or 3 moist and 3 through 5 dry and chroma of 1 or 2. It is silty clay and averages 45 to 55 percent clay. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 5 through 7 dry, and chroma of 2 through 4.

Gibbon series

The Gibbon series consists of deep, somewhat poorly drained soils on bottom lands. Permeability is moderate or moderately slow. These soils formed in calcareous stratified alluvium. Slopes range from 0 to 2 percent.

Gibbon soils are near Colo, Luton, Wann, and Zook soils. Colo soils are noncalcareous and are in similar areas as the Gibbon soils. Luton and Zook soils have more clay in the subsoil and generally are at a lower elevation than the Gibbon soils. Wann soils have more sand and less clay in the control section and are in similar areas as the Gibbon soils.

Typical pedon of Gibbon silty clay loam, 0 to 2 percent slopes, 2,376 feet north and 300 feet west of the southeast corner of sec. 17, T. 18 N., R. 6 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; hard, firm; violent effervescence; moderately alkaline; abrupt smooth boundary.

A12—7 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; hard, firm; violent effervescence; moderately alkaline; clear wavy boundary.

AC—14 to 22 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure parting to weak fine granular; hard, firm; violent effervescence; strongly alkaline; clear wavy boundary.

C1ca—22 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/1) dry; weak fine granular structure; very hard, firm; violent effervescence; strongly alkaline; abrupt smooth boundary.

IIC2—36 to 44 inches; grayish brown (2.5Y 5/2) fine sandy loam, light gray (2.5Y 7/2) dry; few fine distinct reddish brown (5YR 5/4) mottles; massive; slightly hard, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

IIC3—44 to 60 inches; grayish brown (2.5Y 5/2) fine sand, light gray (2.5Y 7/2) dry; few fine distinct reddish brown (5YR 5/4) mottles; single grained; loose; moderately alkaline.

The solum is 15 to 30 inches thick. The mollic epipedon is 7 to 20 inches thick. Depth to free carbonates is less than 10 inches.

The A horizon has value of 2 or 3 moist and 3 through 5 dry and chroma of 1 or 2. It is typically a silty clay loam or silt loam and less commonly a very fine sandy loam or sandy clay loam. In this survey area, some areas have a deposit of loamy sand on the original surface layer. The C horizon has hue of 10YR and 2.5Y in the lower part, value of 4 through 6 moist and 5 through 7 dry, and chroma of 1 or 2. The control section is silt loam or silty clay loam ranging between 18 and 35 percent clay and has less than 15 percent sand coarser than very fine sand. Some pedons have thin strata of clay loam, very fine sandy loam, loam, or fine sandy loam. Below a depth of 40 inches, the C horizon generally is sandier and lighter colored. Concretions of calcium carbonate are in the Ca horizon of some pedons.

Gibbon Variant

The Gibbon Variant consists of deep, poorly drained soils on low bottom lands. Permeability is moderately slow. These soils formed in calcareous stratified alluvium. Slopes range from 0 to 2 percent.

The Gibbon Variant soils are near Colo, Luton, Wann, and Zook soils. These soils are slightly higher in elevation than the Gibbon Variant soils. Colo soils are noncalcareous and somewhat poorly drained. Luton and Zook soils have a fine textured subsoil. Wann soils have more sand and less clay in the control section and are somewhat poorly drained.

Typical pedon of Gibbon Variant silty clay loam, in an area of Gibbon Variant soils, 0 to 2 percent slopes, 300 feet east and 1,056 feet south of the center of sec. 23, T. 19 N., R. 8 E.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; moderately alkaline; abrupt smooth boundary.

A12—7 to 19 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; slight effervescence; moderately alkaline; clear wavy boundary.

AC—19 to 26 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—26 to 34 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable; violent effervescence; strongly alkaline; abrupt smooth boundary.

C2—34 to 50 inches; dark gray (10YR 4/1) silty clay loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable; strong effervescence; strongly alkaline; clear wavy boundary.

C3—50 to 60 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The solum is 15 to 30 inches thick. Depth to free carbonates is less than 10 inches.

The A horizon has value of 2 or 3 moist and 3 through 5 dry and chroma of 1 or 2. It is typically silty clay loam or silt loam and less commonly very fine sandy loam, loam, or clay loam. The C horizon has value of 3 through 6 moist and 5 through 7 dry and chroma of 1 or 2. It is typically silty clay loam or loam and less commonly fine sandy loam or silty clay below a depth of 40 inches. In some pedons snail shells are below a depth of 20 inches.

Inavale series

The Inavale series consists of deep, somewhat excessively drained soils on bottom lands. Permeability is rapid. These soils formed in recent sandy alluvium. Slopes range from 0 to 3 percent.

Inavale soils are near Alda, Boel, Platte, and Wann soils, which are at a slightly higher elevation than Inavale soils. Alda soils have stratified coarse sand and gravelly sand between a depth of 20 and 40 inches. Boel soils are somewhat poorly drained. Platte soils have coarse sand and gravelly sand between a depth of 10 and 20 inches and are somewhat poorly drained. Wann soils have less sand and generally less silt and are somewhat poorly drained.

Typical pedon of Inavale loamy fine sand, 0 to 2 percent slopes, 1,584 feet south and 2,375 feet east of the northwest corner of sec. 13, T. 17 N., R. 6 E.

Ap—0 to 7 inches; grayish brown (10YR 5/2) loamy fine sand, light brownish gray (10YR 6/2) dry; single grained; loose; neutral; abrupt smooth boundary.

AC—7 to 28 inches; grayish brown (10YR 5/2) loamy fine sand, very pale brown (10YR 7/3) dry; single grained; loose; neutral; abrupt smooth boundary.

C—28 to 60 inches; pale brown (10YR 6/3) fine sand and sand, very pale brown (10YR 7/3) dry; thin strata of finer and coarser textured sediment; single grained; loose; mildly alkaline.

The solum is 10 to 30 inches thick. Typically, free carbonates are not present, but they are present in small amounts in some pedons.

The A horizon has value of 4 or 5 moist and 4 through 7 dry and chroma of 2 or 3. It is typically loamy fine sand, but textures of sand, fine sand, loamy sand, sandy loam, fine sandy loam, loam, and silt loam are also included. This horizon is neutral to moderately alkaline. The AC and C horizons have value of 4 through 6 moist and 5 through 7 dry and chroma of 2 or 3. These horizons are loamy fine sand, loamy sand, fine sand, or sand. They are neutral to moderately alkaline. Stratification occurs between a depth of 10 and 40 inches.

Janude series

The Janude series consists of deep, moderately well drained soils on bottom lands. Permeability generally is moderate, but it is moderately slow or slow in the clayey substratum phase. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent.

Janude soils are near Cass, Gibbon, Luton, and Zook soils. Cass soils have a coarse-loamy control section and are at a slightly higher elevation than the Janude soils. Gibbon soils have more clay in the control section, have free carbonates, are somewhat poorly drained, and are at a slightly lower elevation than the Janude soils. Luton and Zook soils have more clay in the subsoil, are poorly drained, and are at a lower elevation than the Janude soils.

Typical pedon of Janude loam, 0 to 2 percent slopes, 2,376 feet south and 50 feet east of the northwest corner of sec. 7, T. 17 N., R. 7 E.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—7 to 16 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; neutral; abrupt smooth boundary.

AC—16 to 40 inches; very dark grayish brown (10YR 3/2) loam, gray (10YR 5/1) dry; weak coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, very friable; violent effervescence; moderately alkaline; clear wavy boundary.

C1—40 to 52 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; few common distinct reddish brown (5YR 4/4) mottles; massive; slightly hard, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C2—52 to 60 inches; grayish brown (10YR 5/2) loam, light gray (10YR 7/1) dry; many common distinct reddish brown (5YR 4/4) mottles; massive; hard, friable; slight effervescence; moderately alkaline.

The solum is 30 to 42 inches thick. Depth to free carbonates ranges from 14 to 30 inches.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. It is loam or fine sandy loam. The AC horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. It is loam or fine sandy loam. The C horizon has value of 4 or 5 moist and 6 or 7 dry and chroma of 1 or 2. It has few to many, faint or distinct mottles. This horizon is typically loam, but the range includes fine sandy loam, sandy loam, and loam. In places, layers of clay loam, silt loam, and silty clay loam are below a depth of 40 inches. The clayey substratum phase is more than 35 percent clay below a depth of 40 inches. The control section ranges from neutral to moderately alkaline.

Judson series

The Judson series consists of deep, well drained soils on colluvial-alluvial foot slopes and fans along bottom lands and in upland drainageways. Permeability is moderate. These soils formed in noncalcareous silty sediment, eroded mostly from adjacent dark colored upland soils that formed in loess. Slopes range from 2 to 6 percent.

Judson soils are near Colo, Kennebec, and Gibbon soils on bottom lands and near Moody, Nora, and Monona soils on uplands and stream terraces. Colo and Gibbon soils are not so well drained and are below Judson soils. Kennebec soils have a thicker A horizon, do not have a B horizon, and have chroma of 2 below a depth of 36 inches. They generally are below Judson soils. Moody and Nora soils have a thinner A horizon, a more strongly developed B horizon, and are above Judson soils. Monona soils have a thinner A horizon, a more strongly developed B horizon, and are below the Judson soils on stream terraces.

Typical pedon of Judson silt loam, 2 to 6 percent slopes, 528 feet west and 50 feet north of the southeast corner of sec. 24, T. 18 N., R. 7 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—7 to 19 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A3—19 to 27 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium and coarse subangular blocky structure; slightly hard, friable; medium acid; clear wavy boundary.

B2—27 to 38 inches; dark brown (10YR 3/3) silty clay loam, dark brown (10YR 4/3) dry; moderate medium and coarse subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B3—38 to 50 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; few medium prominent reddish brown (2.5YR 5/4) mottles; weak medium and coarse subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

C—50 to 60 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; common coarse prominent reddish brown (2.5YR 5/4) mottles; massive; slightly hard, friable; slightly acid.

The solum is 40 to 60 inches thick. The A horizon is 20 to 36 inches thick.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 through 3. The A horizon is silt loam, but the range includes light silty clay loam. Reaction is slightly acid to medium acid. The B horizon has value of 3 through 5 moist and 4 or 5 dry. Its clay content ranges from 30 to 35 percent. The C horizon has value of 4 or 5 moist and 5 or 6 dry and chroma of 3 or 4.

Kennebec series

The Kennebec series consists of deep, well drained soils on bottom lands of narrow stream valleys. Permeability is moderate. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Kennebec soils are near Colo, Judson, and Zook soils. Colo soils are somewhat poorly drained, have more clay in the control section, and are at a slightly lower elevation than the Kennebec soils. Judson soils are more strongly developed, are less stratified, and are on foot slopes above Kennebec soils. Zook soils are poorly

drained, have more clay in the control section, and are at a lower elevation than the Kennebec soils.

Typical pedon of Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes, 1,056 feet north and 1,052 feet east of the southwest corner of sec. 7, T. 20 N., R. 5 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; hard, friable; neutral; abrupt smooth boundary.

A12—8 to 17 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak coarse and medium prismatic structure parting to strong medium and fine subangular blocky; hard, friable; neutral; abrupt smooth boundary.

A13—17 to 29 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; neutral; abrupt smooth boundary.

AC—29 to 37 inches; very dark grayish brown (10YR 3/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak coarse prismatic structure parting to moderate fine granular; hard, friable; slightly acid; abrupt smooth boundary.

C—37 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium and fine subangular blocky structure; hard, friable; neutral.

The solum and mollic epipedon are more than 36 inches thick. Free carbonates are not evident in the solum and typically are not evident to a depth of 60 inches or more.

The A horizon has value of 2 or 3 moist and 2 or 3 dry and chroma of 1 or 2. In the lower part of the A horizon, value may increase gradually 1 or 2 units with increasing depth. This horizon is typically silt loam, but the range includes silty clay loam. The C horizon has value of 2 or 3 moist and 2 through 4 dry and chroma of 1 through 3. The entire pedon is slightly acid to neutral.

Leisy series

The Leisy series consists of deep, well drained soils on uplands. Permeability is moderately rapid in the upper part and moderately slow in the lower part of the pedon. These soils formed in mixed eolian sand and loess. Slopes range from 2 to 6 percent.

Leisy soils are near Moody and Thurman soils. Moody soils have less sand in the control section than the Leisy soils. Thurman soils have more sand, less clay, and less silt in the control section than the Leisy soils. Both soils are on similar landscapes as the Leisy soils.

Typical pedon of Leisy fine sandy loam, 2 to 6 percent slopes, 1,600 feet north and 200 feet east of the southwest corner of sec. 5, T. 20 N., R. 7 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A12—8 to 20 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to weak fine granular; hard, friable; slightly acid; clear wavy boundary.

B1—20 to 28 inches; dark brown (10YR 4/3) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to medium and fine subangular blocky; hard, friable; neutral; abrupt smooth boundary.

B2t—28 to 42 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate medium and coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, friable; neutral; clear wavy boundary.

B3—42 to 60 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; weak medium and coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; neutral.

The mollic epipedon is 10 to 20 inches thick. Carbonates are below a depth of 50 inches in some pedons.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. It is typically fine sandy loam and less commonly loam or loamy fine sand. The B1 horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 2 or 3. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 2 through 4. It is silty clay loam or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 through 7 dry, and chroma of 2 through 4. It is silty clay loam, clay loam, loam, or silt loam, but in some places below a depth of 55 inches, the range is fine sandy loam to fine sand.

Luton series

The Luton series consists of deep, poorly drained soils on bottom lands. Permeability is very slow. These soils formed in clayey alluvial sediments. Slopes range from 0 to 2 percent.

Luton soils are near Gibbon, Saltine, and Zook soils. Gibbon soils have less clay and are at a slightly higher elevation than the Luton soils. Saltine soils have a higher sodium content than the Luton soils, have less clay, and are at a similar elevation. Zook soils have less clay in the control section than the Luton soils, are noncalcareous, and are at a similar or slightly higher elevation.

Typical pedon of Luton silty clay, 0 to 2 percent slopes, 1,320 feet north and 50 feet east of the southwest corner of sec. 1, T. 17 N., R. 8 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay, black (10YR 2/1) dry; weak fine subangular blocky struc-

ture; very hard, extremely firm; very sticky; mildly alkaline; abrupt smooth boundary.

A12—7 to 16 inches; black (10YR 2/1) silty clay, black (10YR 2/1) dry; weak coarse prismatic structure parting to moderate very fine subangular blocky; very hard, extremely firm; very sticky; mildly alkaline; abrupt smooth boundary.

A3—16 to 22 inches; black (10YR 2/1) silty clay, black (10YR 2/1) dry; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; very hard, extremely firm; very sticky; mildly alkaline; abrupt smooth boundary.

B21—22 to 31 inches; black (10YR 2/1) silty clay, very dark grayish brown (10YR 3/2) dry; moderate coarse prismatic structure parting to strong medium and fine subangular blocky; very hard, extremely firm; very sticky; slight effervescence; moderately alkaline; clear wavy boundary.

B22g—31 to 36 inches; very dark gray (5Y 3/1) silty clay, dark gray (2.5Y 4/1) dry; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; very hard, extremely firm; very sticky; strong effervescence; moderately alkaline; abrupt smooth boundary.

B3g—36 to 43 inches; dark gray (2.5Y 3/1) silty clay, dark gray (2.5Y 4/1) dry; few fine distinct reddish brown (2.5YR 5/4) mottles; weak coarse subangular blocky structure; very hard, extremely firm; very sticky; strong effervescence; moderately alkaline; abrupt smooth boundary.

Cg—43 to 60 inches; dark gray (2.5Y 4/1) silty clay, gray (2.5Y 5/1) dry; few fine distinct reddish brown (2.5YR 5/4) mottles; massive; very hard, extremely firm; very sticky; strong effervescence; moderately alkaline.

The solum typically is 36 to 48 inches thick. The matrix is not calcareous above a depth of 36 inches, but some secondary carbonates are in the B horizon.

The A horizon has value of 0 or 2 moist and 0 or 2 dry and chroma of 0 or 1. The A horizon is dominantly silty clay, but the range includes clay. Some small areas have 6 to 18 inches of silt loam or silty clay loam on the surface. The B horizon has hue of 10YR or 5Y, value of 4 or 5 moist or dry, and chroma of 1 or 2. The B horizon typically is 50 to 60 percent clay, but some pedons have layers that are 60 to 70 percent clay. The C horizon has the same color and texture range as that of the B horizon.

Monona series

The Monona series consists of deep, well drained soils on stream terraces. These soils formed in silty loess that covered the terraces. Slopes range from 0 to 6 percent.

Monona soils are near Colo, Kennebec, Judson, and Moody soils. Colo and Kennebec soils have a thicker surface layer and are at a lower elevation than the Monona soils. Judson soils have a thicker surface horizon and a darker colored control section and are at the base of upland slopes above the Monona soils. Moody soils have more clay in the surface soil and subsoil and are on uplands above Monona soils.

Typical pedon of Monona silt loam, terrace, 0 to 2 percent slopes, 2,112 feet east and 100 feet north of the southwest corner of sec. 33, T. 19 N., R. 6 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A12—7 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure parting to weak medium and fine subangular blocky; hard, friable; slightly acid; abrupt smooth boundary.

B1—10 to 17 inches; brown (10YR 4/3) silt loam, yellowish brown (10YR 5/4) dry; weak fine prismatic structure parting to weak fine and very fine subangular blocky; hard, friable; slightly acid; clear wavy boundary.

B2—17 to 25 inches; brown (10YR 4/3) silt loam, yellowish brown (10YR 5/4) dry; moderate coarse and medium prismatic structure parting to strong medium and fine subangular blocky; hard, friable; mildly alkaline; clear wavy boundary.

B3—25 to 33 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and fine prismatic structure parting to weak medium and fine subangular blocky; hard, friable; mildly alkaline; abrupt smooth boundary.

C—33 to 60 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; few medium prominent reddish brown (2.5YR 4/4) mottles; massive; hard, friable; violent effervescence; moderately alkaline.

The A horizon is 10 to 18 inches thick. Depth to free carbonates is generally about 4 feet, but it can range from 2 to 6 feet.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. Clay content ranges from 24 to 27 percent in most pedons. It is slightly acid or medium acid. The B horizon has value of 4 or 5 moist and 5 or 6 dry and chroma of 3 or 4. This horizon has 24 to 27 percent clay in most pedons. It is slightly acid or medium acid. The C horizon has value of 4 or 5 moist and 5 through 7 dry and chroma of 3 through 6. It is neutral to moderately alkaline. Pedons generally have sand and gravel within a depth of 5 feet and less commonly at a depth of 3 1/2 feet.

Moody series

The Moody series consists of deep, well drained soils on uplands and stream terraces. Permeability is moderately slow. These soils formed in silty loess (fig. 12). Slopes range from 0 to 11 percent.

Moody soils are near Belfore, Nora, Leisy, and Thurman soils. Belfore soils have more clay in the B horizon and have free carbonates at a greater depth. Nora soils have less clay in the upper part of the B horizon and have free carbonates nearer the surface. Leisy soils have more sand in the control section. Thurman soils have more sand, less clay, and are on undulating or rolling uplands.

Typical pedon of Moody silty clay loam, 2 to 6 percent slopes, 1,320 feet south and 50 feet east of the northwest corner of sec. 23, T. 18 N., R. 7 E.

Ap—0 to 9 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B21—9 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; neutral; abrupt smooth boundary.

B22—12 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable;. neutral; abrupt smooth boundary.

B23—20 to 34 inches; dark brown (10YR 4/3) silty clay loam; pale brown (10YR 6/3) dry; weak medium prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable; neutral; abrupt smooth boundary.

B3—34 to 40 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable; neutral; abrupt smooth boundary.

C1—40 to 48 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; common medium distinct reddish brown (2.5YR 5/4) mottles; massive, slightly hard, friable; neutral; abrupt smooth boundary.

C2—48 to 60 inches; brown (10YR 5/3) silty clay loam, light yellowish brown (10YR 6/4) dry; common medium distinct reddish brown (2.5YR 5/4) mottles; massive; slightly hard, friable; neutral.

The mollic epipedon is 10 to 17 inches thick and includes the A horizon and extends into the B horizon. The solum is about 30 to 60 inches thick. Depth to free carbonates typically is about 40 inches but ranges from 30 to 60 inches.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 2. It typically is silty clay loam, but the range includes silt loam. This horizon is medium acid through neutral. The B21 horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 2 or 3. The remainder of the B2 horizon generally has hue of 10YR or 2.5Y, value of 3 through 5 moist and 5 or 6 dry, and chroma of 2 through 4. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 5 through 7 dry, and chroma of 2 through 4. This horizon is silt loam or silty clay loam. It is mildly or moderately alkaline.

In map units MoC2 and MoD2, the A horizon is lighter in color and thinner than defined as the range for the Moody series. These differences, however, do not alter the use or behavior of the soil.

Nora series

The Nora series consists of deep, well drained soils on uplands. Permeability is moderate. These soils formed in silty loess (fig. 13). Slopes range from 2 to 15 percent.

Nora soils are near Crofton, Judson, Moody, and Steinauer soils. Crofton soils do not have a mollic epipedon; they have free carbonates at a shallower depth and are on a similar landscape. Judson soils have a thicker mollic epipedon and are on foot slopes below Nora soils. Moody soils have a thicker solum, have lime that is at a lower depth in the pedon, and are less sloping but on a similar landscape. Steinauer soils are not so well developed, formed in glacial till, and are on uplands.

Typical pedon of Nora silty clay loam, 6 to 11 percent slopes, 2,376 feet west and 1,056 feet south of the northeast corner of sec. 11, T. 20 N., R. 8 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

B21—8 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine prismatic structure parting to weak medium and fine subangular blocky; hard, friable; slightly acid; clear wavy boundary.

B22—12 to 21 inches; dark brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; weak coarse and medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable; slightly acid; abrupt smooth boundary.

B3—21 to 25 inches; dark brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; weak coarse and medium prismatic structure parting to weak medium and fine subangular blocky; hard, friable; mildly alkaline; abrupt smooth boundary.

Clca—25 to 34 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine faint distinct strong brown (7.5YR 5/6) mot-

tles; weak coarse prismatic structure parting to weak fine and very fine subangular blocky structure; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C2—34 to 42 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; massive; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C3—42 to 60 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; many coarse dark reddish brown (5YR 3/4) mottles; common medium prominent reddish brown (2.5YR 4/4) iron concretions; massive; hard, friable; violent effervescence; moderately alkaline.

The solum is about 20 to 36 inches thick. Depth to carbonates typically is 20 to 25 inches but ranges from 12 to 30 inches. The mollic epipedon is 7 to 15 inches thick and extends into the B horizon in some pedons.

The A horizon has value of 2 or 3 moist and 3 or 4 dry. It typically is silt loam, but the range includes silty clay loam. It is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 or 4. It is silt loam or silty clay loam generally with less than 35 percent clay. It is slightly acid to mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 through 6 moist and 5 through 7 dry, and chroma of 2 through 4.

In map units NoC2, NoD2, and NoE2, the A horizon is lighter in color and thinner than defined as the range for the Nora series. These differences, however, do not affect the use or behavior characterictics of the soil.

Platte series

The Platte series consists of soils that are shallow over coarse sand and gravelly sand. The soils are somewhat poorly drained and are on bottom lands. In the upper part they have moderately rapid permeability, and in the lower part they have very rapid permeability. They formed in loamy alluvium that is underlain by gravelly sand. Slopes range from 0 to 3 percent.

Platte soils are near and slightly lower than the Alda, Boel, Cass, and Wann soils. Alda soils have coarse sand or gravelly sand between a depth of 20 and 40 inches. Boel soils are deep and have less gravel in the control section. Cass soils are deep, and well drained and have less sand in the control section. Wann soils are deep and have less sand and gravel in the control section.

Typical pedon of Platte loam, 0 to 2 percent slopes, 100 feet west and 3,696 feet south of the northeast corner of sec. 14, T. 17 N., R. 6 E.

Ap—0 to 5 inches; black (10YR 2/1) loam, dark gray (10YR 4/I) dry; weak fine granular structure; slightly hard, friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A12—5 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—12 to 16 inches; very dark brown (10YR 2/2) fine sandy loam, gray (10YR 5/1) dry; weak coarse blocky structure; soft, very friable; slight effervescence; neutral; abrupt smooth boundary.

IIC—16 to 60 inches; light brownish gray (10YR 6/2) gravelly sand, light gray (10YR 7/2) dry; many coarse faint reddish brown (5YR 4/3) mottles; single grained; loose; mildly alkaline.

The thickness of the solum ranges from 5 to 12 inches and corresponds to that of the A horizon. The depth to coarse sand or gravelly sand ranges from 12 to 20 inches. Free carbonates typically are disseminated through the A horizons. They commonly are deeper on the drier sites and are not evident in some pedons on the more moist sites.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. Typically, it is loam or fine sandy loam, but the range in texture includes clay loam to loamy fine sand. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (6 or 7 dry), and chroma of 1 or 2. The IIC horizon ranges from coarse sand to mixed or stratified sand and gravel.

Saltine series

The Saltine series consists of deep, somewhat poorly drained soils on bottom lands and stream terraces. Permeability is slow. These soils formed mainly in silty alluvium or loess that is high in exchangeable sodium. Slopes range from 0 to 2 percent.

Saltine soils are near Colo, Gibbon, Luton, and Zook soils. Colo and Gibbon soils have a mollic epipedon, are not so alkaline, and are at about the same or slightly higher elevation than the Saltine soils. Luton and Zook soils have a mollic epipedon, more clay in the control section, are not so alkaline, and are at about the same elevation as the Saltine soils.

Typical pedon of Saltine silty clay loam, in an area of Saltine-Gibbon complex, 0 to 2 percent slopes, 792 feet west and 100 feet south of the northeast corner of sec. 4, T. 17 N., R. 6 E.

Ap—0 to 7 inches; very dark gray brown (10YR 3/2) silty clay loam, gray (10YR 5/1) dry; weak very fine granular structure; slightly hard, friable; strongly alkaline; abrupt smooth boundary.

B1—7 to 12 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; strong medium and coarse blocky structure parting to strong fine and medium blocky; hard, firm, sticky; slight effervescence; strongly alkaline; clear smooth boundary.

B2—12 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; strong medium and coarse blocky structure parting to strong medium and fine blocky; hard, firm, sticky; violent effervescence; strongly alkaline; clear smooth boundary.

C1—30 to 48 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; massive; hard, firm, sticky; strong effervescence; very strongly alkaline; abrupt smooth boundary.

C2—48 to 55 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; few fine faint yellowish brown (10YR 5/4) mottles, massive; hard, firm, sticky; very strongly alkaline; clear smooth boundary.

C3—55 to 60 inches; dark gray (10YR 4/1) sandy clay loam, gray (10YR 6/1) dry; few fine faint yellowish brown (10YR 5/4) mottles; massive; hard, firm, sticky; very strongly alkaline.

The solum is 16 to 39 inches thick. The surface layer typically does not have free carbonates, but depth to free carbonates ranges from 0 to 10 inches. Above a depth of 20 inches, the soil is generally saline; conductivity of the saturation extract typically ranges from 4 to 8 millimhos per centimeter, but in some seasons, conductivity is less than 4 millimhos per centimeter. Sodium absorption ratio is greater than 13 above a depth of 20 inches and increases with depth below 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 through 5 moist and 4 through 6 dry, and chroma of 1 or 2. Typically, it is silty clay loam or silt loam and less commonly loam and clay loam. It is neutral to strongly alkaline. The B horizon has hue of 10YR or 2.5Y, value of 3 through 6 moist and 4 through 7 dry, and chroma of 1 or 2. Typically, it is silty clay loam or silt loam and has between 18 and 35 percent clay, but some pedons have layers that are loam, clay loam, or silty clay. It is strongly or very strongly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 2 through 5 moist and 5 or 6 dry, and chroma of 1 through 3. This horizon is typically silty clay loam or silt loam. Some pedons have thin layers of loam, clay loam, and silty clay above a depth of 40 inches. Below a depth of 40 inches, the soil material is typically silty clay loam, but some pedons are finer or coarser textured. The C horizon is mildly alkaline to very strongly alkaline.

Steinauer series

The Steinauer series consists of deep, well drained soils on uplands. Permeability is moderately slow. These soils formed in calcareous glacial till. Slopes range from 11 to 30 percent.

Steinauer soils are near Crofton and Nora soils. Crofton soils have less fine sand and coarser sand in the control section and formed in loess. Nora soils are more strongly developed, have less sand in the control section, and formed in loess.

Typical pedon of Steinauer clay loam, 11 to 30 percent slopes, eroded, 2,112 feet north and 528 feet west of the southeast corner of sec. 33, T. 20 N., R. 8 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; hard, friable; violent effervescence; mildly alkaline; abrupt smooth boundary.

AC—6 to 18 inches; yellowish brown (10YR 5/4) clay loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure parting to strong medium and fine subangular blocky; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—18 to 34 inches; 60 percent yellowish brown (10YR 5/4) and 40 percent gray (10YR 6/1) clay loam, pale brown (10YR 6/3) dry; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, friable; violent effervescence; moderately alkaline; clear wavy boundary.

C2—34 to 60 inches; yellowish brown (10YR 5/4) clay loam, very pale brown (10YR 7/3) dry; massive; few medium distinct reddish brown (2.5YR) mottles; violent effervescence; moderately alkaline.

The solum is 8 to 21 inches thick, depending on the slope. The content of pebbles and stones on the surface and in the pedon ranges from less than 1 to 10 percent by volume. Depth to free carbonates ranges from near the surface to about 14 inches below the surface.

The A horizon has value of 4 or 5 moist and 5 or 6 dry. Some pedons have a thin, mollic A horizon less than 6 inches thick. This horizon is dominantly clay loam but ranges from loam to gravelly clay loam. It is mildly or moderately alkaline. The AC horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and dry, and chroma of 1, 2, or 4. It generally has slightly more clay than the A horizon. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 6 or 7 dry, and chroma of 1, 3, or 4. It is loam or clay loam and has thin layers of light clay and seams or pockets of sand and gravel. Stones, pebbles, lime, and iron concretions vary in size and amount from place to place.

Thurman series

The Thurman series consists of deep, somewhat excessively drained soils on uplands. Permeability is rapid. These soils formed in sandy eolian material. Slopes range from 2 to 30 percent.

Thurman soils are near Moody and Leisy soils. Moody soils have more clay, more silt, less sand, and are at a lower elevation than the Thurman soils. Leisy soils have more clay and less sand in the control section and are generally at a lower elevation than the Thurman soils.

Typical pedon of Thurman loamy fine sand, 2 to 6 percent slopes, 125 feet north and 792 feet west of the southeast corner of sec. 6, T. 20 N., R. 7 E.

Ap—0 to 5 inches; very dark grayish brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; single grained; loose; neutral; abrupt smooth boundary.

A12—5 to 12 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; single grained; loose; neutral; abrupt smooth boundary.

AC—12 to 20 inches; dark yellowish brown (10YR 4/4) loamy fine sand, brown (10YR 5/3) dry; single grained; loose; neutral; clear wavy boundary.

C1—20 to 48 inches; yellowish brown (10YR 5/4) fine sand, light yellowish brown (10YR 6/4) dry; single grained; loose; neutral; clear wavy boundary.

C2—48 to 60 inches; yellowish brown (10YR 5/4) fine sand, light yellowish brown (10YR 6/4) dry; few medium distinct dark reddish brown (2.5YR 3/4) mottles; single grained; loose; neutral.

The solum is 12 to 28 inches thick. The soil is slightly acid or neutral throughout the pedon. Free carbonates are not present within a depth of 5 feet, except where soils are underlain by calcareous material.

The A horizon has value of 2 or 3 moist and 3 through 5 dry and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes loamy sand, fine sand, and fine sandy loam. The AC horizon is a transition layer between the A and C horizons, but it is more like the A horizon. The C horizon has value of 5 or 6 moist or dry and chroma of 2 through 4. It is loamy fine sand or fine sand. A buried A horizon is at a depth of 40 to 60 inches in some pedons.

Wann series

The Wann series consists of deep, somewhat poorly drained soils on bottom lands. Permeability is moderately rapid. These soils formed in stratified, calcareous, recent alluvium. Slopes range from 0 to 2 percent.

Wann soils are near Alda, Boel, Gibbon, and Platte soils. Alda soils have coarse sand and gravelly sand between a depth of 20 and 40 inches and are at a slightly lower elevation than Wann soils. Boel soils have more sand in the control section, and Gibbon soils have a finer textured solum; both soils are at the same elevation as the Wann soils. Platte soils have coarse sand or gravelly sand between a depth of 10 and 20 inches and are at a slightly lower elevation than the Wann soils.

Typical pedon of Wann loam, 0 to 2 percent slopes, 50 feet north and 50 feet east of the southwest corner of sec. 29, T. 17 N., R. 9 E.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

A12—7 to 15 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak medium and fine subangular blocky; hard, friable; violent effervescence; moderately alkaline; clear wavy boundary.

AC—15 to 19 inches; very dark grayish brown (10YR 3/2) fine sandy loam, gray (10YR 5/1) dry; weak fine granular structure; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—19 to 23 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; few fine distinct reddish brown (2.5YR 4/4) mottles; weak fine granular structure; loose; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2—23 to 50 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/1) dry; massive; loose; moderately alkaline; clear wavy boundary.

C3—50 to 60 inches; gray (10YR 5/1) sandy loam, light gray (10YR 7/1) dry; single grained; loose; moderately alkaline.

The mollic epipedon is 11 to 20 inches thick. Some pedons do not have carbonates to a depth of about 10 inches.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. The A1 or Ap horizon typically is fine sandy loam or loam, but the upper 10 inches is silt loam to loamy sand. The C horizon has hue of 10YR or 2.5Y and value of 4 through 6 moist and 5 through 7 dry. It is fine sandy loam or sandy loam and typically is coarser textured below a depth of 40 inches. Thin strata of loam or loamy sand 1 to 3 inches thick are common in the C horizon.

Zook series

The Zook series consists of deep, poorly drained soils (fig. 14) on bottom lands. Permeability is slow. These soils formed in silty and clayey alluvium. Slopes range from 0 to 2 percent.

Zook soils are near Colo, Gibbon, Luton, and Saltine soils. Colo and Gibbon soils have less clay in the control section, are better drained, and are at a slightly higher elevation than the Zook soils. Luton soils have more clay and are at a similar elevation as the Zook soils. Saltine soils have more sodium, have less clay in the control section, and are at a similar elevation as the Zook soils.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, 2,640 feet west and 100 feet north of the southeast corner of sec. 34, T. 19 N., R. 5 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium and fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A12—7 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to strong medium and fine subangular blocky; hard, friable; slightly acid; clear wavy boundary.

A3—13 to 18 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium and coarse prismatic structure parting to strong medium and fine subangular blocky; hard, friable; slightly acid; abrupt smooth boundary.

Bg—18 to 43 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong coarse and medium prismatic structure parting to strong coarse and medium subangular blocky; very hard, firm, sticky; neutral; clear wavy boundary.

Cg—43 to 60 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; massive; very hard, firm, sticky; neutral.

The solum typically is more than 40 inches thick but ranges in thickness from 36 to 64 inches. The mollic epipedon is 36 to 50 inches thick. Zook soils are generally medium or slightly acid, but they can be neutral or mildly alkaline or more alkaline. They are noncalcareous to a depth of 50 inches or more.

The A horizon has value of 2 in the upper part and 3 in the lower part and chroma of 1 or 0. It is dominantly silty clay loam and silty clay, but the range includes silt loam in areas where this material is overwash. Below a depth of 16 inches, the B and C horizons are 38 to 46 percent clay, and the amount of clay generally is constant to a depth of about 4 feet or more. These horizons have value of 3 or 5 moist and chroma of 1.

Formation of the soils

Soil is produced by soil-forming processes acting on material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, 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 other four factors. Many of the processes of soil development are unknown.

Parent material

Parent material is the disintegrated and partly weathered rock in which soil forms. It determines the mineralogical and chemical composition of the soil. The soils of Dodge County formed in five kinds of parent material: Peoria and younger loess, glacial till, alluvium, eolian sand, and colluvium.

Loess in Dodge County is brown or yellowish brown, friable, calcareous material that was blown out of river and stream valleys and deposited by the wind on uplands. It consists mostly of silt, and it has some clay and small amounts of sand. The thickness of the loess deposit is commonly 30 to 45 feet, but it can range from a few feet to more than 100 feet. Belfore, Moody, and Nora soils formed in this material.

Beneath the Peoria loess is a thin layer of reddish brown or strong brown material of the Loveland Formation. It is exposed on some of the steeper side slopes in a few places. This material is assumed to be of loess origin. No soils in this survey area are recognized as having been formed in this material.

Beneath the Loveland Formation is glacial till of Kansan age. This till is exposed on side slopes along some of the major streams and in deep gullies. This material is clayey and has some gravel, pebbles, and small stones. The total acreage of soils formed in glacial till is small because only scattered areas occur. Steinauer soils formed in this material.

In Dodge County, alluvium ranges from clay to fine sand in texture. It is commonly stratified. This material was deposited to a depth of 1 to 8 feet over mixed sand and gravel. The most recent alluvium occurs in the narrow upland drainageways and along the major streams where fresh material is deposited by flooding after heavy rains. Colo, Janude, Gibbon, and Inavale soils formed in alluvium. The alluvium along the smaller streams originates mainly from the adjacent uplands. The alluvium in the flood plains of the Platte and Elkhorn Rivers and Logan Creek was transported by the streams and is mixed material derived from the adjacent uplands and from areas outside the county.

The sandy upland soils lying between the Elkhorn River and Cuming Creek are formed in eolian sand mixed with loess. The sand was blown out of the Elkhorn

River valley by northwesterly winds and deposited on the loess. The mantle ranges from a few feet to 30 feet in thickness. Leisy soils formed in a mixture of sand and silt; Thurman soils formed mainly in eolian sand. Other areas have pockets of deep sand on some slopes adjacent to the major valleys. This sand was probably deposited by water and not by wind.

Colluvium consists of recent, deep sediment of friable material deposited by the combined effects of gravity and moving water. It occurs on foot slopes adjacent to the steeper uplands. The colluvium deposits are mostly silt and some clay and a small amount of sand. They are mainly very dark grayish brown or brown and generally range from 2 to 6 feet in thickness. In Dodge County, Judson soils formed in colluvium.

There are no formations of exposed bedrock in Dodge County.

Climate

Climate affects the formation of soils by influencing the rate of weathering and reworking of parent material by rainfall, temperature, and wind. Because soil formation progresses slowly when the soil is dry, soils in arid regions generally are less well developed than those in humid regions. Such factors as the amount of moisture, the length of the growing season, and the prevailing temperature during the growing season affect the amount of vegetation, which is the main source of organic matter in soils. These same factors directly affect the activity of the micro-organisms that convert organic matter to humus. Wind is an important factor because it can remove the top layer of soil, or it can deposit a mantle of sediment on soil.

Dodge County has a continental climate that is characterized by wide daily and seasonal variations. The average annual temperature is 50 degrees F. The average annual precipitation is 28 to 30 inches. Damaging hail storms are infrequent. Because the frost-free season generally is about 160 days, the growing season is adequate for many grain and forage crops. If moisture is sufficient, frost penetrates to a depth of 2 to 3.5 feet. The prevailing direction of the wind is from the south or southeast from May to September and from the northwest during the remainder of the year.

Because the climate is fairly uniform throughout the county, differences in the soils are the result of the interrelationship of the climate and the other soil forming factors. For example, the amount of leaching is dependent not only on the amount of precipitation but also on the relief in the area. Because runoff and evaporation are greater, there is less leaching in the steeper soils and in soils that are exposed more directly to the wind than in the nearly level soils that receive the same amount of rainfall. Erosion caused by rain, melting snow, and wind can prevent the development of a thick surface layer, especially in the steeper areas.

Plant and animal life

After the parent material was deposited, bacteria, fungi, and other simple forms of life invaded it. After a time, prairie grasses began to grow, and fibrous roots penetrated the upper few feet of the soil. The grass roots helped to keep the soils productive by bringing water from the deeper horizons and thus contributing soluble minerals such as calcium, iron, phosphorus, nitrogen, and sulfur. They also helped to develop better soil structure and improve soil aeration.

When plants decay, micro-organisms act on the organic matter and decompose it into stable humus. These micro-organisms include bacteria, nematodes, and protozoa. Nitrogen-fixing bacteria in nodules on the roots of certain legumes remove nitrogen from the air; when the bacteria die, the nitrogen becomes available in the soil. Fungi and such small animals as millipedes, spiders, and mites also act on organic matter and decompose it into humus. Earthworms, insects, and small burrowing animals affect the formation of soils. They mix and work the organic and mineral matter, quickening soil development and making the soil more friable.

As decayed organic matter accumulates, the color gradually darkens and the physical and chemical characteristics of the surface layer change. The soil is enriched with plant nutrients from the decaying organic matter. The tilth is improved, permeability to air and water is established, and water movement into the soil and through the soil is increased. In Dodge County, Colo and Judson soils have a high content of organic matter and Crofton and Inavale soils have a low content of organic matter.

Relief

Relief, or the lay of the land, influences soil formation mainly through its effect on drainage, runoff, and vegetative growth. The degree of slope, shape of the surface, and permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soils. Internal drainage and availability of moisture are important factors in forming the horizons of a soil.

The nearly level and gently sloping soils on uplands have stronger development and more distinct soil horizons than the steeper soils. They absorb more moisture, and water percolates deeper into the profile. Because lime and plant nutrients are leached to a greater depth, a B horizon develops. The nearly level Belfore and the nearly level and gently sloping Moody soils have distinct horizons.

On steep slopes, where runoff is rapid and little moisture penetrates the soil, development of the soil is slower than on the gentler slopes. Erosion removes the surface soil almost as fast as it forms. Lime and other elements are not leached so deeply. In Dodge County, the steep and very steep Crofton soils have little devel-

opment in a soil profile other than a slightly darkened, thin surface layer.

Nearly level soils on bottom lands may receive extra water through runoff from adjacent slopes. In these areas the soils are somewhat poorly drained because of slow runoff or a moderately high water table. Where the water table is moderately high, moisture is brought from the saturation zone to the root zone by capillary action and is used by plants. The moisture in the soil affects the kind and amount of vegetation, which in turn influences soil development. In Dodge County, the Alda, Boel, Colo, Gibbon, Platte, and Wann soils are somewhat poorly drained.

Because of the differences in the lay of the land, some processes of horizon differentiation are slowed, and others are hastened. Relief is a local factor of soil formation. Generally, soils that have gentle slopes have a thick solum and distinct horizons; soils that have steeper slopes have a thinner solum and less distinct horizons.

Time

Time is required for the formation of a mature soil. Mature or old soils have a thick, dark colored surface layer and a distinct subsoil. Soils that formed in soil materials that have been in place long enough for climate, plant and animal life, and relief to alter the parent material are considered to be mature or old soils. In Dodge County, Belfore and Moody soils are mature soils that have well expressed horizons.

Most of the soils on bottom land do not have well developed horizons because new deposits of alluvium are laid down before soil development can take place. The soils with moderately steep slopes have been in place long enough for horizons to form, but because of the slope, soil material is removed by erosion before well expressed horizons can form. Kennebec and Inavale soils are examples of immature soils on bottom land, and Crofton and Steinauer soils are examples of immature soils on uplands.

The degree of profile development depends on the intensity of the different soil-forming factors, on the length of time they have been active, and on the nature of the parent material. Differences in the length of time that geologic materials have been in place are therefore commonly reflected in the distinctness of horizons in the soil profile.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping 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—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse textured (light textured) soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

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 in which a limited amount of soil is disturbed and a maximum amount of soil residue is retained on the surface. Such a system promotes optimum growing conditions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth, soil. The total thickness of weathered soil material to mixed sand and gravel or bedrock. The classes of soil depth are very shallow, 0 to 10 inches; shallow, 10 to 20 inches; moderately deep, 20 to 40 inches; and deep, more than 40 inches.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden

deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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 running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or

commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

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.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

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.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Organic matter. A general term for plant material, which is in or on the soil, in all stages of decomposition.

Organic matter content. The amount of organic matter in soil material. The classes of organic matter content used in this survey are very low, less than 0.5 percent organic matter present; low, 0.5 to 1.0 percent; moderately low, 1.0 to 2.0 percent; moderate, 2.0 to 4.0 percent; and high, 4.0 to 8.0 percent.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree 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 be-

cause it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, the slope is described as *nearly level* if it is 0 to 2 percent, *gently sloping* if 2 to 6 percent, *strongly sloping* if 6 to 11 percent, *moderately steep* if 11 to 15 percent, *steep* if 15 to 30 percent, and *very steep* if 30 to 60 percent.

Slow intake. The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

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 or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.
Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.
Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.
Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

ILLUSTRATIONS

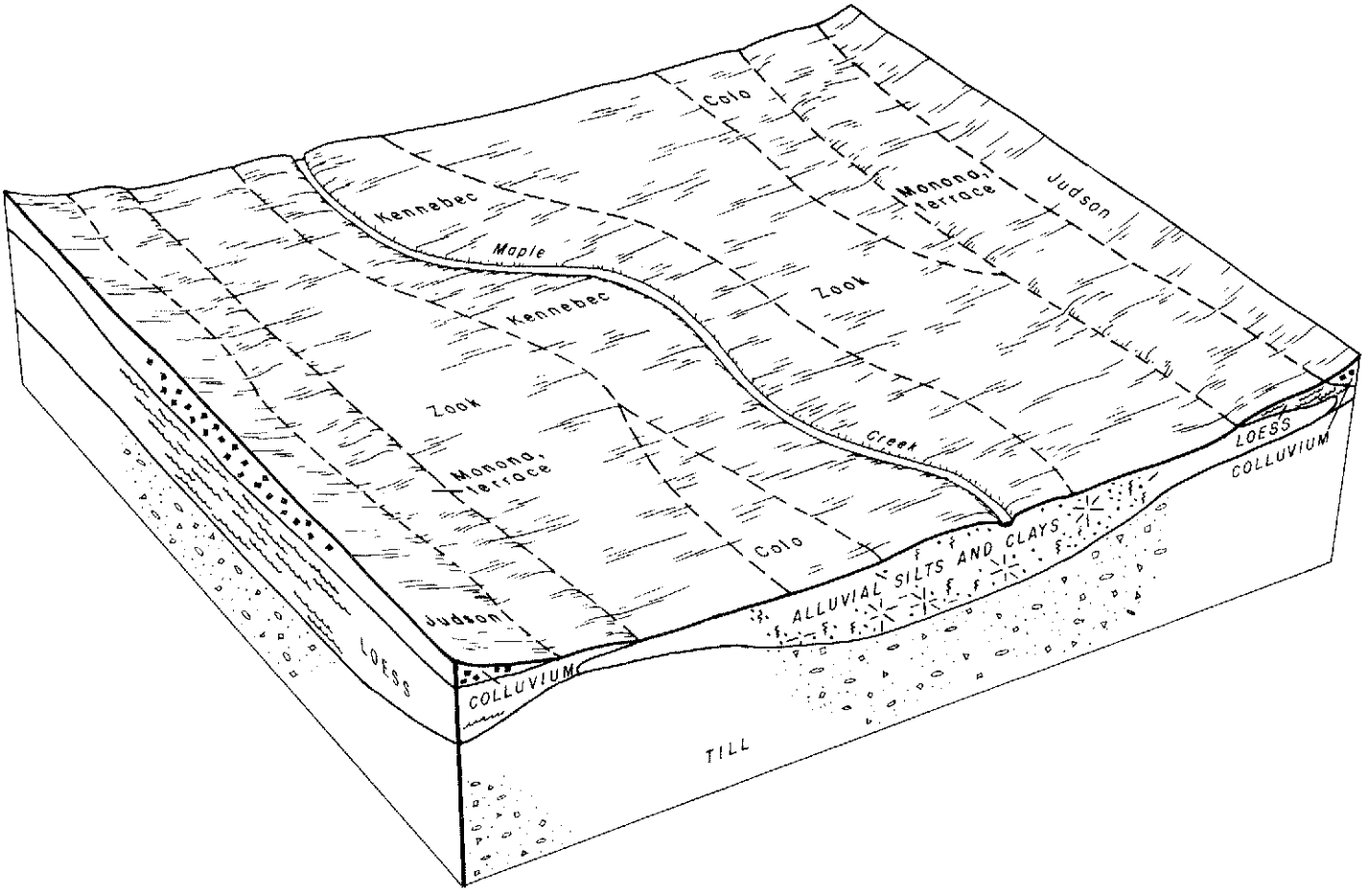

Figure 1.—Typical pattern of soils in the Zook-Kennebec-Judson association and the relationship of the soils to topography and parent material.

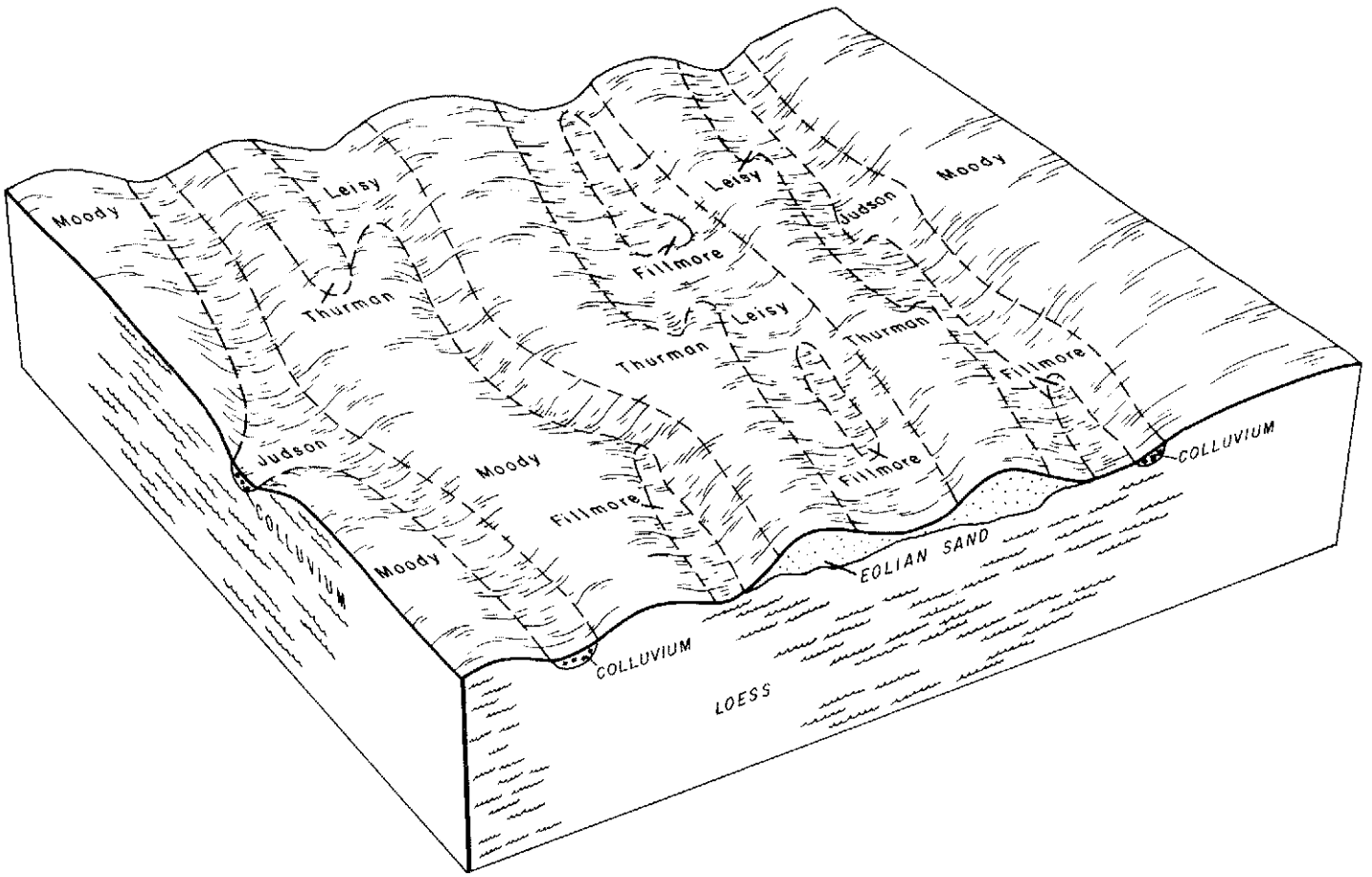

Figure 2.—Typical pattern of soils in the Moody-Thurman-Leisy association and the relationship of the soils to topography and parent material.

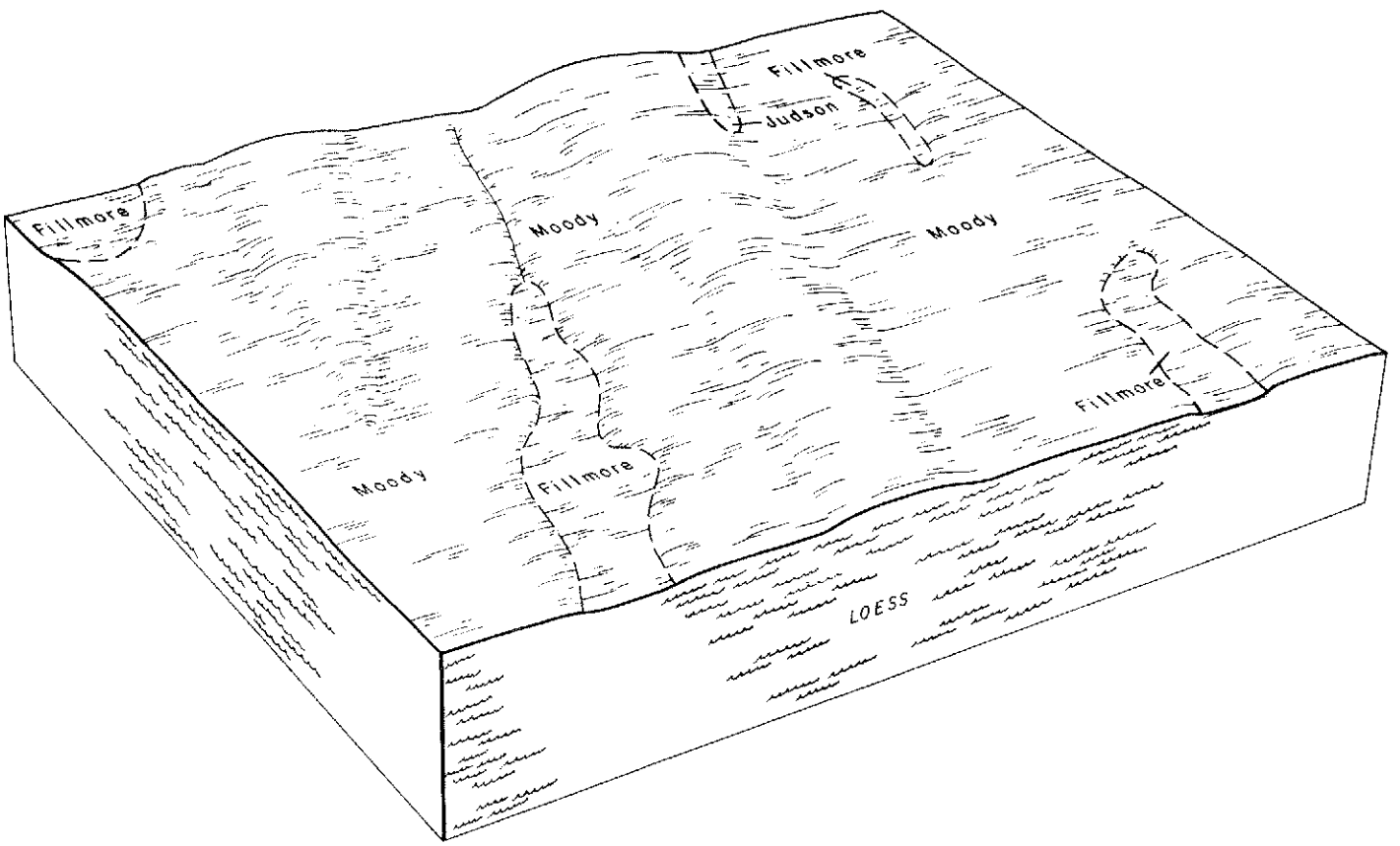

Figure 3.—Typical pattern of soils in the Moody-Fillmore association and the relationship of the soils to topography and parent material.

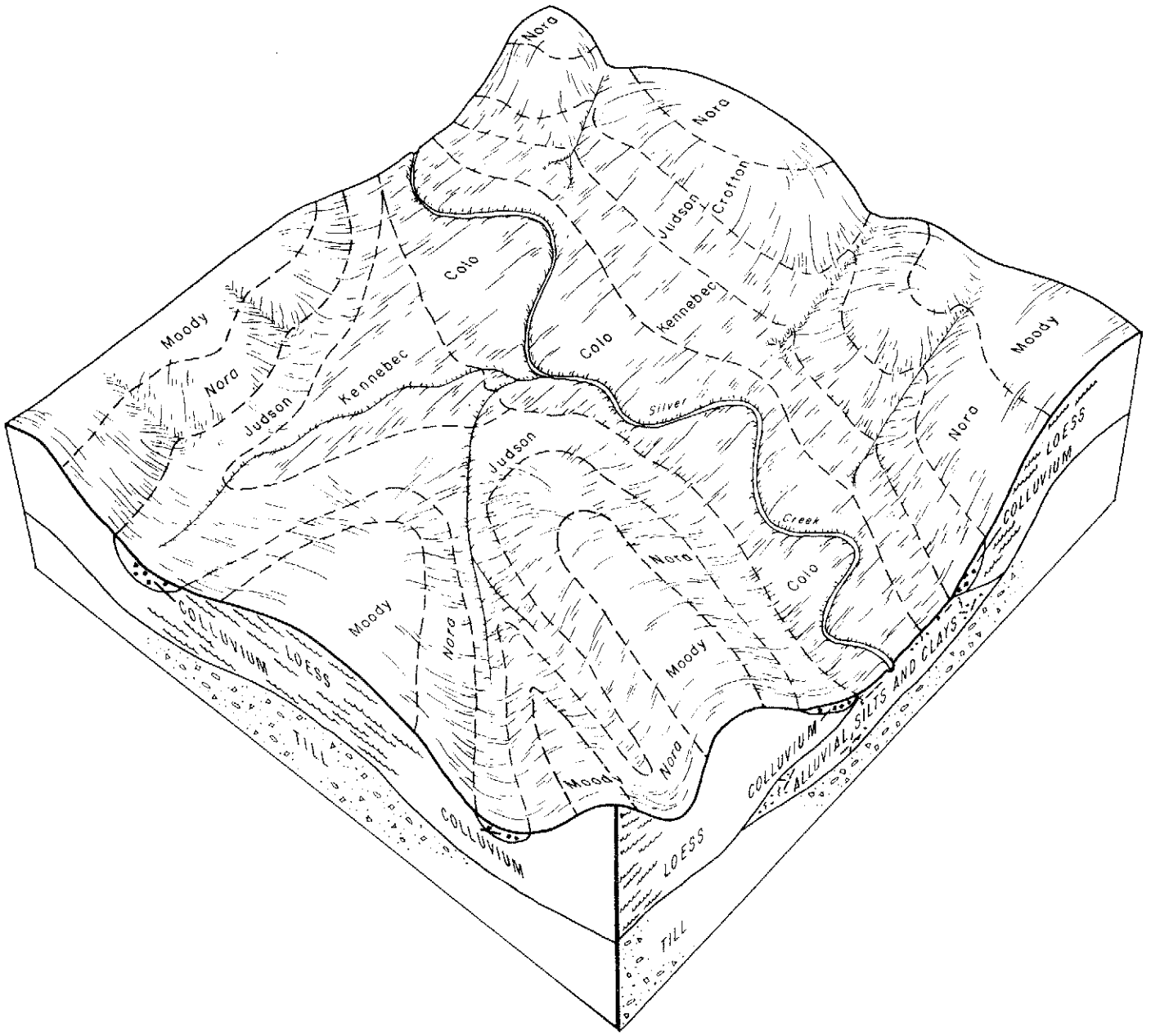

Figure 4.—Typical pattern of soils in the Nora-Moody-Judson association and the relationship of the soils to topography and parent material.

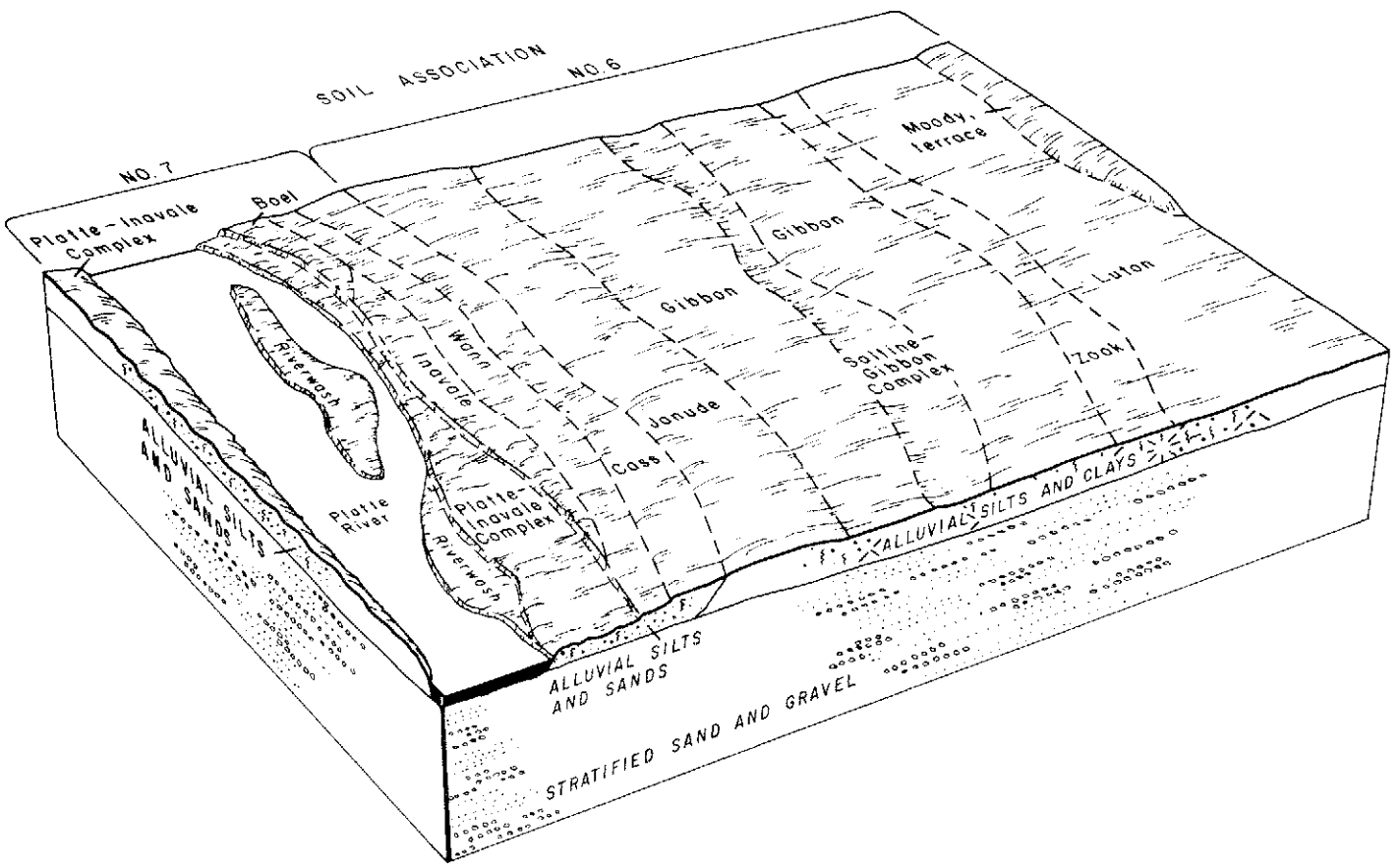

Figure 5.—Typical pattern of soils in the Gibbon-Luton-Janude association and the Inavale-Cass-Wann association and the relationship of the soils to topography and parent material.

Figure 6.—Calco silty clay loam, wet, 0 to 2 percent slopes, has fair potential for use as hayland.

Figure 7.—A windbreak of redcedar, on Monona silt loam, terrace, 0 to 2 percent slopes, helps protect the farmstead during snowstorms.

Figure 8.—The grassed waterway, on Moody silty clay loam, 2 to 6 percent slopes, eroded, helps conserve water and control erosion.

Figure 9.—Terraces on Nora silty clay loam, 11 to 15 percent slopes, eroded, help conserve water and control erosion.

Figure 10.—Some areas of Pits and dumps are suitable for recreational development. This former gravel pit is used for fishing and boating.

Figure 11.—The Moody-Thurman-Leisy association is well suited to wildlife habitat.

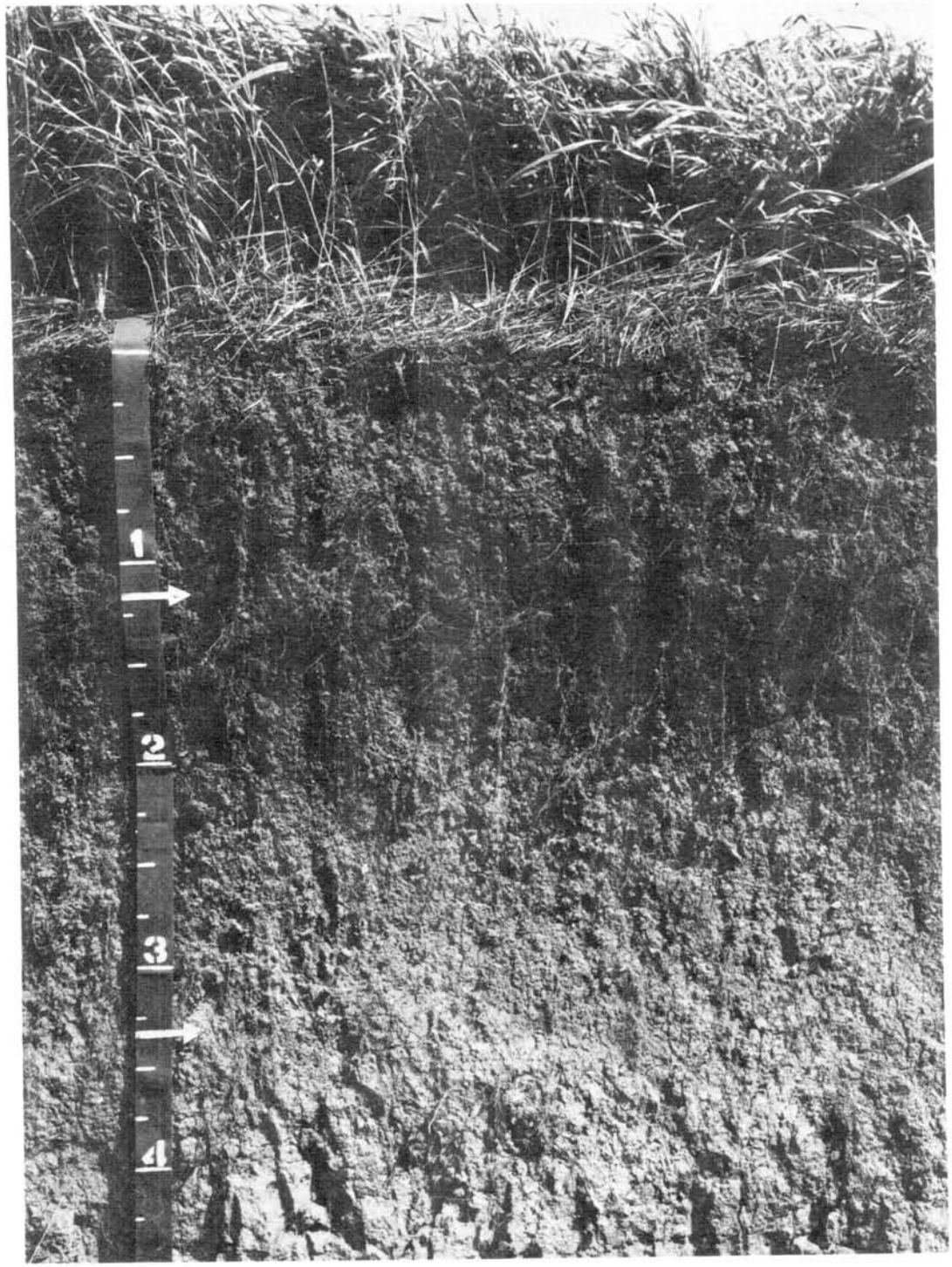

Figure 12.—Profile of Moody silty clay loam, a deep, well drained soil that has a well developed subsoil.

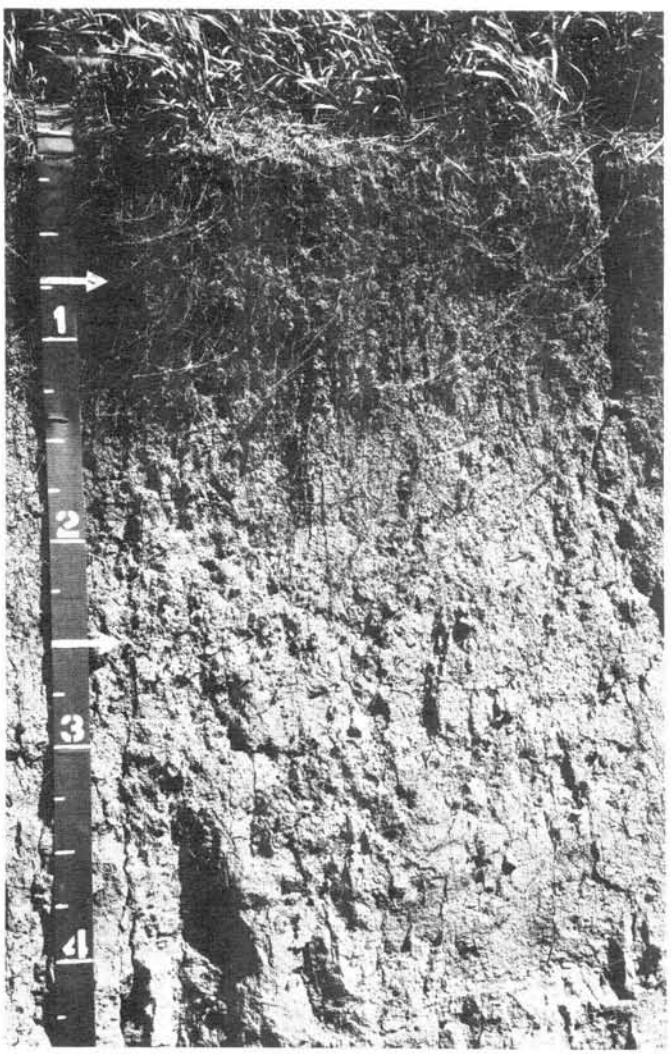

Figure 13.—Profile of Nora silty clay loam, a deep soil that is calcareous below a depth of about 18 inches.

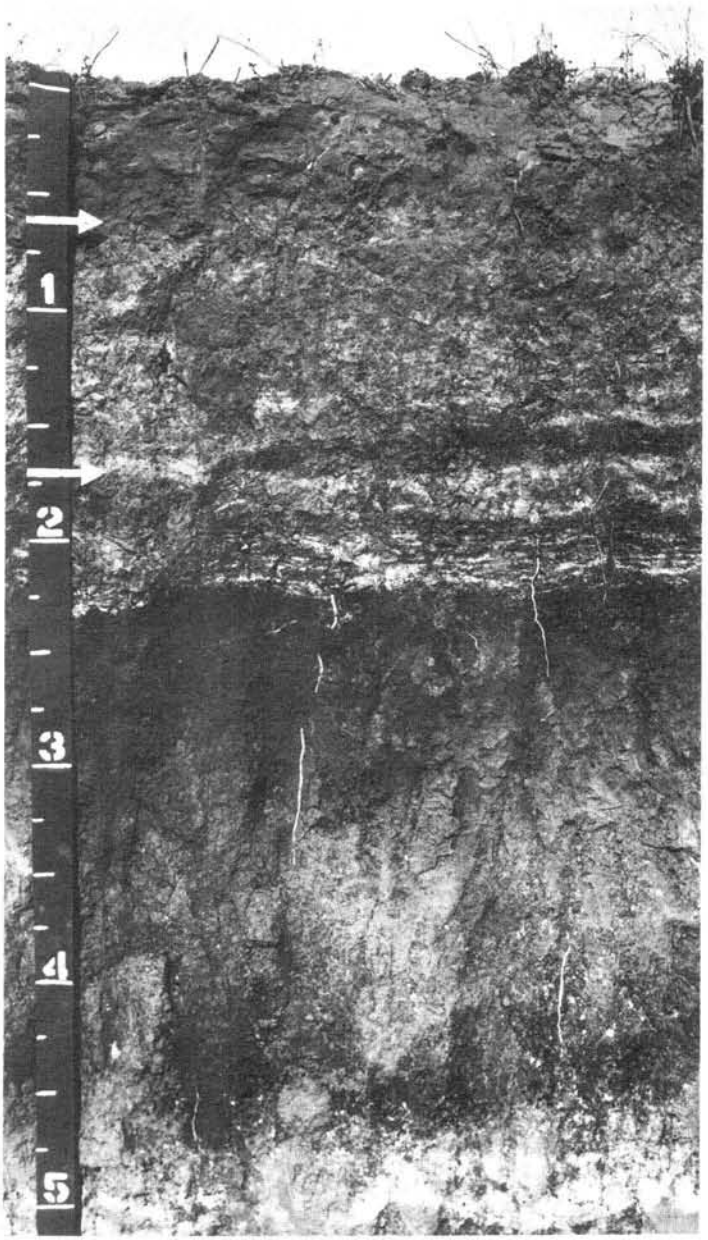

Figure 14.—Profile of Zook silt loam, overwash, 0 to 2 percent slopes. This is a deep, poorly drained soil that formed in clayey sediment that was covered with a silty layer.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data from Fremont, Nebraska. Data in columns 1, 2, and 5 based on period 1945-75; data in columns 3 and 4 based on computer study, 1948-63; data in columns 6 and 7 based on period 1878-1974; data in columns 8 and 9 estimated from nearby stations for period 1939-71]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 will have at least 4 days with--		Average monthly total	1 year in 10 will have--		Average number of days that have 1 inch or more snow cover	Average depth of snow on days that have snow cover
			Maximum temperature equal to or higher than--	Minimum temperature equal to or lower than--		Equal to or Less than--	Equal to or More than--		
	°F	°F	°F	°F	In	In	In		In
January---	32	12	50	-7	0.9	0.2	1.8	18	4
February--	38	17	57	-3	1.1	.2	2.1	11	4
March-----	49	27	69	6	1.9	.4	3.3	10	5
April-----	65	39	84	26	2.7	.8	5.3	1/	1
May-------	75	50	89	37	4.4	1.6	7.1	--	--
June------	84	60	98	50	5.3	1.9	9.0	--	--
July------	89	64	102	55	3.3	1.0	7.1	--	--
August----	87	62	100	53	4.3	.9	7.1	--	--
September-	79	53	96	38	3.2	.6	6.1	--	2/
October---	69	42	88	28	2.1	.3	3.8	--	--
November--	50	29	70	11	1.0	.1	3.2	2	3
December--	37	18	57	-5	.9	.1	2.0	8	4
Year---	63	39	3/103	4/-17	31.1	21.5	40.4	49	4

1/ Less than half a day.
2/ Trace.
3/ Average annual highest maximum.
4/ Average annual lowest minimum.

TABLE 2.--PROBABILITY OF LAST FREEZING TEMPERATURE IN SPRING AND FIRST IN FALL

[Data from Fremont, Nebraska 1/]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than--	Apr. 5	Apr. 12	Apr. 21	May 2	May 16
2 years in 10 later than--	Mar. 30	Apr. 6	Apr. 15	Apr. 26	May 10
5 years in 10 later than--	Mar. 20	Mar. 27	Apr. 5	Apr. 16	Apr. 30
Fall:					
1 year in 10 earlier than	Oct. 31	Oct. 22	Oct. 14	Oct. 4	Sept. 26
2 years in 10 earlier than	Nov. 6	Oct. 27	Oct. 19	Oct. 9	Oct. 1
5 years in 10 earlier than	Nov. 17	Nov. 6	Oct. 29	Oct. 19	Oct. 10

1/ Freeze data are based on temperatures that are measured in a standard National Weather Service thermometer shelter. The thermometers are placed about 5 feet above the ground. The exposure is representative of the surrounding area. At times, temperatures are lower nearer the ground and in local areas that are subject to extreme air drainage on calm nights.

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Af	Alda fine sandy loam, 0 to 2 percent slopes	2,100	0.6
Ag	Alda loam, 0 to 2 percent slopes	940	0.3
Be	Belfore silty clay loam, 0 to 2 percent slopes	6,200	1.8
Bo	Boel loam, 0 to 2 percent slopes	1,290	0.4
Ca	Calco silty clay loam, 0 to 2 percent slopes	3,250	1.0
Cb	Calco silty clay loam, wet, 0 to 2 percent slopes	265	0.1
Cc	Cass fine sandy loam, 0 to 2 percent slopes	1,950	0.6
Cd	Cass fine sandy loam, clayey substratum, 0 to 2 percent slopes	700	0.2
Ce	Cass loam, 0 to 2 percent slopes	2,450	0.7
Cf	Cass loam, clayey substratum, 0 to 2 percent slopes	235	0.1
Cg	Colo silty clay loam, 0 to 2 percent slopes	5,800	1.7
CrD2	Crofton silt loam, 6 to 15 percent slopes, eroded	710	0.2
CrF	Crofton silt loam, 15 to 30 percent slopes	610	0.2
CrG	Crofton silt loam, 30 to 60 percent slopes	490	0.1
Fm	Fillmore silt loam, 0 to 1 percent slops	3,850	1.1
Fp	Fillmore silt loam, ponded, 0 to 1 percent slopes	425	0.1
Ga	Gibbon loamy sand, overwash, 0 to 2 percent slopes	470	0.1
Gc	Gibbon loam, 0 to 2 percent slopes	18,700	5.5
Gd	Gibbon silty clay loam, 0 to 2 percent slopes	11,100	3.3
Gv	Gibbon Variant soils, 0 to 2 percent slopes	1,190	0.4
Im	Inavale loamy fine sand, 0 to 2 percent slopes	2,840	0.8
Jn	Janude loam, 0 to 2 percent slopes	6,050	1.8
Jo	Janude loam, clayey substratum, 0 to 2 percent slopes	9,100	2.7
JuC	Judson silt loam, 2 to 6 percent slopes	16,100	4.8
Ke	Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes	3,700	1.1
Kf	Kennebec and Colo soils, channeled, 0 to 2 percent slopes	4,350	1.3
LeC	Leisy fine sandy loam, 2 to 6 percent slopes	920	0.3
Lu	Luton silty clay, 0 to 2 percent slopes	22,500	6.7
Mn	Monona silt loam, terrace, 0 to 2 percent slopes	3,400	1.0
MnC	Monona silt loam, terrace, 2 to 6 percent slopes	315	0.1
Mo	Moody silty clay loam, 0 to 2 percent slopes	40,700	12.1
MoC	Moody silty clay loam, 2 to 6 percent slopes	37,200	11.0
MoC2	Moody silty clay loam, 2 to 6 percent slopes, eroded	10,200	3.0
MoD	Moody silty clay loam, 6 to 11 percent slopes	1,780	0.5
MoD2	Moody silty clay loam, 6 to 11 percent slopes, eroded	18,100	5.4
Mt	Moody silty clay loam, terrace, 0 to 2 percent slopes	5,150	1.5
NoC2	Nora silty clay loam, 2 to 6 percent slopes, eroded	860	0.3
NoD	Nora silty clay loam, 6 to 11 percent slopes	400	0.1
NoD2	Nora silty clay loam, 6 to 11 percent slopes, eroded	27,100	8.0
NoE2	Nora silty clay loam, 11 to 15 percent slopes, eroded	3,400	1.0
Pb	Pits and dumps	1,430	0.4
Pc	Platte loam, 0 to 2 percent slopes	510	0.2
PxB	Platte-Inavale complex, channeled, 0 to 3 percent slopes	8,550	2.5
Ra	Riverwash	2,660	0.8
Sa	Saltine-Gibbon complex, 0 to 2 percent slopes	5,190	1.5
StF2	Steinauer clay loam, 11 to 30 percent slopes, eroded	490	0.1
ThC	Thurman loamy fine sand, 2 to 6 percent slopes	1,080	0.3
ThD	Thurman loamy fine sand, 6 to 11 percent slopes	970	0.3
TmD2	Thurman-Moody complex, 6 to 11 percent slopes, eroded	1,900	0.6
TmF2	Thurman-Moody complex, 11 to 30 percent slopes, eroded	490	0.1
Wm	Wann fine sandy loam, 0 to 2 percent slopes	2,440	0.7
Wn	Wann loam, 0 to 2 percent slopes	2,250	0.7
Zn	Zook silt loam, overwash, 0 to 2 percent slopes	12,700	3.8
Zo	Zook silty clay loam, 0 to 2 percent slopes	18,300	5.4
Zw	Zook silty clay, 0 to 2 percent slopes	1,430	0.4
	Water areas less than 40 acres	704	0.2
	Total land area	337,984	100.0
	Water areas greater than 40 acres	5,700	
	Total	343,684	

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn		Soybeans		Winter wheat	Oats	Alfalfa hay		Grain sorghum	
	N	I	N	I	N	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu
Af---------- Alda	58	125	30	40	30	50	3.1	4.6	65	110
Ag---------- Alda	65	130	33	44	34	55	3.4	5.0	80	115
Be---------- Belfore	85	135	40	44	38	70	4.3	6.5	85	120
Bo---------- Boel	60	120	30	40	35	45	3.0	4.5	65	95
Ca---------- Calco	95	150	38	45	35	60	4.5	6.5	90	120
Cb---------- Calco	---	---	---	---	---	---	---	---	---	---
Cc---------- Cass	75	135	30	41	30	52	3.8	6.0	70	115
Cd---------- Cass	80	145	40	47	35	58	4.5	6.3	80	117
Ce---------- Cass	77	140	35	45	33	60	4.2	6.1	75	120
Cf---------- Cass	85	150	45	47	40	65	4.8	6.4	85	125
Cg---------- Colo	95	155	38	45	38	60	4.5	6.0	95	120
CrD2---------- Crofton	63	---	---	---	26	35	2.8	---	50	---
CrF---------- Crofton	---	---	---	---	---	---	---	---	---	---
CrG---------- Crofton	---	---	---	---	---	---	---	---	---	---
Fm---------- Fillmore	45	75	30	---	30	40	2.5	---	60	70
Fp---------- Fillmore, ponded	35	---	20	---	18	---	---	---	---	---
Ga---------- Gibbon, overwash	50	100	30	40	22	40	2.5	6.5	55	100
Gc---------- Gibbon	98	150	37	48	40	60	5.0	6.2	110	125
Gd---------- Gibbon	95	130	34	43	35	55	4.2	5.2	85	120
Gv---------- Gibbon Variant	---	---	---	---	---	---	---	---	---	---
Im---------- Inavale	55	100	20	---	18	38	2.0	3.5	40	80
Jn---------- Janude	110	160	42	50	42	75	4.8	6.5	100	120

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Soybeans		Winter wheat	Oats	Alfalfa hay		Grain sorghum	
	N	I	N	I	N	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu
Jo---------- Janude	115	165	45	50	45	80	5.0	6.5	105	125
JuC---------- Judson	95	135	37	48	39	70	4.5	6.0	85	105
Ke---------- Kennebec, occasionally flooded	110	160	42	50	45	75	4.8	6.5	100	125
Kf*---------- Kennebec and Colo	---	---	---	---	---	---	---	---	---	---
LeC---------- Leisy	90	135	36	44	35	62	4.8	6.2	90	115
Lu---------- Luton	75	110	28	38	28	52	3.6	---	80	105
Mn---------- Monona	93	145	39	48	43	68	4.4	6.2	98	125
MnC---------- Monona	88	138	35	43	41	69	4.2	5.8	93	110
Mo---------- Moody	90	140	38	45	40	70	4.8	6.5	88	120
MoC---------- Moody	90	125	35	42	38	68	4.4	6.2	80	110
MoC2---------- Moody	88	120	32	40	37	65	4.0	6.0	75	100
MoD---------- Moody	80	115	32	---	34	60	3.6	5.2	70	105
MoD2---------- Moody	76	110	28	---	32	55	3.2	4.8	65	95
Mt---------- Moody	96	150	40	48	42	75	5.0	6.5	92	125
NoC2---------- Nora	75	115	32	40	35	62	3.7	5.6	70	100
NoD---------- Nora	70	110	28	---	32	57	3.3	5.0	68	100
NoD2---------- Nora	65	105	27	---	30	54	3.0	4.6	60	95
NoE2---------- Nora	52	---	---	---	22	44	2.7	---	56	---
Pb*. Pits and dumps										
Pc---------- Platte	45	65	23	30	20	37	2.5	3.8	35	75
PxB*---------- Platte-Inavale	---	---	---	---	---	---	---	---	---	---
Ra*. Riverwash										

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Soybeans		Winter wheat	Oats	Alfalfa hay		Grain sorghum	
	N	I	N	I	N	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu
Sa* Saltine-Gibbon	50	95	21	---	26	45	3.2	4.5	55	90
StF2 Steinauer	---	---	---	---	---	---	---	---	---	---
ThC Thurman	55	95	30	---	24	35	2.0	4.5	55	85
ThD Thurman	---	85	---	---	---	---	---	4.0	---	80
TmD2* Thurman-Moody	60	100	---	---	30	40	2.7	5.0	50	90
TmF2* Thurman-Moody	---	---	---	---	---	---	---	---	---	---
Wm Wann	80	130	34	40	32	60	4.0	5.0	70	110
Wn Wann	90	135	36	42	35	55	4.4	6.0	75	115
Zn Zook	90	120	35	45	38	60	4.4	6.2	90	120
Zo Zook	95	115	32	42	34	50	4.1	6.0	85	115
Zw Zook	85	110	30	35	31	45	3.8	5.5	75	105

* See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 5.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only those potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Dashes indicate no acreage]

Class		Total acreage	Major management concerns (Subclass)		
			Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres	Acres
I	(N)	73,285	---	---	---
	(I)	73,285	---	---	---
II	(N)	134,505	53,615	78,240	2,650
	(I)	83,730	---	81,080	2,650
III	(N)	91,940	59,360	32,580	---
	(I)	98,175	65,595	32,580	---
IV	(N)	16,055	9,930	935	5,190
	(I)	57,740	52,040	510	5,190
V	(N)	1,455	---	1,455	---
VI	(N)	15,460	2,560	12,900	---
VII	(N)	490	490	---	---
VIII	(N)	4,090	---	2,660	1,430

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[Absence of an entry indicates that trees generally do not grow to the given height on that soil. The symbol < means less than; the symbol > means more than]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Af, Ag---- Alda	Redosier dogwood	Autumn-olive, American plum.	Eastern redcedar, Black Hills spruce.	Austrian pine, Russian mulberry, green ash, honeylocust, golden willow, Scotch pine.	Eastern cottonwood.
Be---- Belfore	Peking cotoneaster.	Autumn-olive, Amur honeysuckle, lilac.	Eastern redcedar, blue spruce.	Ponderosa pine, green ash, common hackberry, honeylocust, Austrian pine, Scotch pine, Russian mulberry, black walnut.	---
Bo---- Boel	Redosier dogwood, silky dogwood.	Autumn-olive, American plum, common chokecherry.	Eastern redcedar, Black Hills spruce.	Austrian pine, Russian mulberry, green ash, honeylocust, golden willow, Scotch pine.	Eastern cottonwood, silver maple.
Ca---- Calco	Redosier dogwood, silky dogwood.	Autumn-olive, American plum, common chokecherry.	Eastern redcedar, Black Hills spruce.	Green ash, Austrian pine, honeylocust, golden willow, Scotch pine.	Silver maple, eastern cottonwood.
Cb---- Calco	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Cc---- Cass	Peking cotoneaster.	Amur honeysuckle, skunkbush sumac, American plum, autumn-olive, common chokecherry.	Eastern redcedar	Austrian pine, green ash, honeylocust, Scotch pine, ponderosa pine.	Eastern cottonwood, silver maple.
Cd---- Cass	Redosier dogwood, silky dogwood.	Autumn-olive, American plum, silver buffaloberry, common chokecherry.	Eastern redcedar, Black Hills spruce.	Austrian pine, Scotch pine, green ash, honeylocust.	Eastern cottonwood, silver maple.
Ce---- Cass	Redosier dogwood, silky dogwood.	Autumn-olive, Amur honeysuckle, Peking cotoneaster.	Eastern redcedar, Black Hills spruce.	Austrian pine, green ash, honeylocust, Scotch pine, ponderosa pine, hackberry, black walnut.	Eastern cottonwood, silver maple.
Cf---- Cass	Redosier dogwood, silky dogwood.	Autumn-olive, American plum, silver buffaloberry, common chokecherry.	Eastern redcedar, Black Hills spruce.	Austrian pine, Scotch pine, green ash, honeylocust.	Eastern cottonwood, silver maple.
Cg---- Colo	Redosier dogwood, silky dogwood.	Autumn-olive, American plum, common chokecherry.	Eastern redcedar, Black Hills spruce.	Green ash, Austrian pine, Scotch pine, golden willow, honeylocust.	Silver maple, eastern cottonwood.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
CrD2---- Crofton	Skunkbush sumac, Peking cotoneaster.	Russian-olive----	Eastern redcedar, bur oak.	Ponderosa pine, Austrian pine, Scotch pine.	---
CrF, CrG. Crofton					
Fm---- Fillmore	---	Redosier dogwood	---	Golden willow	Eastern cottonwood.
Fp Fillmore					
Ga---- Gibbon	Silky dogwood	Redosier dogwood	Eastern redcedar, boxelder.	Golden willow, honeylocust, common hackberry.	Eastern cottonwood, silver maple.
Gc, Gd---- Gibbon	Silky dogwood	Redosier dogwood	Eastern redcedar, boxelder.	Green ash, honeylocust, golden willow, common hackberry.	Eastern cottonwood, silver maple.
Gv. Gibbon Variant					
Im---- Inavale	Peking cotoneaster.	Amur honeysuckle, autumn-olive, American plum, skunkbush sumac, common chokecherry.	Eastern redcedar	Austrian pine, Scotch pine, ponderosa pine, green ash, honeylocust.	Eastern cottonwood.
Jn, Jo---- Janude	Redosier dogwood	Peking cotoneaster, autumn-olive, American plum, Amur honeysuckle, common chokecherry, lilac.	Manchurian crabapple, winterberry evonymus, Amur maple.	Eastern redcedar, Austrian pine, Scotch pine, blue spruce, green ash, honeylocust, common hackberry, black walnut.	Eastern cottonwood, silver maple.
JuC---- Judson	Redosier dogwood	Tatarian honeysuckle, lilac, Peking cotoneaster, Amur honeysuckle, autumn-olive.	Amur maple, Manchurian crabapple, winterberry evonymus.	Eastern redcedar, Scotch pine, Austrian pine, green ash, honeylocust, blue spruce.	Eastern cottonwood.
Ke---- Kennebec	Redosier dogwood	Tatarian honeysuckle, Peking cotoneaster, Amur honeysuckle, autumn-olive.	Amur maple, Manchurian crabapple, winterberry evonymus.	Common hackberry, Norway spruce, honeylocust, eastern redcedar, Austrian pine, blue spruce, green ash.	Silver maple, eastern cottonwood.
Kf*. Kennebec and Colo					
LeC---- Leisy	Peking cotoneaster.	Skunkbush sumac, Amur honeysuckle, American plum, autumn-olive.	Eastern redcedar	Ponderosa pine, Austrian pine, green ash, honeylocust, Scotch pine.	Eastern cottonwood, silver maple.
Lu---- Luton	Silky dogwood, redosier dogwood.	Autumn-olive, American plum, common chokecherry.	Amur maple, Eastern redcedar, Black Hills spruce.	Green ash, golden willow, Austrian pine, honeylocust, Scotch pine.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Mn, MnC---------- Monona	Peking cotoneaster.	Tatarian honeysuckle, autumn-olive, Amur honeysuckle, lilac.	Eastern redcedar, blue spruce.	Norway spruce, common hackberry, Austrian pine, Scotch pine, green ash, honeylocust.	---
Mo, MoC, MoC2, MoD, MoD2, Mt---- Moody	Lilac, Peking cotoneaster.	Common chokecherry, Siberian peashrub, American plum, silver buffaloberry, autumn-olive, Amur honeysuckle.	Eastern redcedar, blue spruce, Amur maple.	Austrian pine, Scotch pine, ponderosa pine, common hackberry, green ash, honeylocust.	---
NoC2, NoD, NoD2, NoE2---------- Nora	Lilac, Peking cotoneaster.	Common chokecherry, Siberian peashrub, American plum, silver buffaloberry, autumn-olive, Amur honeysuckle.	Eastern redcedar, Amur maple, blue spruce.	Austrian pine, Scotch pine, common hackberry, Ponderosa pine, green ash, honeylocust.	---
Pb*. Pits and dumps					
Pc---------- Platte	Redosier dogwood, silky dogwood.	Autumn-olive, silver buffaloberry, American plum, common chokecherry.	Eastern redcedar, Black Hills spruce.	Austrian pine, green ash, Scotch pine, golden willow, honeylocust.	Eastern cottonwood, silver maple.
PxB*: Platte.					
Inavale----------	Peking cotoneaster.	Amur honeysuckle, autumn-olive, American plum, skunkbush sumac, common chokecherry.	Eastern redcedar	Austrian pine, Scotch pine, ponderosa pine, green ash, honeylocust.	Eastern cottonwood.
Ra*. Riverwash					
Sa*: Saltine.					
Gibbon----------	---	Redosier dogwood	Eastern redcedar, boxelder.	Green ash, honeylocust, golden willow.	Eastern cottonwood, silver maple.
StF2. Steinauer					
ThC---------- Thurman	Peking cotoneaster.	Amur honeysuckle, autumn-olive, skunkbush sumac, American plum, common chokecherry.	Eastern redcedar	Austrian pine, green ash, honeylocust, Austrian pine, Scotch pine.	Eastern cottonwood.

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
ThD---------- Thurman	Peking cotoneaster, skunkbush sumac.	---	Eastern redcedar	Austrian pine, ponderosa pine, Scotch pine.	---
TmD2* Thurman----------	Peking cotoneaster, skunkbush sumac.	---	Eastern redcedar	Austrian pine, ponderosa pine, Scotch pine.	---
Moody---------- TmF2. Thurman-Moody	Lilac, Peking cotoneaster.	Common chokecherry, Siberian peashrub, American plum, silver buffaloberry, autumn-olive, Amur honeysuckle.	Common hackberry, eastern redcedar.	Green ash, honeylocust, ponderosa pine, Austrian pine, Scotch pine.	---
Wm, Wn---------- Wann	Redosier dogwood, silky dogwood.	Autumn-olive, common chokecherry, silver buffaloberry, American plum.	Eastern redcedar, Black Hills spruce.	Green ash, honeylocust, golden willow, Scotch pine, Austrian pine.	Eastern cottonwood, silver maple.
Zn, Zo, Zw--------- Zook	Silky dogwood, redosier dogwood.	Autumn-olive, American plum, common chokecherry.	Amur maple, eastern redcedar.	Green ash, honeylocust, golden willow, Scotch pine, Austrian pine.	Silver maple, eastern cottonwood.

* See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 7.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Af, Ag---------- Alda	Severe: wetness, floods, cutbanks cave.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Severe: floods, frost action.
Be---------- Belfore	Slight----------	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Bo---------- Boel	Severe: wetness, floods, cutbanks cave.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods.
Ca, Cb---------- Calco	Severe: wetness, floods.	Severe: floods, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, low strength.
Cc---------- Cass	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: frost action, floods.
Cd---------- Cass	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, frost action.
Ce---------- Cass	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: frost action, floods.
Cf---------- Cass	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, frost action.
Cg---------- Colo	Severe: wetness, floods.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell.	Severe: floods, low strength.
CrD2---------- Crofton	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope, low strength.	Severe: slope.	Moderate: slope, frost action, low strength.
CrF, CrG---------- Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Fm, Fp---------- Fillmore	Severe: floods, too clayey, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.
Ga---------- Gibbon	Severe: floods, wetness, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Gc, Gd---------- Gibbon	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, frost action.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Gv---------- Gibbon Variant	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.
Im---------- Inavale	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Jn---------- Janude	Moderate: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, frost action, low strength.
Jo---------- Janude	Moderate: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, frost action.
JuC---------- Judson	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
Ke---------- Kennebec	Severe: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.
Kf*: Kennebec----------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.
Colo----------	Severe: wetness, floods.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell.	Severe: floods, low strength.
LeC---------- Leisy	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Moderate: low strength, frost action.
Lu---------- Luton	Severe: wetness, too clayey, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, low strength, floods.
Mn---------- Monona	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength, frost action.
MnC---------- Monona	Slight----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Severe: low strength, frost action.
Mo---------- Moody	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
MoC, MoC2---------- Moody	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, slope.	Severe: frost action, low strength.
MoD, MoD2---------- Moody	Moderate: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Mt---------- Moody	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
NoC2---------- Nora	Slight----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
NoD, NoD2, NoE2--- Nora	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: frost action, low strength.
Pb*. Pits and dumps					
Pc---------- Platte	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
PxB*: Platte----------	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Inavale----------	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Ra*. Riverwash					
Sa*: Saltine----------	Severe: wetness, floods.	Severe: floods, low strength, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: low strength, floods, frost action.
Gibbon----------	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, frost action.
StF2---------- Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.
ThC---------- Thurman	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Slight.
ThD---------- Thurman	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
TmD2*: Thurman----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Moody----------	Moderate: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: frost action, low strength.
TmF2*: Thurman----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
TmF2*: Moody	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.
Wm, Wn Wann	Severe: wetness, floods.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, frost action.
Zn, Zo, Zw Zook	Severe: wetness, floods, too clayey.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength, wetness.

* See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 8.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," and "fair." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Af, Ag Alda	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Fair: small stones.
Be Belfore	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Bo Boel	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: floods, seepage, wetness.	Poor: too sandy.
Ca, Cb Calco	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.
Cc Cass	Moderate: floods.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Cd Cass	Severe: wetness.	Severe: floods, seepage, wetness.	Severe: seepage.	Severe: wetness, seepage.	Good.
Ce Cass	Moderate: floods.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Cf Cass	Severe: wetness.	Severe: floods, seepage, wetness.	Severe: seepage.	Severe: wetness, seepage.	Good.
Cg Colo	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Fair: too clayey.
CrD2 Crofton	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
CrF Crofton	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
CrG Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Fm, Fp Fillmore	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: floods, too clayey, wetness.	Severe: floods, wetness.	Poor: wetness, too clayey.
Ga, Gc, Gd Gibbon	Severe: wetness, floods.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Good.
Gv Gibbon Variant	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.

TABLE 8.--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
Im---------- Inavale	Severe: floods.	Severe: floods, seepage.	Severe: seepage, too sandy, floods.	Severe: seepage, floods.	Poor: too sandy.
Jn---------- Janude	Moderate: floods, wetness. percs slowly.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Jo---------- Janude	Severe: wetness.	Severe: wetness, floods.	Moderate: floods, wetness.	Moderate: floods, wetness.	Good.
JuC---------- Judson	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
Ke---------- Kennebec	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
Kf*: Kennebec----------	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Good.
Colo----------	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
LeC---------- Leisy	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
Lu---------- Luton	Severe: percs slowly, wetness, floods.	Severe: floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: wetness, too clayey.
Mn---------- Monona	Slight----------	Moderate: seepage.	Slight----------	Slight----------	Good.
MnC---------- Monona	Slight----------	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
Mo---------- Moody	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Good.
MoC, MoC2---------- Moody	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
MoD, MoD2---------- Moody	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.	Fair: slope.
Mt---------- Moody	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Good.
NoC2---------- Nora	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
NoD, NoD2, NoE2----- Nora	Moderate: slope, percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Pb*. Pits and dumps					

See footnote at end of table.

TABLE 8.--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
Pc Platte	Severe: floods, wetness.	Severe: seepage, wetness, floods.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: small stones, too sandy, seepage.
PxB*: Platte	Severe: floods, wetness.	Severe: seepage, wetness, floods.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: small stones, too sandy, seepage.
Inavale	Severe: floods.	Severe: floods, seepage.	Severe: seepage, too sandy, floods.	Severe: seepage, floods.	Poor: too sandy.
Ra*. Riverwash					
Sa*: Saltine	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: too clayey.
Gibbon	Severe: wetness, floods.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Good.
StF2 Steinauer	Severe: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope.
ThC Thurman	Slight	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Fair: too sandy.
ThD Thurman	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Fair: too sandy, slope.
TmD2*: Thurman	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Fair: too sandy, slope.
Moody	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
TmF2*: Thurman	Severe: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage, slope.	Poor: slope.
Moody	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Wm, Wn Wann	Severe: wetness.	Severe: seepage, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Good.
Zn, Zo, Zw Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.

* See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 9.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Af, Ag Alda	Fair: low strength, wetness.	Good	Good	Good.
Be Belfore	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
Bo Boel	Fair: wetness.	Good	Unsuited: excess fines.	Good.
Ca, Cb Calco	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Cc Cass	Fair: low strength, frost action.	Fair: excess fines.	Unsuited: excess fines.	Good.
Cd Cass	Fair: low strength, wetness.	Good	Unsuited: excess fines.	Good.
Ce Cass	Fair: low strength, frost action.	Fair: excess fines.	Unsuited: excess fines.	Good.
Cf Cass	Fair: low strength, wetness.	Good	Unsuited: excess fines.	Good.
Cg Colo	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
CrD2 Crofton	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
CrF Crofton	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
CrG Crofton	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Fm, Fp Fillmore	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Ga Gibbon	Fair: wetness.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Gc Gibbon	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Gd Gibbon	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Gv Gibbon Variant	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Im---------- Inavale	Good----------	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Jn---------- Janude	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Jo---------- Janude	Fair: frost action, wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
JuC---------- Judson	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ke---------- Kennebec	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Kf*: Kennebec----------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Colo----------	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
LeC---------- Leisy	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Lu---------- Luton	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey.
Mn, MnC---------- Monona	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Mo, MoC, MoC2---------- Moody	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
MoD, MoD2---------- Moody	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
Mt---------- Moody	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
NoC2---------- Nora	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
NoD, NoD2, NoE2------- Nora	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
Pb*. Pits and dumps				
Pc---------- Platte	Poor: wetness.	Good----------	Good----------	Poor: wetness.
PxB*: Platte----------	Poor: wetness.	Good----------	Good----------	Poor: wetness.
Inavale----------	Good----------	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Ra*. Riverwash				

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Sa*:				
Saltine	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
Gibbon	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
StF2:				
Steinauer	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
ThC, ThD:				
Thurman	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
TmD2*:				
Thurman	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
Moody	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
TmF2*:				
Thurman	Fair: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope.
Moody	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Wm, Wn:				
Wann	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
Zn, Zo:				
Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Zw:				
Zook	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.

* See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 10.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Af---- Alda	Seepage	Seepage, wetness.	Poor outlets, cutbanks cave, frost action.	Wetness, droughty, soil blowing.	Not needed	Droughty.
Ag---- Alda	Seepage	Seepage, wetness.	Poor outlets, cutbanks cave, frost action.	Wetness, droughty.	Not needed	Droughty.
Be---- Belfore	Favorable	Hard to pack	Not needed	Favorable	Not needed	Favorable.
Bo---- Boel	Seepage	Seepage, piping.	Floods	Fast intake, wetness, droughty.	Not needed	Droughty.
Ca---- Calco	Favorable	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Not needed	Favorable.
Cb---- Calco	Favorable	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Not needed	Wetness.
Cc---- Cass	Seepage	Seepage	Not needed	Soil blowing	Not needed	Favorable.
Cd---- Cass	Seepage	Wetness, piping.	Not needed	Soil blowing	Not needed	Favorable.
Ce---- Cass	Seepage	Seepage	Not needed	Soil blowing	Not needed	Favorable.
Cf---- Cass	Seepage	Wetness, piping.	Not needed	Favorable	Not needed	Favorable.
Cg---- Colo	Favorable	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Not needed	Favorable.
CrD2---- Crofton	Slope, seepage.	Piping	Not needed	Erodes easily, slope.	Erodes easily	Slope, erodes easily.
CrF, CrG---- Crofton	Seepage, slope.	Piping	Not needed	Erodes easily, slope.	Erodes easily, slope.	Slope, erodes easily.
Fm, Fp---- Fillmore	Seepage	Wetness	Poor outlets, percs slowly, frost action.	Wetness, slow intake, percs slowly.	Not needed	Wetness, erodes easily.
Ga---- Gibbon	Seepage	Wetness	Floods, frost action.	Soil blowing, floods.	Not needed	Favorable.
Gc, Gd---- Gibbon	Seepage	Piping, wetness.	Floods	Wetness, floods.	Not needed	Favorable.
Gv---- Gibbon Variant	Favorable	Wetness	Floods, frost action.	Wetness, floods, erodes easily.	Not needed	Wetness, erodes easily.
Im---- Inavale	Seepage	Seepage, piping.	Not needed	Fast intake, droughty, soil blowing.	Not needed	Droughty.
Jn---- Janude	Seepage	Favorable	Not needed	Favorable	Not needed	Favorable.
Jo---- Janude	Seepage	Favorable	Favorable	Percs slowly	Not needed	Favorable.
JuC---- Judson	Seepage	Favorable	Not needed	Favorable	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ke Kennebec	Seepage	Favorable	Floods, frost action.	Floods	Not needed	Favorable.
Kf*: Kennebec	Seepage	Favorable	Not needed	Floods, wetness.	Not needed	Favorable.
Colo	Favorable	Hard to pack, wetness.	Floods, frost action.	Floods, wetness.	Not needed	Favorable.
LeC Leisy	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Erodes easily.
Lu Luton	Favorable	Hard to pack, wetness.	Percs slowly, poor outlets.	Wetness, percs slowly, floods.	Not needed	Wetness, percs slowly.
Mn Monona	Seepage	Piping	Not needed	Favorable	Not needed	Erodes easily.
MnC Monona	Seepage	Piping	Not needed	Favorable	Erodes easily	Erodes easily.
Mo Moody	Seepage	Favorable	Not needed	Favorable	Not needed	Erodes easily.
MoC, MoC2 Moody	Seepage	Favorable	Not needed	Favorable	Erodes easily	Erodes easily.
MoD, MoD2 Moody	Slope, seepage.	Favorable	Not needed	Slope	Erodes easily	Slope, erodes easily.
Mt Moody	Seepage	Favorable	Not needed	Favorable	Not needed	Erodes easily.
NoC2 Nora	Seepage	Favorable	Not needed	Favorable	Erodes easily	Erodes easily.
NoD, NoD2 Nora	Slope, seepage.	Favorable	Not needed	Slope	Erodes easily	Slope, erodes easily.
NoE2 Nora	Slope, seepage.	Favorable	Not needed	Slope	Slope, erodes easily.	Slope, erodes easily.
Pb*. Pits and dumps						
Pc Platte	Seepage	Seepage, wetness.	Floods	Floods, droughty, wetness.	Not needed	Favorable.
PxB*: Platte	Seepage	Seepage, wetness.	Floods	Floods, droughty, wetness.	Not needed	Wetness.
Inavale	Seepage	Seepage, piping.	Not needed	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
Ra*. Riverwash						
Sa*: Saltine	Seepage	Piping, wetness.	Percs slowly, floods, frost action.	Excess sodium, slow intake, wetness.	Not needed	Excess sodium, percs slowly.
Gibbon	Seepage	Piping, wetness.	Floods	Wetness, floods.	Not needed	Favorable.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
StF2---------- Steinauer	Slope----------	Favorable------	Not needed-----	Slope----------	Slope----------	Slope.
ThC---------- Thurman	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, soil blowing, droughty.	Too sandy, soil blowing.	Droughty.
ThD---------- Thurman	Slope, seepage.	Seepage, piping.	Not needed-----	Fast intake, soil blowing, slope.	Too sandy, soil blowing.	Droughty, slope.
TmD2*: Thurman----------	Slope, seepage.	Seepage, piping.	Not needed-----	Fast intake, soil blowing, slope.	Too sandy, soil blowing.	Droughty, slope.
Moody----------	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Erodes easily	Slope, erodes easily.
TmF2*: Thurman----------	Slope, seepage.	Seepage, piping.	Not needed-----	Fast intake, soil blowing, slope.	Slope, too sandy, soil blowing.	Droughty, slope.
Moody----------	Slope, seepage.	Favorable------	Not needed-----	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Wm---------- Wann	Seepage--------	Piping, wetness.	Floods, frost action.	Floods, soil blowing, wetness.	Not needed-----	Favorable.
Wn---------- Wann	Seepage--------	Piping, wetness.	Floods, frost action.	Floods, wetness.	Not needed-----	Favorable.
Zn, Zo, Zw-------- Zook	Favorable------	Hard to pack, wetness.	Floods, percs slowly, frost action.	Floods, wetness, percs slowly.	Not needed-----	Wetness.

* See description of the map unit for the composition and behavior characteristsics of the map unit.

TABLE 11.--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
Af, Ag---- Alda	Severe: floods.	Moderate: wetness.	Moderate: wetness, floods.	Slight.
Be---- Belfore	Slight----	Slight----	Slight----	Slight.
Bo---- Boel	Severe: floods.	Moderate: wetness.	Moderate: wetness, floods.	Slight.
Ca, Cb---- Calco	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Cc, Cd, Ce, Cf---- Cass	Severe: floods.	Slight----	Slight----	Slight.
Cg---- Colo	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
CrD2---- Crofton	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
CrF---- Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
CrG---- Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Fm, Fp---- Fillmore	Severe: floods, wetness, percs slowly.	Severe: wetness.	Severe: wetness, percs slowly.	Severe: wetness.
Ga---- Gibbon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Gc---- Gibbon	Severe: floods.	Moderate: floods, wetness.	Moderate: floods, wetness.	Moderate: wetness.
Gd---- Gibbon	Severe: floods.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness, floods.	Moderate: too clayey.
Gv---- Gibbon Variant	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Moderate: wetness, floods, too clayey.
Im---- Inavale	Severe: floods.	Moderate: too sandy.	Moderate: too sandy, floods.	Moderate: too sandy.
Jn, Jo---- Janude	Severe: floods.	Slight----	Slight----	Slight.
JuC---- Judson	Slight----	Slight----	Moderate: slope.	Slight.
Ke---- Kennebec	Severe: floods.	Slight----	Moderate: floods.	Slight.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Kf*:				
Kennebec	Severe: floods.	Moderate: floods, too clayey.	Moderate: floods.	Moderate: too clayey, floods.
Colo	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
LeC: Leisy	Slight	Slight	Moderate: slope.	Slight.
Lu: Luton	Severe: floods, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: too clayey, wetness, floods.	Severe: wetness, too clayey.
Mn: Monona	Slight	Slight	Slight	Slight.
MnC: Monona	Slight	Slight	Moderate: slope.	Slight.
Mo: Moody	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
MoC, MoC2: Moody	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
MoD, MoD2: Moody	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
Mt: Moody	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
NoC2: Nora	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
NoD, NoD2, NoE2: Nora	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
Pb*. Pits and dumps				
Pc: Platte	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
PxB*:				
Platte	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Inavale	Severe: floods.	Moderate: too sandy.	Moderate: too sandy, floods.	Moderate: too sandy.
Ra*. Riverwash				

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Sa*:				
Saltine	Severe: floods.	Moderate: wetness, too clayey.	Moderate: wetness, floods, too clayey.	Moderate: too clayey.
Gibbon	Severe: floods.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness, floods.	Moderate: too clayey.
StF2	Severe:	Severe:	Severe:	Moderate:
Steinauer	slope.	slope.	slope.	too clayey, slope.
ThC	Moderate:	Moderate:	Moderate:	Moderate:
Thurman	too sandy.	too sandy.	too sandy.	too sandy.
ThD	Moderate:	Moderate:	Severe:	Moderate:
Thurman	too sandy.	too sandy.	slope.	too sandy.
TmD2*:				
Thurman	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
Moody	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
TmF2*:				
Thurman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy.
Moody	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, clayey.
Wm, Wn	Severe:	Moderate:	Moderate:	Slight.
Wann	floods.	wetness.	floods, wetness.	
Zn, Zo	Severe:	Severe:	Severe:	Severe:
Zook	wetness, floods.	wetness.	floods, wetness.	wetness.
Zw	Severe:	Severe:	Severe:	Severe:
Zook	wetness, floods, too clayey.	wetness, too clayey.	wetness, too clayey.	wetness, too clayey.

* See description of the map unit for the composition and behavior characteristics of the map unit.

TABLE 12.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
Af, Ag---------- Alda	Fair	Fair	Good	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Good.
Be---------- Belfore	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Bo---------- Boel	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Poor	Good.
Ca---------- Calco	Good	Fair	Good	Poor	Very poor.	Good	Good	Fair	Fair	Poor	Fair	Good.
Cb---------- Calco	Poor	Poor	Good	Poor	Very poor.	Good	Good	Good	Poor	Poor	Good	Good.
Cc---------- Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Cd---------- Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ce---------- Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Cf---------- Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Cg---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Good	Fair	Fair	Good	Fair.
CrD2---------- Crofton	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
CrF, CrG---------- Crofton	Poor	Fair	Good	Poor	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Fm---------- Fillmore	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Good	Fair.
Fp---------- Fillmore	Poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Poor.
Ga---------- Gibbon	Poor	Fair	Good	Good	Fair	Good	Fair	Good	Fair	Fair	Fair	Good.
Gc, Gd---------- Gibbon	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
Gv---------- Gibbon Variant	Poor	Poor	Fair	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Poor.
Im---------- Inavale	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Jn---------- Janude	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Jo---------- Janude	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
JuC---------- Judson	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Ke---------- Kennebec	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Kf*:												
Kennebec	Poor	Fair	Good	Good	Good	Good	Poor	Poor	Poor	Good	Poor	Good.
Colo	Poor	Fair	Good	Fair	Poor	Good	Good	Good	Poor	Fair	Good	Good.
LeC---- Leisy	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Lu---- Luton	Fair	Fair	Fair	Poor	Very poor.	Fair	Good	Good	Fair	Poor	Good	Fair.
Mn, MnC---- Monona	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Mo---- Moody	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
MoC, MoC2. Moody	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
MoD, MoD2---- Moody	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Mt---- Moody	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
NoC2---- Nora	Good	Good	Good	Good	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
NoD, NoD2, NoE2. Nora	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Pb*. Pits and dumps												
Pc---- Platte	Fair	Good	Fair	Fair	Fair	Good	Fair	Good	Fair	Fair	Good	Fair.
PxB*:												
Platte----	Fair	Good	Fair	Fair	Fair	Good	Fair	Good	Fair	Fair	Good	Fair.
Inavale----	Poor	Poor	Good	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Ra*. Riverwash												
Sa*:												
Saltine----	Poor	Fair	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Poor.
Gibbon----	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Fair	Fair	Good.
StF2---- Steinauer	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
ThC---- Thurman	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
ThD---- Thurman	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
TmD2*:												
Thurman----	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Moody----	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
TmF2*: Thurman	Poor	Fair	Good	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Poor.
Moody	Poor	Good	Good	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Very poor.	Fair.
Wm, Wn Wann	Good	Good	Good	Good	Fair	Good	Poor	Fair	Good	Good	Fair	Good.
Zn, Zo, Zw Zook	Good	Fair	Good	Fair	Poor	Fair	Good	Good	Fair	Fair	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Af Alda	0-12	Fine sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-85	30-50	<20	NP-5
	12-29	Fine sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-85	30-50	<20	NP-5
	29-60	Sand and gravel	SP, GP, GP-GM, SP-SM	A-1, A-3, A-2	0	30-90	20-85	20-55	0-10	---	NP
Ag Alda	0-12	Loam	ML, CL-ML	A-4	0	95-100	95-100	85-95	50-75	20-35	3-10
	12-29	Fine sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-85	30-50	<20	NP-5
	29-60	Sand and gravel	SP, GP, GP-GM, SP-SM	A-1, A-3, A-2	0	30-90	20-85	20-55	0-10	---	NP
Be Belfore	0-14	Silty clay loam	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-30
	14-37	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-60	20-30
	37-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-30
Bo Boel	0-10	Loam	ML	A-4	0	100	100	85-95	70-95	24-35	2-10
	10-60	Fine sand, loamy fine sand, coarse sand.	SP, SM	A-2, A-3	0	100	100	85-95	0-25	---	NP
Ca, Cb Calco	0-39	Silty clay loam	ML, MH, CH, CL	A-7	0	100	100	95-100	85-100	41-60	15-30
	39-60	Silty clay loam	CH, CL	A-7	0	100	100	90-100	80-100	40-55	15-30
Cc Cass	0-20	Fine sandy loam	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	20-38	Fine sandy loam, sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	38-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Cd Cass	0-20	Fine sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-85	40-50	<20	NP-5
	20-40	Sandy loam, fine sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	95-100	85-95	20-40	<20	NP-5
	40-55	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	25-40	11-20
	55-60	Loamy fine sand, fine sand, coarse sand.	SM, SP	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Ce Cass	0-20	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	5-15
	20-38	Fine sandy loam, sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	38-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Cf Cass	0-20	Loam	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-75	20-35	5-15
	20-40	Sandy loam, fine sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	95-100	85-95	20-40	<20	NP-5
	40-55	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	25-40	11-20
	55-60	Loamy fine sand, fine sand, coarse sand.	SM, SP	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Cg Colo	0-40	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	40-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	15-30
CrD2, CrF, CrG Crofton	0-6	Silt loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-22
	6-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	95-100	32-40	11-18

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Fm, Fp---------- Fillmore	0-20	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-40	2-20
	20-40	Silty clay------	CH	A-7	0	100	100	100	95-100	50-75	30-45
	40-60	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-75	20-45
Ga---------- Gibbon	0-18	Loamy sand------	SM	A-2	0	100	100	50-75	15-30	---	NP
	18-49	Loam------------	ML	A-4	0	100	100	85-95	60-75	22-35	2-8
	49-60	Loamy fine sand	SM	A-2	0	95-100	95-100	50-75	15-30	---	NP
Gc---------- Gibbon	0-14	Loam------------	ML, CL	A-6, A-4	0	100	100	95-100	70-100	30-40	6-15
	14-36	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	60-95	25-45	15-25
	36-60	Stratified loamy fine sand to silty clay loam.	SM, SC, CL, ML	A-4, A-6 A-2	0	100	100	70-95	35-95	<35	NP-15
Gd---------- Gibbon	0-14	Silty clay loam	ML, CL	A-6, A-4	0	100	100	95-100	85-100	30-40	6-15
	14-36	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	60-95	25-45	15-25
	36-60	Stratified fine sand to silty clay loam.	SP-SM, SM, SC CL, ML	A-4, A-6 A-3	0	100	100	65-95	20-95	<35	NP-15
Gv---------- Gibbon Variant	0-19	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	25-35	12-18
	19-26	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	25-35	12-18
	26-60	Silty clay loam, loam.	ML, CL	A-4, A-6	0	100	100	85-100	60-95	25-40	3-15
Im---------- Inavale	0-7	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	7-28	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	28-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Jn---------- Janude	0-16	Loam------------	ML, CL-ML	A-4	0	100	100	85-100	60-75	25-34	2-7
	16-40	Loam, fine sandy loam.	ML, SM-SC	A-4	0	100	100	85-100	60-75	20-34	NP-7
	40-60	Fine sandy loam, loam, sandy loam.	SM, ML, CL, SC	A-4, A-6	0	100	100	70-100	35-100	20-35	3-15
Jo---------- Janude	0-14	Loam------------	ML, CL-ML	A-4	0	100	100	85-100	60-75	25-34	3-7
	14-42	Loam, silty clay loam.	ML, CL SM-SC	A-4, A-6	0	100	100	85-100	60-95	25-40	8-15
	42-55	Silty clay------	CH, CL	A-6, A-7	0	100	100	95-100	90-95	41-55	20-32
	55-60	Loam------------	ML, CL-ML	A-4	0	100	100	85-100	35-70	25-34	3-7
JuC---------- Judson	0-7	Silt loam-------	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-20
	7-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
Ke---------- Kennebec	0-37	Silt loam-------	CL, ML	A-6, A-7	0	100	100	95-100	90-100	30-50	10-20
	37-60	Silt loam, silty clay loam.	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-50	10-20

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Kf*:											
Kennebec	0-37	Silt loam	CL, ML	A-6, A-7	0	100	100	95-100	90-100	30-50	10-20
	37-60	Silt loam, silty clay loam.	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-50	10-20
Colo	0-10	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	10-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	15-30
	38-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
LeC	0-8	Fine sandy loam	SM	A-4	0	100	100	70-85	35-45	---	NP
Leisy	8-28	Loam	ML, CL, CL-ML	A-4	0	100	100	85-95	60-75	20-35	2-10
	28-60	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-95	35-50	16-30
Lu	0-22	Silty clay	CH, MH, CL	A-7	0	100	100	95-100	90-100	40-85	20-60
Luton	22-60	Silty clay	CH	A-7	0	100	100	95-100	90-100	55-85	35-60
Mn, MnC	0-10	Silt loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
Monona	10-33	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	33-60	Silt loam	ML, CL	A-6, A-7	0	100	100	95-100	95-100	30-45	10-20
Mo, MoC, MoC2, MoD, MoD2, Mt	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	13-28
Moody	9-40	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	32-55	11-33
	40-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-45	6-35
NoC2, NoD, NoD2, NoE2	0-8	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-50	12-27
Nora	8-25	Silt loam, silty clay loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	30-51	11-27
	25-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	98-100	95-100	85-100	27-47	6-24
Pb*.											
Pits and dumps											
Pc	0-12	Loam	CL-ML, CL	A-4, A-6	0	100	95-100	85-95	60-75	22-35	4-15
Platte	12-16	Fine sandy loam, loam, loamy very fine sand.	ML, CL-ML	A-4	0	100	95-100	85-95	50-65	---	NP-5
	16-60	Gravelly coarse sand.	SP-SM, SM	A-1	0	70-90	50-75	30-50	5-15	---	NP
PxB*:											
Platte	0-12	Loam	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-95	60-75	4-15
	12-16	Very fine sandy loam, loam, loamy very fine sand.	ML, CL-ML	A-4	0	100	100	95-100	85-95	50-65	NP-5
	16-60	Gravelly coarse sand.	Sp-SM, SM	A-1	0	70-90	50-75	30-50	5-15	---	NP

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PxB*:											
Inavale	0-7	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	7-28	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	28-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Ra*.											
Riverwash											
Sa*:											
Saltine	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	70-95	35-50	15-30
	7-30	Silt loam, silty clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	85-100	60-95	25-50	7-25
	30-48	Silty clay loam, silt loam, silty clay.	CL, CH	A-4, A-6, A-7	0	100	100	95-100	70-95	25-55	7-35
	48-60	Silty clay loam, silt loam, sandy clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	70-95	25-50	7-25
Gibbon	0-14	Silty clay loam	ML, CL	A-6, A-4	0	100	100	95-100	85-100	30-40	6-15
	14-36	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	80-95	25-45	15-25
	36-60	Stratified fine sandy loam to silty clay loam.	SM, SC, CL, ML	A-4, A-6	0	100	100	70-95	35-95	15-35	NP-15
StF2	0-6	Clay loam	CL	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-50	15-25
Steinauer	6-18	Clay loam	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	15-30
	18-60	Loam, clay loam	CL	A-6	0-5	95-100	95-100	90-100	60-75	20-40	10-20
ThC, ThD	0-12	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	85-100	5-30	---	NP
Thurman	12-60	Loamy fine sand, fine sand, very fine sand.	SM, SP-SM	A-2, A-3	0	100	100	85-100	5-25	---	NP
TmD2*, TmF2*:											
Thurman	0-12	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	90-100	5-30	---	NP
	12-60	Loamy fine sand, fine sand, very fine sand.	SM, SP-SM	A-2, A-3	0	100	100	85-100	5-25	---	NP
Moody	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	13-28
	9-40	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	32-55	11-33
	40-60	Silt loam	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-45	6-25
Wm	0-15	Fine sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-85	30-45	<25	NP-5
Wann	15-60	Sandy loam, fine sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-80	30-45	0-26	NP-5
Wn	0-15	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	55-75	15-30	2-15
Wann	15-60	Sandy loam, fine sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	95-100	70-80	30-45	0-26	NP-5

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Zn---------- Zook	0-20 20-60	Silt loam------- Silty clay, silty clay loam.	CL, CL-ML CH	A-4, A-6 A-7	0 0	100 98-100	100 100	95-100 95-100	95-100 95-100	25-40 60-85	5-15 40-60
Zo---------- Zook	0-18 18-60	Silty clay loam Silty clay, silty clay loam.	MH, CH, CL, OL CH	A-7, A-6 A-7	0 0	98-100 100	100 100	95-100 95-100	95-100 95-100	38-70 50-85	15-35 30-50
Zw---------- Zook	0-18 18-60	Silty clay------ Silty clay, silty clay loam.	CH CH	A-7 A-7	0 0	100 100	100 100	95-100 95-100	95-100 95-100	60-85 60-85	40-60 40-60

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater than. 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	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Wind erodibility group
							Uncoated steel	Concrete	
	In	In/hr	In/in	pH	Mmhos/cm				
Af	0-12	2.0-6.0	0.16-0.18	6.1-8.4	<2	Low	Moderate	Low	3
Alda	12-29	2.0-6.0	0.15-0.17	6.6-8.4	<2	Low	Moderate	Low	
	29-60	>20.0	0.02-0.04	6.6-8.4	<2	Low	Moderate	Low	
Ag	0-12	0.6-2.0	0.20-0.22	6.1-8.4	<2	Low	Moderate	Low	6
Alda	12-29	2.0-6.0	0.15-0.17	6.6-8.4	<2	Low	Moderate	Low	
	29-60	>20.0	0.02-0.04	6.6-8.4	<2	Low	Moderate	Low	
Be	0-14	0.2-0.6	0.21-0.23	5.1-6.5	<2	High	High	Low	7
Belfore	14-37	0.2-0.6	0.12-0.14	6.1-8.4	<2	High	High	Low	
	37-60	0.2-0.6	0.18-0.20	6.1-8.4	<2	High	High	Low	
Bo	0-10	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low	High	Low	6
Boel	10-60	6.0-20	0.05-0.07	6.6-8.4	<2	Low	High	Low	
Ca, Cb	0-39	0.2-0.6	0.21-0.23	7.4-8.4	<2	High	High	Low	7
Calco	39-60	0.2-0.6	0.18-0.20	7.4-8.4	<2	High	High	Low	
Cc	0-20	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low	Moderate	Low	3
Cass	20-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low	Moderate	Low	
	38-60	6.0-20	0.08-0.10	6.1-8.4	<2	Low	Moderate	Low	
Cd	0-20	0.6-6.0	0.16-0.18	5.6-7.3	<2	Low	Moderate	Low	3
Cass	20-40	2.0-6.0	0.12-0.17	6.1-7.8	<2	Low	Moderate	Low	
	40-55	0.2-0.6	0.18-0.20	6.1-7.8	<2	Moderate	Moderate	Low	
	55-60	6.0-20	0.05-0.10	6.1-7.8	<2	Low	Moderate	Low	
Ce	0-20	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low	Moderate	Low	5
Cass	20-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low	Moderate	Low	
	38-60	6.0-20	0.08-0.10	6.1-8.4	<2	Low	Moderate	Low	
Cf	0-20	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low	Moderate	Low	5
Cass	20-40	2.0-6.0	0.12-0.17	6.1-7.8	<2	Low	Moderate	Low	
	40-55	0.2-0.6	0.18-0.20	6.1-7.8	<2	Moderate	Moderate	Low	
	55-60	6.0-20	0.05-0.10	6.1-7.8	<2	Low	Moderate	Low	
Cg	0-40	0.2-0.6	0.21-0.23	5.6-7.3	<2	High	High	Moderate	7
Colo	40-60	0.2-0.6	0.18-0.20	6.1-7.3	<2	High	High	Moderate	
CrD2, CrF, CrG	0-6	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low	Low	Low	4L
Crofton	6-60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	Low	Low	
Fm, Fp	0-20	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	High	Low	6
Fillmore	20-40	<0.06	0.11-0.13	5.6-7.8	<2	High	High	Low	
	40-60	0.06-0.6	0.10-0.20	6.6-8.4	<2	Moderate	High	Low	
Ga	0-18	6.0-20	0.10-0.12	5.1-5.5	<2	Low	Moderate	Low	2
Gibbon	18-49	0.6-2.0	0.17-0.19	6.1-7.3	<2	Low	Moderate	Low	
	49-60	6.0-20	0.08-0.10	6.1-7.8	<2	Low	Moderate	Low	
Gc, Gd	0-14	0.2-2.0	0.21-0.23	7.4-8.4	<2	Moderate	High	Low	7
Gibbon	14-36	0.2-2.0	0.20-0.22	7.9-8.4	<2	Moderate	High	Low	
	36-60	0.2-20	0.08-0.23	8.5-9.0	<2	Low	High	Low	
Gv	0-19	0.2-0.6	0.21-0.23	7.9-8.4	<2	Moderate	High	Low	7
Gibbon Variant	19-26	0.2-0.6	0.18-0.20	7.9-8.4	<2	Moderate	High	Low	
	26-60	0.2-2.0	0.17-0.20	8.5-9.0	<2	Moderate	High	Low	
Im	0-7	>6.0	0.10-0.12	5.6-7.3	<2	Low	High	Low	2
Inavale	7-28	6.0-20	0.09-0.11	6.6-8.4	<2	Low	High	Low	
	28-60	6.0-20	0.05-0.07	6.6-8.4	<2	Low	High	Low	
Jn	0-16	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low	Moderate	Low	5
Janude	16-40	0.6-2.0	0.17-0.19	6.6-8.4	<2	Low	Moderate	Low	
	40-60	0.6-6.0	0.14-0.20	6.6-8.4	<2	Low	Moderate	Low	

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Wind erodibility group
							Uncoated steel	Concrete	
	In	In/hr	In/in	pH	Mmhos/cm				
Jo	0-14	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low	Moderate	Low	5
Janude	14-42	0.2-2.0	0.17-0.19	6.6-8.4	<2	Low	Moderate	Low	
	42-55	0.06-0.2	0.10-0.13	6.6-8.4	<2	High	Moderate	Low	
	55-60	0.6-2.0	0.17-0.19	6.6-8.4	<2	Low	Moderate	Low	
JuC	0-17	0.6-2.0	0.21-0.23	6.1-7.3	<2	Moderate	Moderate	Low	7
Judson	17-60	0.6-2.0	0.21-0.23	6.1-7.8	<2	Moderate	Moderate	Low	
Ke	0-37	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	Moderate	Low	6
Kennebec	37-60	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	Moderate	Low	
Kf*:									
Kennebec	0-37	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	Moderate	Low	6
	37-60	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	Moderate	Low	
Colo	0-10	0.2-0.6	0.21-0.23	5.6-7.3	<2	High	High	Moderate	7
	10-60	0.2-0.6	0.18-0.20	6.1-7.3	<2	High	High	Moderate	
	38-60	0.2-0.6	0.18-0.20	6.1-7.3	<2	High	High	Moderate	
LeC	0-8	2.0-6.0	0.16-0.18	6.1-6.5	<2	Low	Moderate	Low	3
Leisy	8-28	0.6-2.0	0.17-0.19	6.1-6.5	<2	Low	Moderate	Low	
	28-60	0.2-0.6	0.18-0.20	5.6-7.3	<2	Moderate	Moderate	Low	
Lu	0-22	<0.06	0.12-0.14	6.6-7.8	<2	High	High	Low	4
Luton	22-60	<0.06	0.11-0.13	6.6-8.4	<2	High	High	Low	
Mn, MnC	0-10	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	Low	Low	6
Monona	10-33	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	Low	Low	
	33-60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	Low	Low	
Mo, MoC, MoC2, MoD, MoD2, Mt	0-9	0.2-2.0	0.19-0.22	5.6-7.3	<2	Moderate	Moderate	Low	7
Moody	9-40	0.2-0.6	0.17-0.20	6.1-7.3	<2	Moderate	Moderate	Low	
	40-60	0.2-2.0	0.18-0.20	7.4-8.4	<2	Moderate	Moderate	Low	
NoC2, NoD, NoD2, NoE2	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	Moderate	Low	7
Nora	8-25	0.6-2.0	0.17-0.20	6.6-7.8	<2	Moderate	Moderate	Low	
	25-60	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	Moderate	Low	
Pb*.									
Pits and dumps									
Pc	0-12	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low	High	Moderate	5
Platte	12-16	0.6-2.0	0.17-0.19	6.6-8.4	<2	Low	High	Moderate	
	16-60	>20	0.02-0.04	6.6-8.4	<2	Low	High	Moderate	
PxB*:									
Platte	0-12	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low	High	Moderate	5
	12-16	0.6-2.0	0.17-0.19	6.6-8.4	<2	Low	High	Moderate	
	16-60	>20	0.02-0.04	6.6-8.4	<2	Low	High	Moderate	
Inavale	0-7	>6.0	0.10-0.12	5.6-7.3	<2	Low	High	Low	2
	7-28	6.0-20	0.09-0.11	6.6-8.4	<2	Low	High	Low	
	28-60	6.0-20	0.05-0.07	6.6-8.4	<2	Low	High	Low	
Ra*.									
Riverwash									
Sa*:									
Saltine	0-7	0.2-0.6	0.17-0.23	7.4-9.0	4-8	High	High	High	6
	7-30	0.6-2.0	0.17-0.22	>8.5	4-8	Moderate	High	High	
	30-48	0.06-2.0	0.10-0.22	>7.4	<2	High	High	High	
	48-60	0.2-2.0	0.18-0.22	>7.4	<2	Moderate	High	High	

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Wind erodibility group
							Uncoated steel	Concrete	
	In	In/hr	In/in	pH	Mmhos/cm				
Sa*:									
Gibbon	0-14	0.2-2.0	0.21-0.23	7.4-8.4	<2	Moderate	High	Low	7
	14-36	0.2-2.0	0.20-0.22	7.9-8.4	<2	Moderate	High	Low	
	36-60	0.2-6.0	0.16-0.23	8.5-9.0	<2	Low	High	Low	
StF2	0-6	0.2-0.6	0.16-0.17	7.4-8.4	<2	Moderate	High	Low	4L
Steinauer	6-18	0.2-0.6	0.14-0.17	7.9-8.4	<2	Moderate	High	Low	
	18-60	0.2-2.0	0.13-0.16	7.9-8.4	<2	Moderate	High	Low	
ThC, ThD	0-12	6.0-20	0.10-0.12	6.1-7.3	<2	Low	Low	Low	2
Thurman	12-60	6.0-20	0.06-0.11	6.1-7.3	<2	Low	Low	Low	
TmD2*, TmF2*:									
Thurman	0-12	6.0-20	0.10-0.12	6.1-7.3	<2	Low	Low	Low	2
	12-60	6.0-20	0.06-0.11	6.1-7.3	<2	Low	Low	Low	
Moody	0-9	0.2-2.0	0.19-0.22	5.6-7.3	<2	Moderate	Moderate	Low	7
	9-40	0.2-2.0	0.17-0.20	6.1-7.3	<2	Moderate	Moderate	Low	
	40-60	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	Moderate	Low	
Wm	0-15	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low	Moderate	Low	3
Wann	15-60	2.0-6.0	0.15-0.17	7.9-8.4	<2	Low	High	Low	
Wn	0-15	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low	Moderate	Low	5
Wann	15-60	2.0-6.0	0.15-0.17	7.9-8.4	<2	Low	High	Low	
Zn	0-20	0.6-2.0	0.22-0.24	5.6-7.8	<2	Moderate	High	Moderate	6
Zook	20-60	0.06-0.2	0.11-0.13	5.6-7.8	<2	High	High	Moderate	
Zo	0-18	0.2-0.6	0.21-0.23	5.6-7.8	<2	High	High	Moderate	7
Zook	18-60	0.06-0.2	0.11-0.13	5.6-7.8	<2	High	High	Moderate	
Zw	0-18	0.06-0.2	0.11-0.13	5.6-7.8	<2	High	High	Moderate	4
Zook	18-60	0.06-0.2	0.11-0.13	5.6-7.8	<2	High	High	Moderate	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain such terms as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock depth
		Frequency	Duration	Months	Depth	Kind	Months	
					Ft			In
Af, Ag---------- Alda	C	Occasional	Brief------	Apr-Jul	2.0-4.0	Apparent	Nov-May	>60
Be---------- Belfore	B	None--------	---	---	>6.0	---	---	>60
Bo-------)-------- Boel	A	Occasional	Brief------	Mar-Jun	2.0-3.5	Apparent	Nov-May	>60
Ca---------- Calco	B/D	Occasional	Brief------	Mar-Jun	2.0-3.0	Apparent	Nov-May	>60
Cb* Calco	B/D	Frequent----	Brief------	Mar-Jun	+.5-2.0	Apparent	Nov-May	>60
Cc---------- Cass	B	Rare--------	Brief------	Mar-Jun	>6.0	---	---	>60
Cd---------- Cass	B	Rare--------	---	---	2.5-3.5	Perched	Nov-Jun	>60
Ce---------- Cass	B	Rare--------	Brief------	Mar-Jun	>6.0	---	---	>60
Cf---------- Cass	B	Rare--------	---	---	2.5-3.5	Perched	Nov-Jun	>60
Cg---------- Colo	B/D	Occasional	Brief------	Mar-Jun	2.0-3.0	Apparent	Nov-May	>60
CrD2, CrF, CrG---- Crofton	B	None--------	---	---	>6.0	---	---	>60
Fm*---------- Fillmore	D	Occasional	Long-------	Apr-Jul	+.5-1.0	Perched	Mar-Jul	>60
Fp*---------- Fillmore	D	Frequent----	Long-------	Apr-Jul	+.5-1.0	Perched	Mar-Jul	>60
Ga, Gc, Gd-------- Gibbon	B	Occasional	Very brief	Mar-Jul	2.0-4.0	Apparent	Nov-Jun	>60
Gv*---------- Gibbon Variant	B	Frequent----	Brief------	Mar-Jul	+.5-2.0	Apparent	Nov-Jun	>60
Im---------- Inavale	A	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60
Jn---------- Janude	B	Rare--------	---	---	4.0-6.0	Apparent	Nov-Jun	>60
Jo---------- Janude	B	Rare--------	---	---	2.5-3.5	Perched	Nov-Jun	>60
JuC---------- Judson	B	None--------	---	---	>6.0	---	---	>60
Ke---------- Kennebec	B	Occasional--	Brief------	Feb-Nov	4.0-6.0	Apparent	Nov-May	>60

See footnotes at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock depth
		Frequency	Duration	Months	Depth	Kind	Months	
					Ft			In
Kf**:								
Kennebec	B	Frequent	Brief	Feb-Nov	4.0-6.0	Apparent	Nov-May	>60
Colo	B/D	Frequent	Brief	Mar-Jun	2.0-3.0	Apparent	Nov-May	>60
LeC---------- Leisy	B	None	---	---	>6.0	---	---	>60
Lu---------- Luton	D	Occasional	Brief	Mar-Jun	1.0-3.0	Perched	Nov-May	>60
Mn, MnC---------- Monona	B	None	---	---	>6.0	---	---	>60
Mo, MoC, MoC2, MoD, MoD2, Mt---- Moody	B	None	---	---	>6.0	---	---	>60
NoC2, NoD, NoD2, NoE2---------- Nora	B	None	---	---	>6.0	---	---	>60
Pb**. Pits and dumps								
Pc---------- Platte	B/D	Occasional	Brief	Apr-Oct	1.5-3.0	Apparent	Apr-Jun	>60
PxB**:								
Platte----------	B/D	Frequent	Brief	Apr-Oct	0.5-2.0	Apparent	Apr-Jun	>60
Inavale----------	A	Occasional	Very brief	Jan-Jul	5.0-8.0	---	---	>60
Ra**. Riverwash								
Sa**:								
Saltine----------	C	Occasional	Brief	Apr-Jul	2.0-3.0	Apparent	Nov-Jul	>60
Gibbon----------	B	Occasional	Very brief	Mar-Jul	2.0-4.0	Apparent	Nov-Jun	>60
StF2---------- Steinauer	B	None	---	---	>6.0	---	---	>60
ThC, ThD---------- Thurman	A	None	---	---	>6.0	---	---	>60
TmD2**, TmF2**:								
Thurman----------	A	None	---	---	>6.0	---	---	>60
Moody----------	B	None	---	---	>6.0	---	---	>60
Wm, Wn---------- Wann	B	Occasional	Brief	Mar-Nov	2.0-4.0	Apparent	Apr-Jun	>60
Zn, Zo, Zw-------- Zook	C/D	Occasional	Brief	Mar-Jun	1.0-3.0	Perched	Nov-May	>60

* In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water table rises above the surface. The second numeral indicates the depth below the surface.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING TEST DATA

[Dashes indicate data were not available. NP means nonplastic. TR means trace]

Soil name, report number, horizon, and depth in inches[1]	Classification		Grain size distribution								Liquid limit	Plasticity index	Particle density
			Percentage passing sieve					Percentage smaller than--					
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			
											Pct		G/cc
Gibbon sil:[2] (S74NE-053-007)													
Ap------ 0 to 6	A-4 (08)	CL	100	100	100	98	74	23	16	15	30	10	2.58
Ac------ 14 to 28	A-6 (10)	CL	100	100	100	98	65	37	25	23	37	20	2.67
C1------ 28 to 36	A-6 (09)	CL	100	100	100	98	62	35	25	24	35	19	2.65
Janude loam:[3] (S74NE-053-006)													
Ap------ 0 to 7	A-4 (07)	CL-ML	100	100	100	99	69	32	20	17	28	7	2.62
Ac------ 16 to 40	A-4 (00)	SM-SC	100	100	100	97	37	20	14	12	23	5	2.65
C1------ 40 to 52	A-4 (02)	SC	100	100	100	90	43	24	17	15	27	10	2.66
Moody sicl:[4] (S74NE-053-002)													
Ap------ 0 to 7	A-6 (10)	CL	100	100	100	100	99	60	37	32	39	16	2.63
B22----- 18 to 25	A-7-6(18)	CH	100	100	100	100	99	62	40	36	52	29	2.74
C1------ 46 to 60	A-7-6(12)	CL	100	100	100	100	99	54	33	30	41	19	2.66
Nora sicl:[5] (S74NE-053-004)													
Ap------ 0 to 8	A-7-6(13)	ML	100	100	100	100	97	60	38	30	48	19	2.63
B22----- 12 to 21	A-7-6(16)	CH	100	100	100	100	98	77	41	34	51	25	2.70
C1ca---- 25 to 34	A-7-6(15)	CL	100	99	99	98	97	64	37	30	47	24	2.71
Thurman lfs:[6] (S74NE-053-003)													
Ap------ 0 to 5	A-2-4(00)	SM	100	100	100	98	20	6	6	5	--	NP	2.61
A12----- 5 to 12	A-2-4(00)	SM	100	100	100	97	20	9	5	5	--	NP	2.63
C1------ 20 to 48	A-2-4(00)	SM	100	100	100	98	18	9	5	4	--	NP	2.62
Zook sicl:[7] (S74NE-053-005)													
Ap------ 0 to 7	A-6 (10)	CL	100	100	99	99	96	58	35	31	39	16	2.62
Bg------ 18 to 43	A-7-6(22)	CH	100	100	100	99	96	71	49	42	60	36	2.65
Cg------ 43 to 60	A-7-6(19)	CH	100	100	100	100	97	62	43	38	51	32	2.71

[1]All pedons sampled are within the concept of the series named.

[2]Gibbon silt loam:
2640 ft s. & 100 ft e. of nw. corner of sec. 8 t.17n.,r.7e.

[3]Janude loam:
2,376 ft s. & 50 ft e. of nw. corner of sec. 7, t.17n.,r.7e.

[4]Moody silty clay loam:
1,056 ft s. & 100 ft w. of ne. corner of sec. 34, t.19n.,r.8e.

[5]Nora silty clay loam:
2,376 ft w. & 792 ft s. of ne. corner of sec. 11, t.20n.,r.8e.

[6]Thurman loamy fine sand:
125 ft n. & 792 ft w. of se. corner of sec. 6, t.20n.,r.7e.

[7]Zook silty clay loam:
2,640 ft w. & 100 ft n. of se. corner of sec. 34, t.19n.,r.5e.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Alda	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Belfore	Fine, montmorillonitic, mesic Udic Haplustolls
Boel	Sandy, mixed, mesic Fluvaquentic Haplustolls
Calco	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Cass	Coarse-loamy, mixed, mesic Fluventic Haplustolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Crofton	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls
Gibbon	Fine-silty, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Gibbon Variant	Fine-silty, mixed, mesic Fluvaquentic Haplaquolls
Inavale	Sandy, mixed, mesic Typic Ustifluvents
Janude	Coarse-loamy, mixed, mesic Cumulic Haplustolls
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Leisy	Fine-loamy, mixed, mesic Udic Argiustolls
Luton	Fine, montmorillonitic, mesic Vertic Haplaquolls
Monona	Fine-silty, mixed, mesic Typic Hapludolls
Moody	Fine-silty, mixed, mesic Udic Haplustolls
Nora	Fine-silty, mixed, mesic Udic Haplustolls
Platte	Sandy, mixed, mesic Mollic Fluvaquents
Saltine	Fine-silty, mixed, mesic Typic Halaquepts
Steinauer	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Thurman	Sandy, mixed, mesic Udorthentic Haplustolls
Wann	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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