SOIL SURVEY OF

Webster County, Nebraska

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of Nebraska
Conservation and Survey Division

Issued May 1974

Major fieldwork for this soil survey was done in the period 1958–65. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1967. 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 Webster County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SURVEY

THIS SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Webster County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The Guide to Mapping Units can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and windbreak groups.

Foresters and others can refer to the section Management of Soils for Windbreaks, where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soil and wildlife in the section Management of Soils for Wildlife.

Ranchers and others can find, under Management of Soils for Range, groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section Engineering Interpretations of Soils.

Engineers and builders can find, under Engineering Uses of Soils, tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section Formation and Classification of the Soils.

Newcomers in Webster County may be especially interested in the section General Soil Map, where broad patterns of soils are described. They may also be interested in the section General Nature of the County.

Cover: **Small cow-calf herd on Holdrege-Coly-Geary association. About 160 acres of this range was seeded to native grass.**

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SOIL SURVEY OF WEBSTER COUNTY, NEBRASKA

BY HARRY E. PADEN AND LARRY G. RAGON,[1] SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

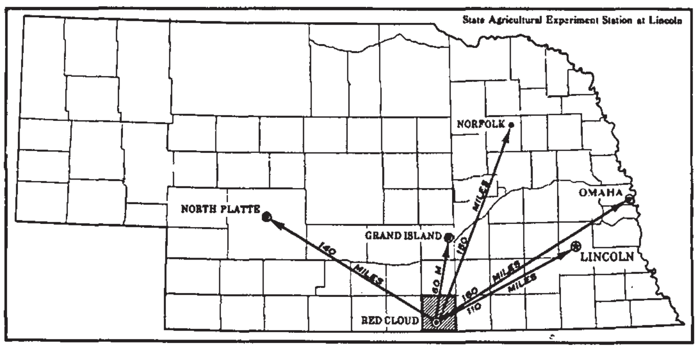

Figure 1.—**Location of Webster County in Nebraska.**

WEBSTER COUNTY is in south-central Nebraska, adjoining Kansas (fig. 1).

It is 24 miles square and has a total area of 368,000 acres. Red Cloud is the county seat and the largest town in the county.

Webster County had a population of 6,477 in 1970. Farming is the principal occupation. There are 218,000 acres of cultivated land and 150,000 acres in native grasses. The major crops grown in the county are corn, grain sorghum, wheat, and alfalfa. A large part of the corn, grain sorghum, and alfalfa is fed to livestock. Beef cattle, dairy cattle, and hogs are the major livestock raised. Wheat is a cash crop.

Water for irrigation is available from deep wells in some places north of the Republican River Valley. Several areas in the Republican River Valley are irrigated. Water is available from a reservoir upstream in Harlan County and is delivered by the Bostwick Irrigation District Canal.

Webster County is in the Loess Plains part of the Great Plains physiographic province. The Republican River enters the county from the west, 5 miles north of the Kansas line. It flows eastward across the southern part of the county and leaves the county about 4 miles north of the Kansas line. The Republican River Valley is about 2 miles wide and consists of bottom land, well-formed stream terraces, and a few adjacent foot slopes. Upland soils north of the Republican River Valley formed mainly in loess. A few soils south of the valley formed in material weathered from chalky limestone bedrock.

More than 80 percent of the soils in Webster County are well drained. About 40 percent are nearly level or very gently sloping. Soils of the Holdrege series are the most extensive in the county. The main concerns in management are conservation of water, control of water erosion, control of soil blowing, and maintenance of high fertility.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Webster County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams; 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 that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*6*).[2]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Holdrege and Hastings, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Holdrege silt loam, 1 to 3 percent slopes, is one of several phases within the Holdrege series.

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[1] Part of the fieldwork was done by ROBERT S. POLLOCK, DONALD A. YOST, JACK YOUNG, and LOREN GREINER, Soil Conservation Service.

[2] Italic numbers in parentheses refer to Literature Cited, p. 70.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Only one such kind of mapping unit is shown on the soil map of Webster County: an undifferentiated group.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Coly and Hobbs soils is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gravelly land is a land type in Webster County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Webster County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Boundaries and names of the soil associations on the general soil map may differ from those in published surveys of adjacent counties. Such differences result from changes in the concepts of soil classification that have occurred since publication.

The six soil associations in Webster County are described on the following pages.

1. Hastings-Hord-Holdrege Association

Nearly level and very gently sloping, deep, silty soils on loess-mantled uplands

This association consists of soils that formed in loess on broad upland plains. The topography is mainly nearly level and very gently sloping. Steeper slopes border the small intermittent upland drainageways.

This association makes up about 14 percent of the county. Hastings soils make up about 40 percent of the association; Hord soils, 27 percent; Holdrege soils, 19 percent; and less extensive soils, the remaining 14 percent (fig. 2).

Hastings soils are nearly level and very gently sloping and are well drained. The surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is gray, grayish-brown, and light brownish-gray silty clay loam. The underlying material is brown silt loam. Lime is at a depth of about 40 inches.

Hord soils are nearly level and very gently sloping and are well drained. Their surface layer typically is grayish-brown to gray silt loam about 10 inches thick. The subsoil is grayish-brown and light brownish-gray silt loam and silty clay loam. At a depth of 36 inches is pale-brown, calcareous silt loam.

Holdrege soils are well drained and nearly level and very gently sloping. Typically, the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is grayish-brown to pale-brown silty clay loam. At a depth of 32 inches is pale-brown, calcareous silt loam.

Less extensive in this association are the Crete, Fillmore, Coly, and Hobbs soils. Crete soils are on concave areas and broad flats. Fillmore soils are in swales and shallow undrained depressions. Coly soils are along drainageways, and Hobbs soils are at the bottom of the drainageways.

Nearly all this association is used for cultivated crops. A small part is used for range. The wet undrained depres-

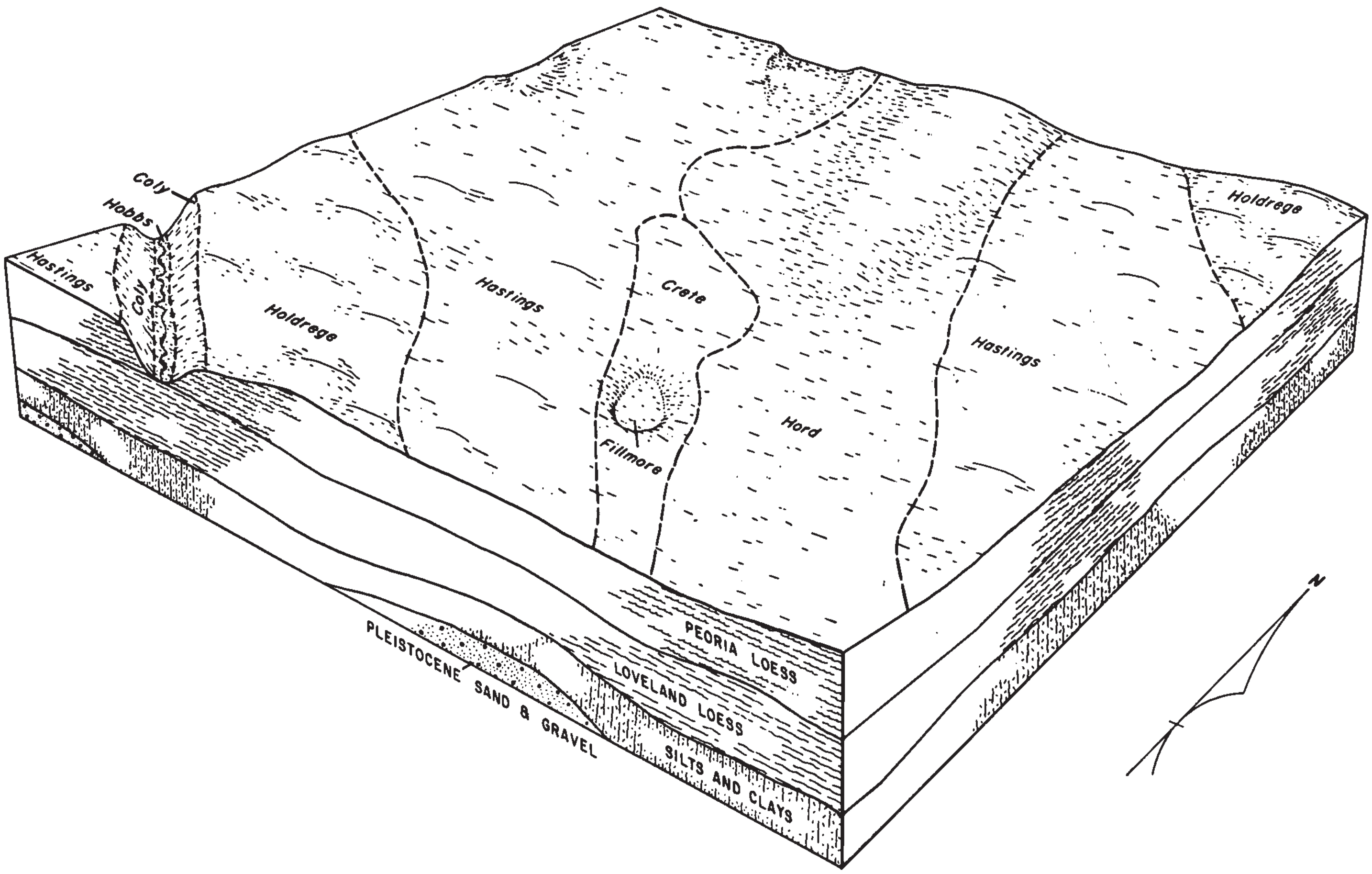

Figure 2.—**Pattern of soils and underlying material in association 1.**

sions are used by wildlife. The main enterprises are growing cash crops, dairying, and raising swine and beef cattle. Corn, grain sorghum, wheat, and alfalfa are the principal crops.

The main concerns of management are controlling soil blowing and maintaining good tilth and high fertility. Improved surface drainage is needed in some areas. The annual precipitation is the limiting factor in crop production under dryland management.

This is an area of the county where the soils are highly fertile and where water erosion is ordinarily not a severe problem. Farms range from 240 to 480 acres in size. Improved dirt or gravel roads are on nearly all section lines.

2. Holdrege-Coly-Geary Association

Nearly level to steep, deep, silty soils on loess-mantled uplands

This association consists of nearly level and very gently sloping divides, a quarter of a mile to a mile wide, separated by drainageways bordered by moderately steep and steep slopes.

This association makes up about 58 percent of the county. Holdrege soils make up about 55 percent of this association; Coly soils, 15 percent; Geary soils, 10 percent; and less extensive soils, the remaining 20 percent (fig. 3).

Holdrege soils are very gently sloping to moderately sloping and are well drained. They are on the divides and slopes. The surface layer typically is dark grayish-brown silt loam about 12 inches thick. The subsoil is grayish-brown and pale-brown silty clay loam. Pale-brown, calcareous silt loam is at a depth of about 32 inches.

Coly soils are gently sloping to steep and are well drained. They are along drainageways. The surface layer typically is grayish-brown, calcareous silt loam about 6 inches thick. Below the surface layer is a light brownish-gray, calcareous silt loam transitional layer about 4 inches thick. At a depth of about 10 inches is light-gray, calcareous silt loam.

Geary soils are gently sloping to steep and are well drained. They are along intermittent drainageways. The surface layer typically is dark grayish-brown silt loam about 12 inches thick. The subsoil is brown silty clay about 22 inches thick. The underlying material is light reddish-brown silt loam and is calcareous at a depth of about 42 inches.

The less extensive Hobbs soil occupies the bottom of upland drainageways. Silty alluvial land is in frequently flooded areas. Rough broken land, loess, is on very steep bluffs and canyon walls.

Most of this association is cultivated, but a significant part is in range. Some severely eroded areas are seeded to

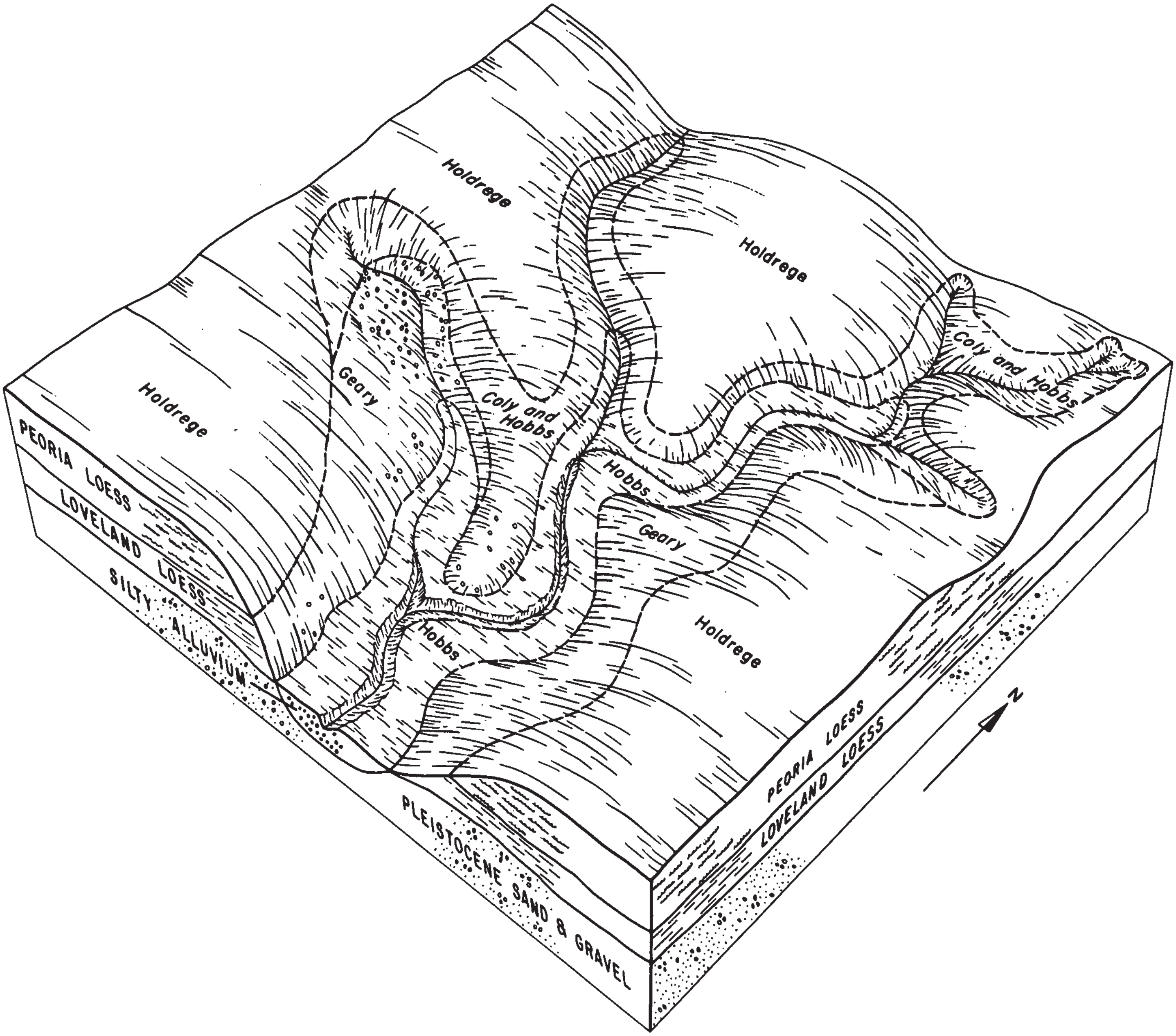

***Figure 3.*—Pattern of soils and underlying material in association 2.**

native or tame grass. Growing cash crops, raising swine and beef cattle, and dairying are the main enterprises. Corn, wheat, grain sorghum (fig. 4), and alfalfa are the crops most commonly grown on the cultivated soils of this association.

The principal concern of management is controlling water erosion and soil blowing. A secondary concern is maintaining good tilth and high fertility.

Most farms range from 320 to 640 acres in size. Improved dirt or gravel roads are on nearly all section lines. There are no particular transportation problems in marketing the farm products.

3. Meadin-Geary Association

Gently sloping to steep, loamy soils that are shallow over sand and gravel, and deep, silty soils on loess-mantled uplands

This association consists of gently sloping to steep soils bordering drainageways. The Meadin soils are below the Geary soils in the landscape.

This association makes up about 3 percent of the county. Meadin soils make up about 50 percent of this association; Geary soils, 30 percent; and less extensive soils, the remaining 20 percent (fig. 5).

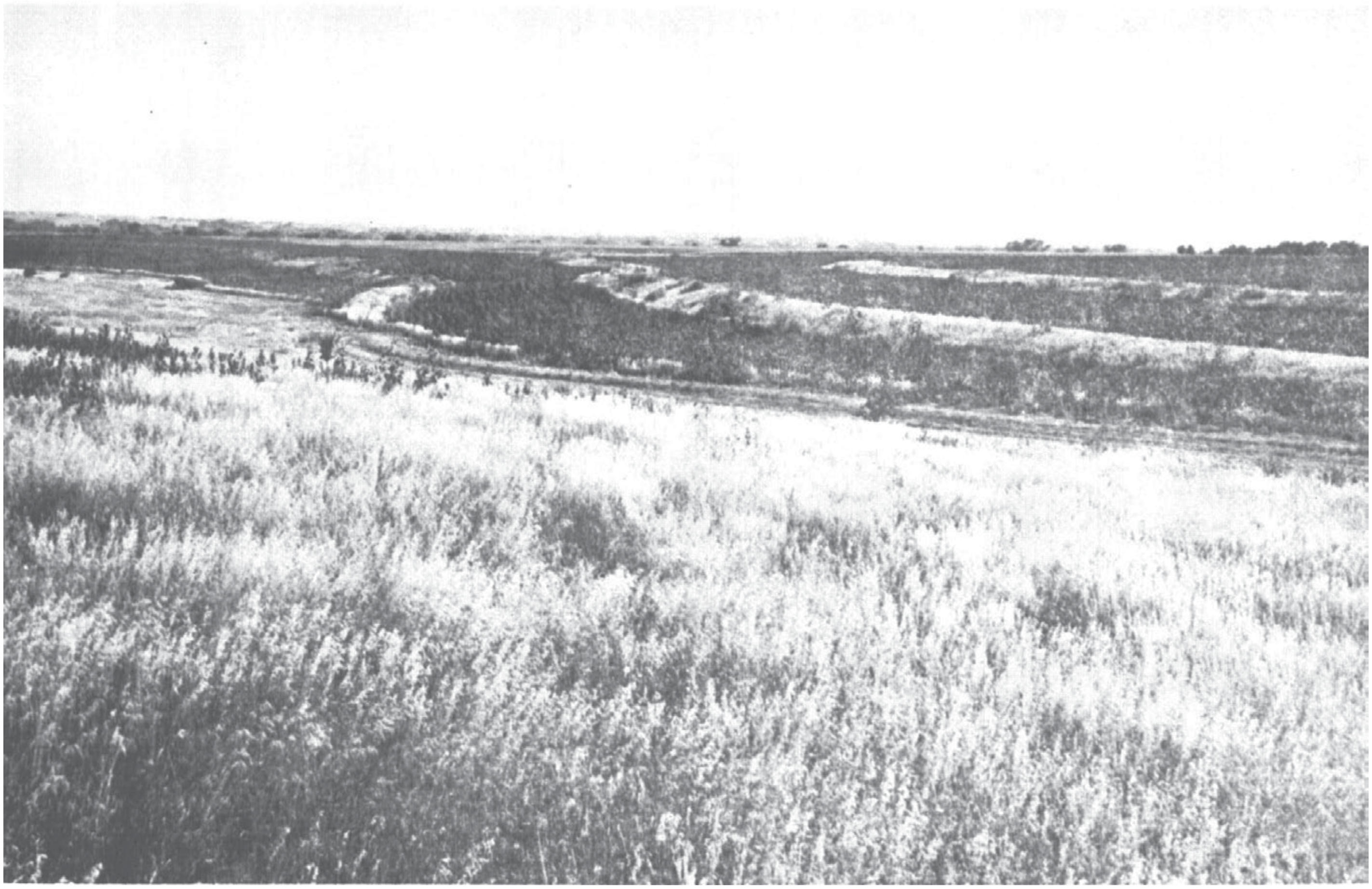

Figure 4. **Grain sorghum on terraced cropland. The class VI land in foreground was seeded to native grass. This landscape is in association 2.**

Meadin soils are moderately sloping to steep and are excessively drained. Typically, the surface layer is dark grayish-brown loam about 6 inches thick. Beneath this is a grayish-brown gravelly sandy loam transitional layer about 8 inches thick. The underlying material is light-gray coarse sand and gravel.

Geary soils are gently sloping to steep and are well drained. In a typical profile, the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is brown silty clay loam about 22 inches thick. Light reddish-brown silt loam is at a depth of about 34 inches. Lime is at a depth of about 42 inches.

Gravelly land is in the lowest part of the landscape.

Most of this association is in native grass and is used for range. The main enterprises are grazing and feeding livestock. A few areas are cultivated, and wheat, grain sorghum, corn, and alfalfa are the main crops. Operating units in this association range from 480 to 720 acres in size. Improved dirt and gravel roads are on nearly all section lines.

The main concern in grassland management is maintaining proper livestock grazing practices. Controlling water erosion and maintaining high fertility are the main concerns in management on cultivated soils.

4. Geary-Holdrege-Kipson Association

Gently sloping to steep, deep, silty soils that formed in loess, and shallow, silty soils that formed in material derived from chalky limestone; on uplands

This soil association consists of gently sloping to steep soils that border upland drainageways. The creeks and drains are deeply entrenched and drain northward into the Republican River Valley. The area is capped by loess. Chalky limestone outcrops are on the sides of drainageways.

This association makes up about 16 percent of the county. Geary soils make up about 35 percent of this association; Holdrege soils, 25 percent; Kipson soils, 12 percent; and less extensive soils, the remaining 28 percent (fig. 6).

Geary soils are gently sloping to steep and are well drained. They border upland drainageways. Typically, the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is brown silty clay loam about 22 inches thick. The underlying material is light reddish-brown silt loam that is calcareous at a depth of 42 inches.

Holdrege soils are gently sloping to moderately sloping and are well drained. The surface layer typically is dark

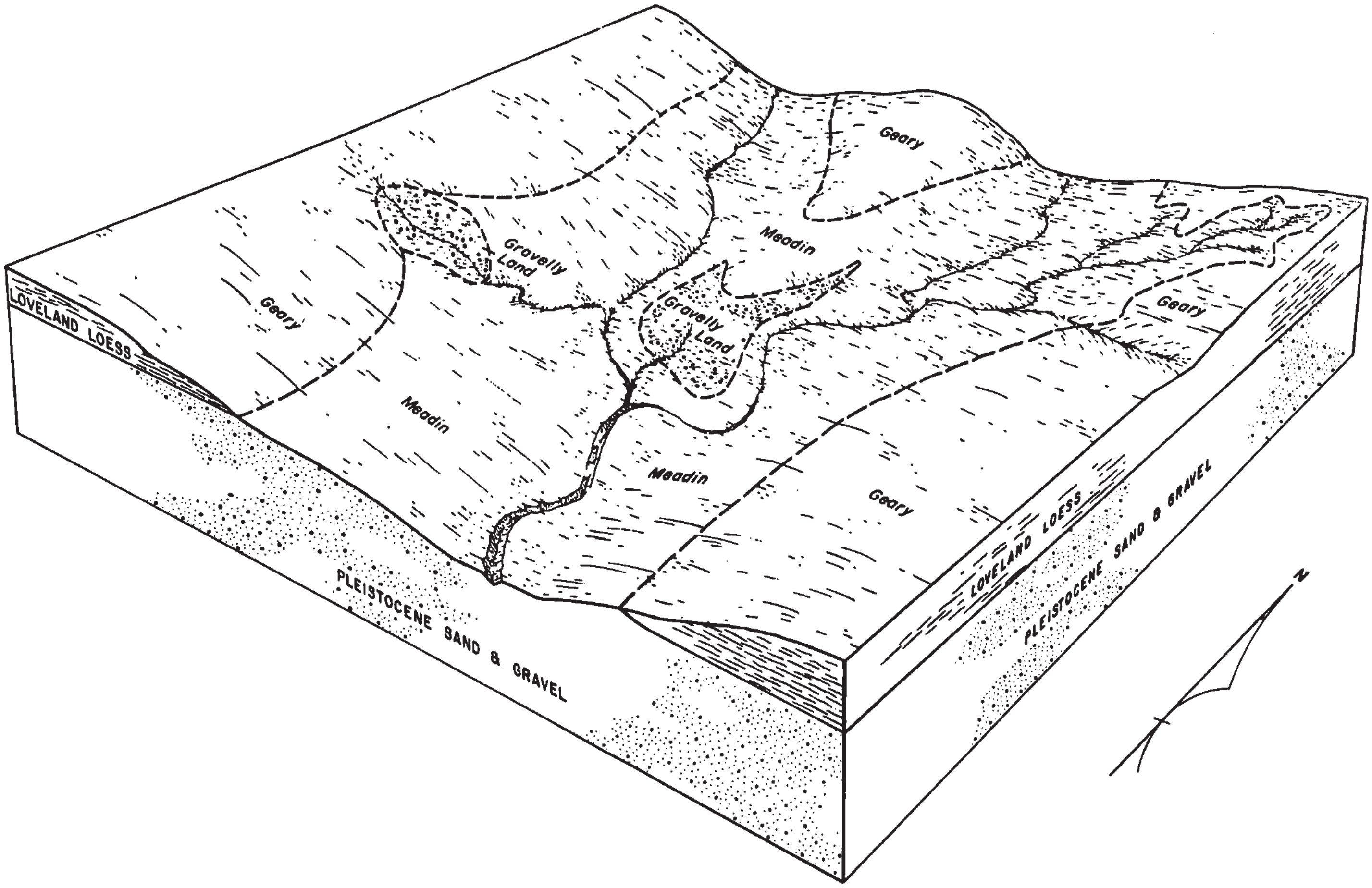

***Figure 5.*—Pattern of soils and underlying material in association 3.**

grayish-brown silt loam about 12 inches thick. The subsoil is grayish-brown and pale-brown silty clay loam to a depth of about 32 inches. The underlying material is pale-brown, calcareous silt loam.

Kipson soils are moderately sloping to steep and somewhat excessively drained. They are adjacent to drainageways. Typically, the surface layer is dark grayish-brown silt loam about 9 inches thick. The material below the surface layer is a light brownish-gray silt loam transitional layer about 6 inches thick. The consolidated, chalky limestone bedrock is at a depth of about 15 inches.

Less extensive in this association are the Coly, Hobbs, and Wakeen soils. Coly soils are moderately steep to steep and are adjacent to drainageways. Hobbs soils are on the occasionally flooded bottoms of upland drainageways. Wakeen soils are gently sloping to steep and are on long, concave slopes adjacent to drainageways. Silty alluvial land is along creeks and streams. Rough broken land, loess, and Rough stony land are very steep and are on upland breaks and sides of drainageways.

Most of this soil association is in native grasses, and the main enterprise is raising beef cattle. Only a small percentage of the acreage is cultivated. Some soils formerly were cultivated, but are now seeded to native or tame grasses. The principal concern in management is maintaining proper livestock grazing practices. The water supply for livestock is limited to farm ponds and wells.

Farms and ranches in this association are the largest in Webster County and range from 500 to 900 acres in size. Trails or improved dirt roads are on most section lines; only a few roads are graveled or paved.

5. McCook-Munjor-Gibbon Association

Nearly level and very gently sloping, deep, loamy soils on bottom lands

This soil association consists of nearly level and very gently sloping soils on bottom lands of the Republican River and a few of its principal tributary streams.

This soil association makes up about 6 percent of the county. McCook soils make up about 30 percent of this association; Munjor soils, about 16 percent; Gibbon soils, 14 percent; and less extensive soils, the remaining 40 percent (fig. 7).

McCook soils are nearly level and very gently sloping and are well drained. They are on the highest part of the flood plains. The surface layer typically is gray silt loam about 12 inches thick. Beneath this is a light brownish-gray silt loam transitional layer about 9 inches thick. The underlying material is light brownish-gray to light-gray very fine sandy loam and silt loam. Light-gray loamy fine sand is below a depth of 43 inches.

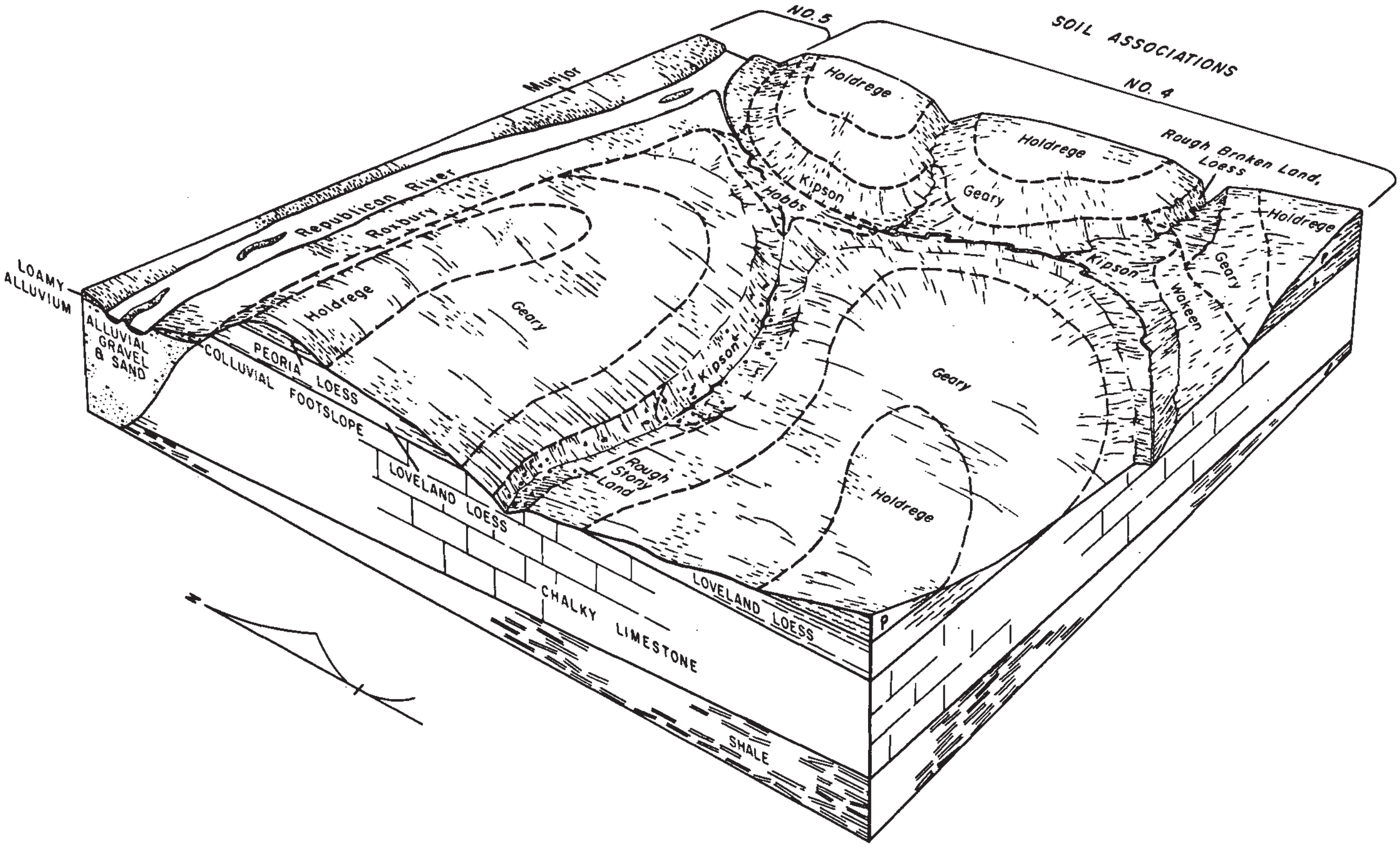

Figure 6.—**Pattern of soils and underlying material in association 4 and part of association 5.**

Munjor soils are nearly level and very gently sloping and are well drained. Typically, the surface layer is grayish-brown fine sandy loam about 8 inches thick. The underlying material is light brownish-gray fine sandy loam in the upper part and pale-brown medium sand in the lower part.

Gibbon soils are nearly level and somewhat poorly drained. The surface layer is very dark gray to light-gray silty clay loam about 18 inches thick. The underlying material is light brownish-gray to light-gray silt loam and very fine sandy loam in the upper part and light-gray fine sandy loam in the lower part.

Less extensive soils are numerous. The occasionally flooded Hobbs soils are on the bottoms of drainageways. Humbarger soils are in the lowest areas of the well-drained soils. Inavale soils are excessively drained soils on bottom lands. Roxbury soils occupy colluvial-alluvial positions at the outlets of streams that emerge onto the flood plain of the Republican River. Sandy alluvial land is on sand bars along dissected channels of the Republican River. Wet alluvial land is in depressions and low lying flats along the river, and Marsh occupies the lowest bottom land positions.

Most of this association is used for cultivated crops. A few sandy, undrained, and very wet areas are used for permanent range and pasture and as wildlife habitat. This is a diversified area of the county. The main enterprises are growing cash crops, dairying, and the feeding of swine and beef cattle.

The main hazards are soil blowing in some areas and lack of adequate drainage in others. Maintaining high fertility where the soils are cultivated is a concern in management. Water for irrigation is available in most places from wells, and in some areas from the Bostwick Irrigation District Canal.

Farms range from 240 to 480 acres in size. There are few roads on section lines. The farm-to-market road system is adequate. There are few farmsteads in this association.

6. Hord Association

Nearly level and very gently sloping, deep, silty soils on stream terraces

This soil association consists of stream terraces of the Republican River Valley and a few of the minor streams in the county. The topography is nearly level and very gently sloping.

This soil association makes up about 3 percent of the county. Hord soils make up about 95 percent of this association and less extensive soils the remaining 5 percent.

Hord soils are nearly level and very gently slopping, well-drained soils that formed in silty alluvium. Typically, the surface layer is grayish-brown and gray silt loam about 13 inches thick. The subsoil is grayish-brown and light brownish-gray silt loam and light silty clay loam. At a depth of 36 inches is pale-brown, calcareous silt loam.

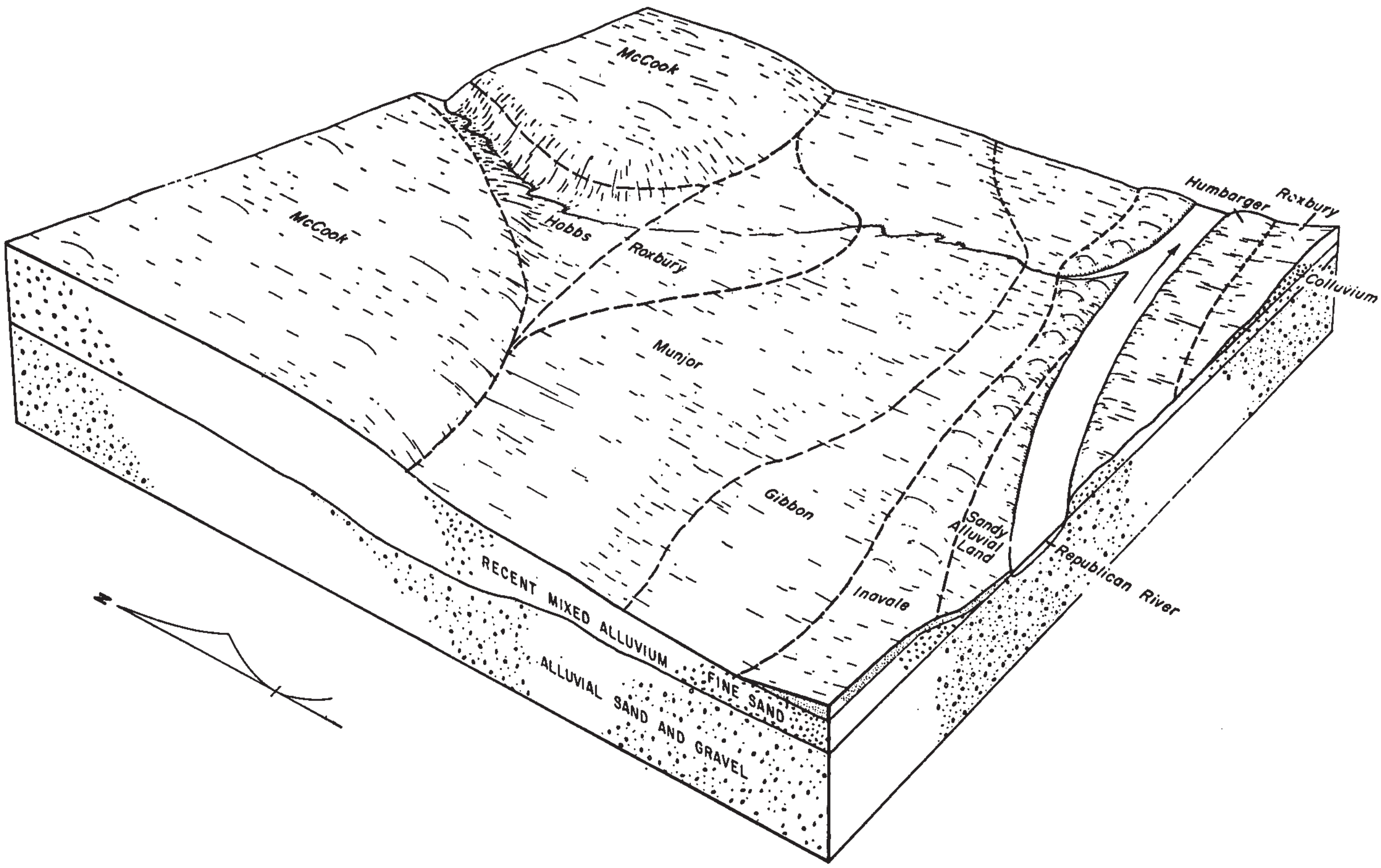

***Figure 7.*—Pattern of soils and underlying material in association 5.**

Less extensive in this association are the Roxbury and Hobbs soils. Roxbury soils are on foot slopes below Hord soils. Hobbs soils are in bottoms of upland drainageways that merge onto stream terraces. Silty alluvial land is adjacent to streams.

Nearly all the soils in this association are cultivated. A few small areas are in permanent grass. Corn, grain sorghum, wheat, and alfalfa are the most important crops. Irrigation is important in this association. Irrigation water is available from the Bostwick Irrigation District in most places. Lack of adequate rainfall during the growing season is a limitation where irrigation water is not available. Maintaining fertility and managing water are the main concerns in management on irrigated land. The soils are well suited to crops commonly grown in the county.

Farmsteads are numerous in this association. The farms range from 240 to 400 acres in size. Improved dirt, gravel, or paved roads are on most section lines. Marketing of farm products is mainly in the nearby towns.

Descriptions of the Soils

This section describes the soil series and mapping units in Webster County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a dry soil.

As mentioned in the section How This Survey Was Made, not all mapping units are members of a soil series. Gravelly land and Rough stony land, for example, do not belong to a soil series, but nevertheless are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and windbreak group in which the mapping unit has been placed. The page for the description of each capability unit, range site, or other interpretative group can be found by referring to the Guide to Mapping Units at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in de-

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Coly silt loam, 3 to 10 percent slopes	5, 668	1. 6	Hord silt loam, terrace, 0 to 1 percent slopes	6, 559	1. 8
Coly and Hobbs soils	36, 995	10. 0	Hord silt loam, terrace, 1 to 3 percent slopes	3, 982	1. 0
Crete silt loam, 0 to 1 percent slopes	3, 143	. 9	Humbarger silt loam	406	. 1
Fillmore silt loam	959	. 2	Inavale fine sand, 0 to 3 percent slopes	406	. 1
Geary silt loam, 3 to 7 percent slopes	4, 075	1. 1	Inavale fine sandy loam, 0 to 3 percent slopes	575	. 1
Geary silt loam, 7 to 10 percent slopes	5, 224	1. 4	Inavale loamy fine sand, 0 to 3 percent slopes	1, 214	. 3
Geary soils, 3 to 7 percent slopes, severely eroded	5, 683	1. 5	Kipson silt loam, 7 to 31 percent slopes	8, 009	2. 1
Geary soils, 7 to 10 percent slopes, severely eroded	4, 118	1. 1	Marsh	89	(1)
Geary and Hobbs soils	37, 814	10. 3	McCook silt loam	7, 021	2. 1
Gibbon silty clay loam	3, 196	. 8	McCook fine sandy loam	483	. 1
Gravelly land	1, 009	. 2	Meadin loam, 8 to 31 percent slopes	6, 070	1. 7
Hastings silt loam, 0 to 1 percent slopes	25, 578	6. 9	Munjor fine sandy loam, 0 to 3 percent slopes	2, 492	. 8
Hastings silt loam, 1 to 3 percent slopes	1, 744	. 5	Munjor loamy fine sand, 0 to 3 percent slopes	121	(1)
Hobbs silt loam, occasionally flooded	18, 306	5. 0	Munjor fine sandy loam, slightly wet variant	1, 054	. 2
Holdrege silt loam, 0 to 1 percent slopes	23, 836	6. 5	Rough broken land, loess	3, 174	. 8
Holdrege silt loam, 1 to 3 percent slopes	22, 187	6. 0	Rough stony land	1, 039	. 3
Holdrege silt loam, 1 to 3 percent slopes, eroded	7, 141	2. 0	Roxbury silt loam	1, 432	. 4
Holdrege silt loam, 3 to 7 percent slopes	11, 475	3. 2	Sandy alluvial land	986	. 2
Holdrege silt loam, 3 to 7 percent slopes, eroded	16, 552	4. 5	Silty alluvial land	10, 524	2. 9
Holdrege silt loam, 7 to 10 percent slopes	7, 011	2. 0	Wakeen silt loam, 3 to 10 percent slopes	854	. 2
Holdrege soils, 3 to 7 percent slopes, severely eroded	41, 132	11. 3	Wakeen silt loam, 3 to 10 percent slopes, eroded	1, 475	. 4
Holdrege soils, 7 to 10 percent slopes, severely eroded	16, 022	4. 4	Wakeen silt loam, 10 to 31 percent slopes	2, 135	. 6
Hord silt loam, 0 to 1 percent slopes	7, 367	2. 0	Wet alluvial land	458	. 1
			Water area	1, 108	. 3
			Gravel pits	99	(1)
			Total	368, 000	100. 0

[1] Less than 0.05 percent.

scribing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).

A given soil series in this county may be identified by a different name in a recently published soil survey of an adjacent county. Such differences in name result from changes in the concepts of soil classification that have occurred since publication. The characteristics of the soil series described in this county are considered to be within the range defined for that series. In those instances where a soil has one or more features outside the defined range for the series, the differences are explained.

Coly Series

The Coly series consists of deep, well-drained soils on the uplands. These soils formed in loess. They are gently sloping to steep and are along natural intermittent drainageways.

In a typical profile, the surface layer is grayish-brown silt loam about 6 inches thick. Beneath this is a transitional layer of soft, light brownish-gray silt loam about 4 inches thick. The underlying material, to depth of 60 inches, is light-gray silt loam (fig. 8). The soil is calcareous throughout the profile.

Coly soils have a high available water capacity. Permeability is moderate. Natural fertility and the organic-matter content are low.

Most areas of Coly soils are in native grasses and are used for grazing. A small acreage is cultivated.

Typical profile of Coly silt loam in an area of Coly and Hobbs soils in rangeland, 0.6 mile north and 130 feet west of the southeast corner of sec. 23, T. 4 N., R. 11 W.:

A—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; soft, very friable; worm casts are common; calcareous; moderately alkaline; clear, smooth boundary.

AC—6 to 10 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; weak, medium, granular structure; soft, very friable; worm casts are common; calcareous; moderately alkaline; clear, smooth boundary.

C1—10 to 22 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure; soft, very friable; a few threadlike lime accumulations; cleavage planes are coated with lime; calcareous; moderately alkaline; gradual, smooth boundary.

C2—22 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; massive; soft, very friable; calcareous; moderately alkaline.

The solum ranges from 3 to 14 inches in thickness. The A horizon ranges from 3 to 6 inches in thickness and from grayish brown to light brownish gray in color. The C horizon ranges from light gray to very pale brown. Calcium carbonate is within a depth of 10 inches.

Coly soils are associated with Geary and Holdrege soils. They have a thinner A horizon than those soils and have lime at a higher level, but do not have a B horizon.

Coly silt loam, 3 to 10 percent slopes (CbCW).—This soil is on loess uplands, along intermittent drainageways. Runoff is medium.

The profile of this soil is about 5 inches thinner than the one described as typical for the series. Some of the underlying material has been mixed into the plow layer

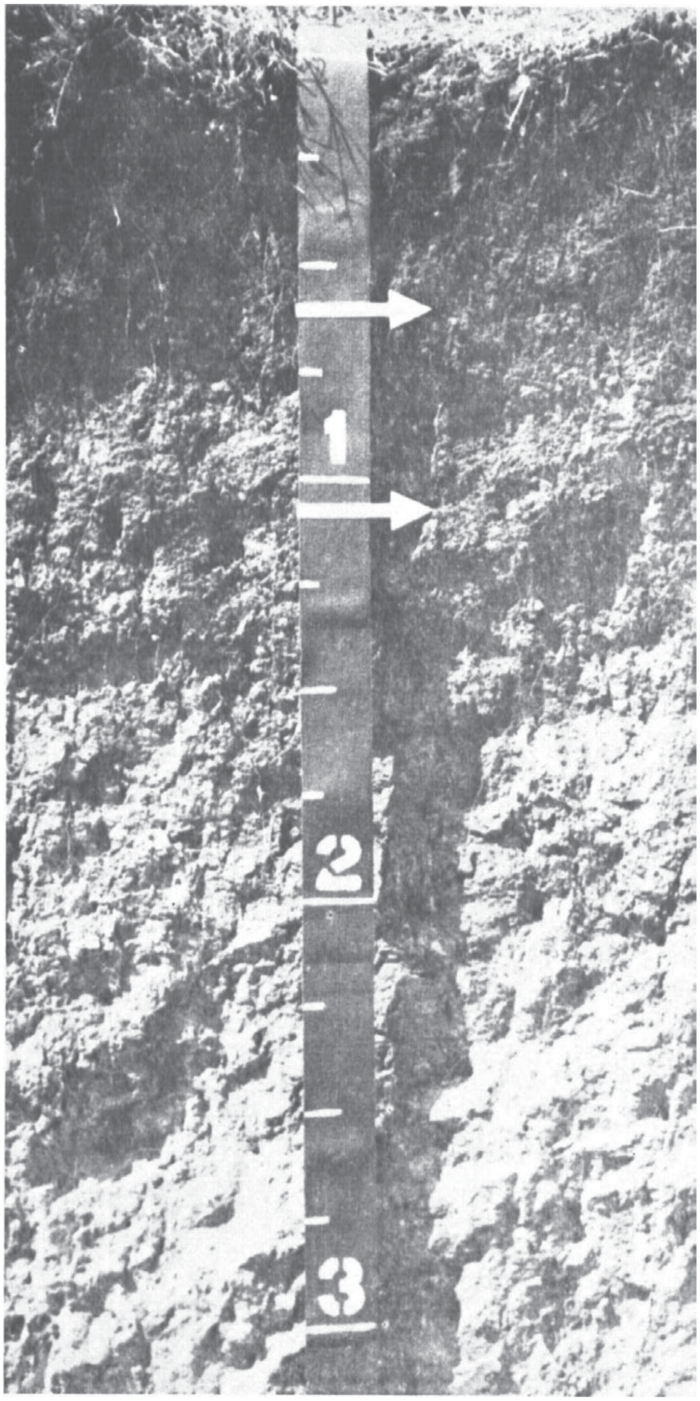

Figure 8.—**Profile of Coly silt loam showing boundaries between surface layer, transitional layer, and underlying material. This soil has a thin surface layer and is calcareous throughout the profile.**

during cultivation. Included with this soil in mapping were small areas of severely eroded Holdrege soils.

This Coly soil is susceptible to water erosion and to soil blowing (fig. 9). Increasing the organic-matter content and fertility is essential.

Much of the acreage is cultivated, but because of the erosion hazard and low fertility, the soil is better suited to range.

Wheat, grain sorghum, and alfalfa are the main crops. Corn is grown on a small acreage and is not so well suited. Some areas have been seeded to native grasses. This soil is suited to trees and to use by upland wildlife. Capability unit IVe-8, dryland; Limy Upland range site; Silty to Clayey windbreak group.

Coly and Hobbs soils (0 to 31 percent slopes) (CH).—This mapping unit is about 65 percent Coly soils and about 35 percent Hobbs soils. These soils occupy the sides and bottoms of upland drainageways. Coly soils have slopes of 10 to 31 percent and are on the sides of drainageways. Hobbs soils have slopes of 0 to 3 percent and are on the bottoms of the drainageways.

The Coly soil has the profile described as typical for the Coly series. The Hobbs soil has a profile similar to the one described under the heading Hobbs Series, but it has lighter colored underlying material and is more stratified with light- and dark-colored soil material. Included in mapping were areas of Geary and Hobbs soils.

Controlling water erosion and keeping range grasses productive and healthy are the main concerns in management. Runoff is rapid.

These soils are in native grass and are used mainly for grazing. They are suited to windbreak plantings, and they furnish food and cover for wildlife. Both soils in capability unit VIe-9; Coly soil in Limy Upland range site and Silty to Clayey windbreak group and Hobbs soil in Silty Overflow range site and Moderately Wet windbreak group.

Crete Series

The Crete series consists of deep, moderately well drained soils on uplands. These soils formed in loess. They are nearly level.

In a typical profile, the surface layer is gray silt loam about 14 inches thick. The subsoil, about 24 inches thick, is brown, hard silty clay in the upper part and grayish-brown, slightly hard silty clay loam in the lower part. The underlying material is pale-brown silt loam (fig. 10). Lime is at a depth of 38 inches.

Crete soils have slow permeability and high available water capacity. Natural fertility is high, and the organic-matter content is moderate.

Almost all areas of Crete soils are cultivated. Many are irrigated. The soils are suited to all the crops commonly grown in the county.

Typical profile of Crete silt loam, 0 to 1 percent slopes, in a cultivated field 0.12 mile east and 180 feet south of the northwest corner of sec. 16, T. 4 N., R. 11 W.:

Ap—0 to 7 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; slightly acid; abrupt, smooth boundary.

A12—7 to 11 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, granular structure; soft when dry, very friable when moist; slightly acid; clear, smooth boundary.

A3—11 to 14 inches, gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; dark-colored organic stains on cleavage planes; slightly hard when dry, firm when moist; neutral; clear, smooth boundary.

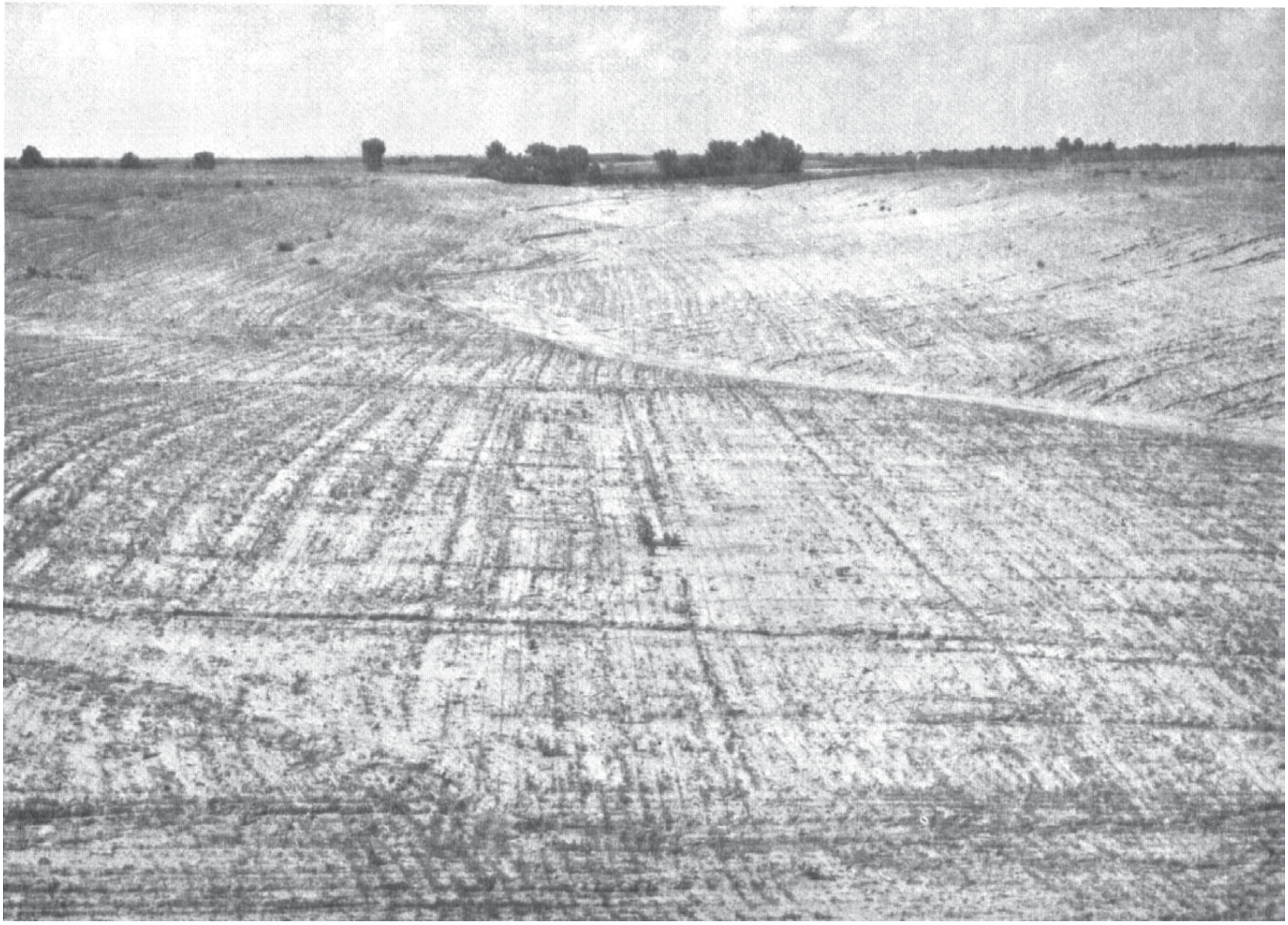

Figure 9.—**Field of Coly silt loam, 3 to 10 percent slopes, severely eroded by water.**

B2t—14 to 30 inches, brown (10YR 5/3) silty clay, dark brown (10YR 3/3) when moist; strong, very fine, angular blocky structure; dark-colored organic stains on cleavage planes appear as tonguelike appendages; hard when dry, very firm when moist; neutral; clear, smooth boundary.

B3—30 to 38 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, angular blocky structure; slightly hard when dry, firm when moist; mildly alkaline; gradual, smooth boundary.

C1—38 to 46 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; few, soft lime accumulations; mildly alkaline; gradual, smooth boundary.

C2—46 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; few, small calcium carbonate concretions and a few threadlike calcium carbonate accumulations; mildly alkaline.

The solum ranges from 33 to 58 inches in thickness. The A horizon ranges from 11 to 20 inches in thickness and is gray, dark gray, or grayish brown. The B2t horizon ranges from 14 to 24 inches in thickness and is commonly brown or light brownish gray. The depth to calcium carbonate ranges from 25 to 40 inches.

Crete soils are associated with Hastings and Fillmore soils. They have a finer textured B horizon than Hastings soils. They are better drained than Fillmore soils, which are in shallow depressions, and they do not have an A2 horizon, which is typical of those soils.

Crete silt loam, 0 to 1 percent slopes (Ce).—This soil is on flats and in very slight depressions.

Included with this soil in mapping were small areas of Fillmore and Hastings soils.

This Crete soil has slow permeability and, because of the fine-textured subsoil, it is somewhat droughty late in summer. In spring, however, fieldwork can be delayed because of wetness. Water is released slowly to plants. Maintaining a high level of fertility is essential. Runoff is slow.

Most of the acreage is cultivated. Wheat, grain sorghum, corn, and alfalfa are the major crops grown. Some areas are irrigated with water from deep wells. Corn and grain sorghum are the principal irrigated crops. This soil is suitable for windbreak plantings and for use by wildlife as a source of food. Capability units IIs-2 dryland, IIs-2 irrigated; Clayey range site; Silty to Clayey windbreak group.

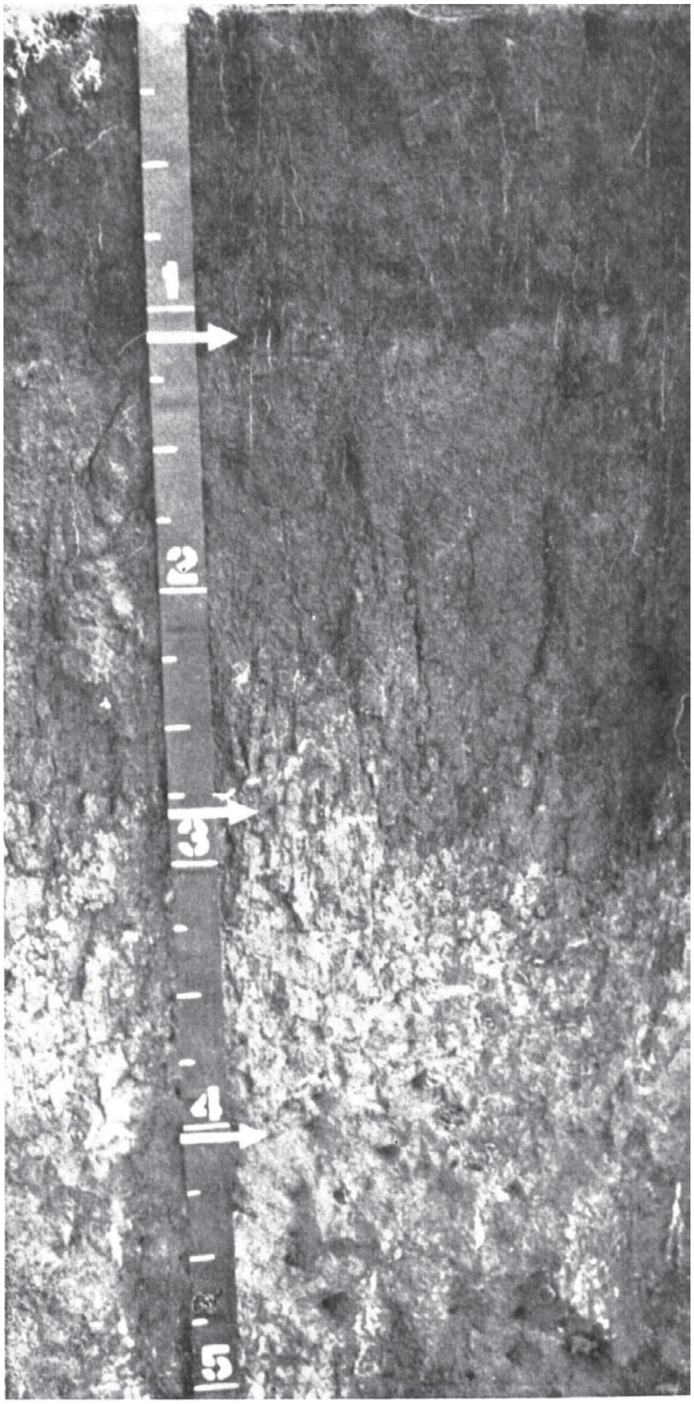

Figure 10.—Profile of a Crete soil. The slowly permeable B horizon is at a depth of 14 to 34 inches.

Fillmore Series

The Fillmore series consists of deep, poorly drained soils in shallow upland depressions. These soils formed in loess and have a claypan.

In a typical profile, the surface layer is gray silt loam about 6 inches thick. The subsurface layer is light-gray silt loam about 4 inches thick. The subsoil is 32 inches thick. The upper 11 inches is dark-gray, very hard silty clay that has many, black, shotlike concretions; the next 11 inches is gray, very hard silty clay; and the lower 10 inches is grayish-brown, hard silty clay loam. The underlying material is pale-brown, calcareous silt loam.

Fillmore soils have high available water capacity and slow permeability. The organic-matter content is moderate, and natural fertility is high.

Most areas of Fillmore soils are cultivated. A few of the larger areas are in native grasses and are used for grazing.

Typical profile of Fillmore silt loam, in native grasses 0.55 mile west and 100 feet south of the northeast corner of sec. 14, T. 3 N., R. 11 W.:

A1—0 to 6 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure parting to weak, medium, granular; slightly hard when dry, very friable when moist; slightly acid; clear, smooth boundary.

A2—6 to 10 inches, light-gray (10YR 6/1) silt loam, gray (10YR 5/1) when moist; weak, medium, platy structure parting to weak, fine, granular; soft when dry, friable when moist; slightly acid; abrupt, smooth boundary.

B21t—10 to 21 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) when moist; strong, medium and coarse, angular blocky structure; very hard when dry, very firm when moist; shiny clay films on most peds; many, shotlike ferromagnesium pellets and stains; neutral; clear, smooth boundary.

B22t—21 to 32 inches, gray (10YR 5/1) silty clay, dark gray (10YR 4/1) when moist; strong, coarse and medium, angular blocky structure; very hard when dry, very firm when moist; shiny clay films on most peds; neutral; clear, smooth boundary.

B3—32 to 42 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; gradual, smooth boundary.

C1—42 to 54 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, friable when moist; mildly alkaline; gradual, smooth boundary.

C2—54 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; calcareous; moderately alkaline.

The solum ranges from 36 to 54 inches in thickness. The A horizon ranges from 10 to 19 inches in thickness. The A1 horizon is commonly dark gray or gray. The A2 horizon ranges from 4 to 8 inches in thickness. The B22t is gray or grayish brown. The depth to carbonates ranges from 36 to 54 inches.

Fillmore soils are associated with Crete soils. They differ from Crete soils in having an A2 horizon, and they are more poorly drained.

Fillmore silt loam (0 to 1 percent slopes) (Fm).—This soil is on flats or in shallow basinlike depressions.

Included with this soil in mapping were a few small areas of soils that are ponded most of the year.

Lack of drainage is a hazard in most areas. After a heavy rain, excess water accumulates on this soil for periods of several days to 2 weeks. Wetness commonly delays fieldwork.

Because the fine-textured subsoil releases water slowly to plants, however, this soil can be droughty late in summer. Permeability is slow. Maintaining a high level of fertility is essential, especially in irrigated areas. Runoff is very slow or ponded.

Most areas are cultivated. Some are drained, graded, and irrigated with water from deep wells. Wheat and grain sorghum are the principal irrigated crops. Wheat is commonly grown under dryland management. Alfalfa is not suited, except in areas where the soil has been drained. Capability units IIIw-2 dryland, IIs-21 irrigated; Clayey Overflow range site; Moderately Wet windbreak group.

Geary Series

The Geary series consists of deep, well-drained soils on uplands. These soils formed in light reddish-brown loess of the Loveland Formation. They are gently sloping to steep.

In a typical profile, the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is about 22 inches thick. The upper part is brown, hard light silty clay loam; the middle part is brown, very hard silty clay loam and the lower part is brown, hard silty clay loam. The underlying material is light reddish-brown silt loam. Below a depth of 42 inches is lime.

Geary soils have a high available water capacity. Permeability is moderate. In eroded areas, the organic-matter content is moderate and fertility is medium.

Most of the acreage of Geary soils is in native grass and is used for grazing. A less extensive acreage is cultivated, and is mainly under dryland management.

Typical profile of Geary silt loam, 7 to 10 percent slopes, in native grasses, 0.5 mile east, 0.46 mile south, and 40 feet east of the northwest corner of sec. 35, T. 1 N., R. 12 W.:

A—0 to 12 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B1—12 to 16 inches, brown (7.5YR 4/2) light silty clay loam, dark brown (7.5YR 3/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B2t-16 to 26 inches, brown (7.5YR 5/3) silty clay loam, brown (7.5YR 4/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; slightly acid; gradual, smooth boundary.

B3—26 to 34 inches, brown (7.5YR 5/3) silty clay loam, brown (7.5YR 4/3) when moist; weak, coarse, subangular blocky structure; hard when dry, firm when moist; neutral; gradual, smooth boundary.

C1—34 to 42 inches, light reddish-brown (5YR 6/4) silt loam, reddish brown (5YR 5/4) when moist; moderate, medium, prismatic structure; slightly hard when dry, friable when moist; mildly alkaline; clear, wavy boundary.

C2—42 to 60 inches, light reddish-brown (5YR 6/4) silt loam, reddish brown (5YR 5/4) when moist; moderate, medium, prismatic structure; slightly hard when dry, friable when moist, cleavage planes are coated with dark organic stains; calcareous; mildly alkaline.

The solum ranges from 25 to 48 inches in thickness. The A horizon ranges from 6 to 13 inches in thickness, and the B horizon from 19 to 35 inches. The B2t horizon is 27 to 35 percent clay.

In mapping units GsB3 and GsC3, the surface layer is lighter colored than is defined in the range for the series. This difference, however, does not alter the usefulness or behavior of the soils.

Geary soils are associated with Holdrege, Coly, and Meadin soils. They formed in reddish-brown loess, whereas Holdrege soils formed in pale-brown loess. They have a thicker, more strongly developed profile than Coly soils and have lime at a lower level in the profile. They are deep and formed in loess, whereas Meadin soils are shallow over mixed sand and gravel.

Geary silt loam, 3 to 7 percent slopes (GsB).—This sloping soil is along intermittent upland drainageways. It has a profile similar to the one described as typical for the series, but the surface layer is thicker.

Included with this soil in mapping were small areas of Geary soils, 7 to 10 percent slopes, a few small areas of severely eroded Geary soils, and a few small areas of Holdrege soils, 3 to 7 percent slopes.

Natural fertility is medium, and the organic-matter content is moderate. In cultivated areas, water erosion and soil blowing are hazards. Increasing and maintaining the fertility is a concern in management. Runoff is medium.

Although suited to cultivated crops, most areas of this soil are in native grass and are used for range. Principal crops are wheat, grain sorghum, corn, and alfalfa. This soil is suited to windbreak plantings. Capability units IIIe-1 dryland, IIIe-1 irrigated; Silty range site; Silty to Clayey windbreak group.

Geary silt loam, 7 to 10 percent slopes (GsC).—This soil borders intermittent natural drainageways. Slopes are short. Areas are generally long and narrow.

This soil has the profile described as typical for the Geary series. Included in mapping were small areas of Geary soils, 3 to 7 percent slopes, and a few small areas of severely eroded Geary soils.

The organic-matter content is moderate, and natural fertility is medium. Water erosion and soil blowing are the main hazards in cultivated areas. Runoff is rapid.

This soil is suited to cultivated crops, but most areas are in native grasses and are used for grazing. Principal crops are corn, grain sorghum, wheat, and alfalfa. The soil is also suited to trees and to use by wildlife. Capability units IVe-1 dryland, IVe-1 irrigated; Silty range site; Silty to Clayey windbreak group.

Geary soils, 3 to 7 percent slopes, severely eroded (GsB3).—These soils are on upland ridgetops and sides of intermittent upland drainageways.

The profile of these soils is similar to the one described as typical for the series, but the surface layer is lighter colored and thinner. The present surface layer and much of the subsoil were removed by water erosion and soil blowing. The texture of the surface layer is silty clay loam in most areas, but is clay loam and silt loam in some. Included in mapping were areas of severely eroded Geary soils, 7 to 10 percent slopes, and small areas of severely eroded Holdrege soils, 3 to 7 percent slopes.

Fertility and the organic-matter content are low. Severe water erosion is the principal hazard. This soil is also susceptible to soil blowing. Maintaining fertility in irrigated areas is a concern in management. Runoff is rapid.

Most areas of these soils are cultivated. Wheat, grain sorghum, corn, and alfalfa are the principal crops. Some areas have been seeded to adapted native grasses and are used for grazing. These soils are suited to windbreak plantings that provide food and cover for wildlife. Capability unit IVe-8 dryland; Silty range site; Silty to Clayey windbreak group.

Geary soils, 7 to 10 percent slopes, severely eroded (GsC3).—These soils are on ridgetops and sides of upland drainageways. Slopes are short.

These soils have a profile similar to the one described as typical for the Geary series, but the surface layer and subsoil are thinner, and the surface layer is lighter colored. A large part of the original surface layer and upper part of the subsoil has been removed by soil blowing and water erosion. The present surface layer is silty clay loam in most places, but is clay loam or silty loam in some. Included in mapping were areas of severely eroded Geary soils, 3 to 7 percent slopes, and a few small areas of Meadin soils, 7 to 10 percent slopes.

Fertility and the organic-matter content are low. Permeability is moderate. Soil blowing and water erosion are hazards. Increasing and maintaining fertility are essential practices in management. Runoff is rapid.

Most areas are cultivated. Wheat, grain sorghum, and alfalfa are the major crops grown. These soils are poorly suited to cultivated crops. Some areas have been seeded to adapted native grasses and are used for grazing. These soils are suited to trees, and they provide food and cover for wildlife. Capability unit IVe–8 dryland; Silty range site; Silty to Clayey windbreak group.

Geary and Hobbs soils (0 to 31 percent slopes) (GH).—This mapping unit is about 65 percent Geary soils and 35 percent Hobbs soils. These soils occupy the short sides and narrow bottoms of upland drainageways. Geary soils are mainly moderately steep and steep and are on the sides of drainageways. Hobbs soils are nearly level or very gently sloping and are on the bottoms of the drains.

Geary soils have a profile similar to the one described as typical for the Geary series, but the surface layer is thinner. Hobbs soils have the profile described under the heading Hobbs series. Included in mapping were areas of Coly soils that have slopes of 10 to 31 percent and small areas of Meadin soils, 8 to 31 percent slopes.

The organic-matter content of the Geary soils is moderate, and natural fertility is medium. The organic-matter content of the Hobbs soils is moderate, and natural fertility is high. Permeability of both soils is moderate.

Water erosion on the steep slopes and occasional flooding on the bottom land are common hazards. Runoff is very rapid on Geary soils and medium on Hobbs soils.

Geary soils are too steep for cultivation. Nearly all areas are in native grass and are used for grazing. These soils are suited to trees and they provide food and cover for wildlife. Both soils in capability unit VIe–9 dryland; Geary soil in Silty range site and Silty to Clayey windbreak group, and Hobbs soil in Silty Overflow range site and Moderately Wet windbreak group.

Gibbon Series

The Gibbon series consists of deep, somewhat poorly drained soils on bottom lands. These soils formed in loamy alluvium along the Republican River. They are nearly level. The water table fluctuates seasonally between depths of 2 and 6 feet.

In a typical profile, the surface layer is silty clay loam about 18 inches thick. The upper part is dark gray, the middle part is very dark gray, and the lower part is light gray. The underlying material is soft, mottled, light brownish-gray silt loam in the upper part and light-gray, mottled very fine sandy loam in the middle part. Beneath this is light-gray, mottled fine sandy loam. The profile is calcareous throughout.

Gibbon soils have high available water capacity and moderate permeability. They have high natural fertility and moderate organic-matter content.

Nearly all areas of Gibbon soils are cultivated. The soils are suited to all the crops commonly grown in the county.

Typical profile of Gibbon silty clay loam, in a cultivated field 0.58 mile east and 70 feet south of the northwest corner of sec. 9, T. 1 N., R. 12 W.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; hard, firm; calcareous; mildly alkaline; abrupt, smooth boundary.

A12—5 to 11 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; moderate, fine, granular structure; hard, firm; calcareous; mildly alkaline; clear, smooth boundary.

A3ca—11 to 18 inches, light-gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) when moist; moderate, very fine, granular structure; hard, firm; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—18 to 26 inches, light brownish-gray (10YR 6/2) silt loam, dark gray (10YR 4/1) when moist; common, medium, distinct, grayish, brownish, and yellowish mottles; massive; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C2—26 to 36 inches, light-gray (10YR 7/2) very fine sandy loam, light brownish gray (10YR 6/2) when moist; common, coarse, prominent, brownish mottles; massive; soft when dry, very friable when moist; calcareous; strongly alkaline; clear, smooth boundary.

C3—36 to 60 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) when moist; common, coarse, prominent, brownish mottles; massive; soft when dry, very friable when moist; calcareous; strongly alkaline.

The A horizon ranges from 12 to 24 inches in thickness. The lower part of the C horizon is commonly stratified with material that ranges from fine sandy loam to silty clay loam. Mixed sand and gravel is at a depth of 3 to 6 feet. The depth to carbonates ranges from 0 to 10 inches.

Gibbon soils are associated with Munjor, slightly wet variant soils, Humbarger soils, and Wet alluvial land. They are finer textured than Munjor, slightly wet variant soils. They have a higher water table than Humbarger soils but a lower water table than Wet alluvial land.

Gibbon silty clay loam (0 to 1 percent slopes) (Gg).—This somewhat poorly drained soil is on bottom lands.

Included in mapping were a few small areas of the well-drained Humbarger soils and small areas of Wet alluvial land.

Wetness caused by a water table that fluctuates between depths of 2 and 6 feet is the major limitation. It sometimes delays tillage in spring. Phosphorus is commonly needed for legumes. Maintaining a high level of fertility is essential. Runoff is slow.

Corn, grain sorghum, and alfalfa are the principal crops. A few areas are in permanent vegetation. The soil is suited to windbreak plantings, and it provides food and cover for wildlife. Capability units IIw–4 dryland, IIw–4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Gravelly Land

Gravelly land (3 to 31 percent slopes) (Gv) occupies the sides of upland drainageways, north of the Republican River Valley.

Sand and gravel are at the surface in most areas. The upper few inches is commonly darkened by organic matter. Small pockets of silt and clay hold the sand and gravel together in some places. Included in mapping were small areas of Meadin and Geary soils.

Gravelly land has very low available water capacity. Permeability is very rapid. Runoff is slow to medium. Much of the rainfall is absorbed by the porous material. Natural fertility is low. The organic-matter content is very low.

Nearly all areas of Gravelly land are in native grasses and are used mainly for grazing. Some areas are used as a source of sand and gravel for construction purposes. None are suited to trees or to wildlife. Capability unit VIIs–3 dryland; Shallow to Gravel range site; Undesirable windbreak group.

Hastings Series

The Hastings series consists of deep, well-drained soils on uplands. These soils formed in loess. They are nearly level and very gently sloping.

In a typical profile, the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is about 24 inches thick. The upper part is gray, slightly hard light silty clay loam; the middle part is grayish-brown, very hard heavy silty clay loam; and the lower part is light brownish-gray, hard silty clay loam. The underlying material, at a depth of 36 inches, is pale-brown silt loam.

Hastings soils have a high available water capacity. Permeability is moderately slow. Natural fertility is high, and the organic-matter content is moderate.

Nearly all areas of Hastings soils are cultivated. Many are irrigated. The soils are suited to all of the crops commonly grown in the county. A few small areas are in native grass.

Typical profile of Hastings silt loam, 0 to 1 percent slopes, in a cultivated field 0.42 mile north and 54 feet east of the southwest corner of sec. 26, T. 4 N., R. 10 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 12 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable; slightly acid; clear, smooth boundary.

B1—12 to 16 inches, gray (10YR 5/1) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure parting to moderate, fine, subangular blocky; hard, friable; neutral; clear, smooth boundary.

B21t—16 to 21 inches, grayish-brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, blocky; very hard, very firm; neutral; gradual, smooth boundary.

B22t—21 to 28 inches, grayish-brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium and coarse, prismatic structure parting to moderate, medium and fine, blocky; very hard, very firm; dark organic stains on cleavage planes; neutral; clear, smooth boundary.

B3—28 to 36 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) when moist; weak, very coarse, prismatic structure parting to moderate, medium and coarse, subangular blocky; hard, friable; dark organic stains on cleavage planes; mildly alkaline; gradual, smooth boundary.

C1—36 to 40 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; common, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; slightly hard, very friable; mildly alkaline; clear, smooth boundary.

C2ca—40 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; common, distinct, yellowish-brown (10YR 5/6) mottles; massive; soft, very friable; soft, white calcium carbonate segregations; moderately alkaline.

The solum ranges from 30 to 44 inches in thickness. The A horizon ranges from 8 to 12 inches in thickness and is mainly dark grayish brown and grayish brown in color. The B2t horizon ranges from 12 to 16 inches in thickness, is heavy silty clay loam or light silty clay, and ranges from grayish brown to light brownish gray in color. The depth to carbonates ranges from 36 to 40 inches.

Hastings soils are associated with Crete, Holdrege, and Hord soils. Their B horizon is not so fine textured as that of Crete soils, but is finer textured than that of Holdrege and Hord soils.

Hastings silt loam, 0 to 1 percent slopes (Hs).—This soil is on uplands. Areas are irregularly shaped and range from 10 to 160 acres in size.

This soil has the profile described as typical for the Hastings series (fig. 11). Included in mapping were small areas of nearly level Holdrege, Hord, and Crete soils.

Crop production under dryland management is limited by a shortage of rainfall. Soil blowing is a hazard unless the soil is protected by vegetation or organic matter. Fertility maintenance and water management are concerns in irrigated areas. Runoff is slow.

This soil is easily worked. Much of the acreage is irrigated with water from deep wells. The soil is suited to trees and to use by wildlife as a source of food. Capability units IIc–1 dryland, I–2 irrigated; Silty range site; Silty to Clayey windbreak group.

Hastings silt loam, 1 to 3 percent slopes (HsA).—This soil is on uplands. Areas are irregularly shaped and range from 10 to 200 acres in size.

This soil has a profile similar to the one described as typical for the series, but the surface layer is slightly thinner. Included in mapping were small areas of very gently sloping Holdrege soils.

This Hastings soil is susceptible to water erosion and soil blowing. Fertility maintenance and water management are special concerns in irrigated areas. Runoff is slow.

Nearly all areas are cultivated. Wheat, corn, grain sorghum, and alfalfa are the crops commonly grown. Some areas are irrigated with water from deep wells. The principal irrigated crops are corn and grain sorghum. The soil is well suited to windbreak plantings and to use by wildlife as a source of food. Capability units IIe–1 dryland, IIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Hobbs Series

The Hobbs series consists of deep, moderately well drained soils on the bottoms of upland drainageways. These soils formed in silty alluvium washed from adjacent uplands. They are nearly level and very gently sloping. They are occasionally flooded. The water table is below a depth of 8 feet.

In a typical profile, the surface layer is grayish-brown silt loam about 28 inches thick. Beneath this is a transitional layer of slightly hard, dark-gray silt loam 12 inches thick. At a depth of 40 inches is grayish-brown silt loam.

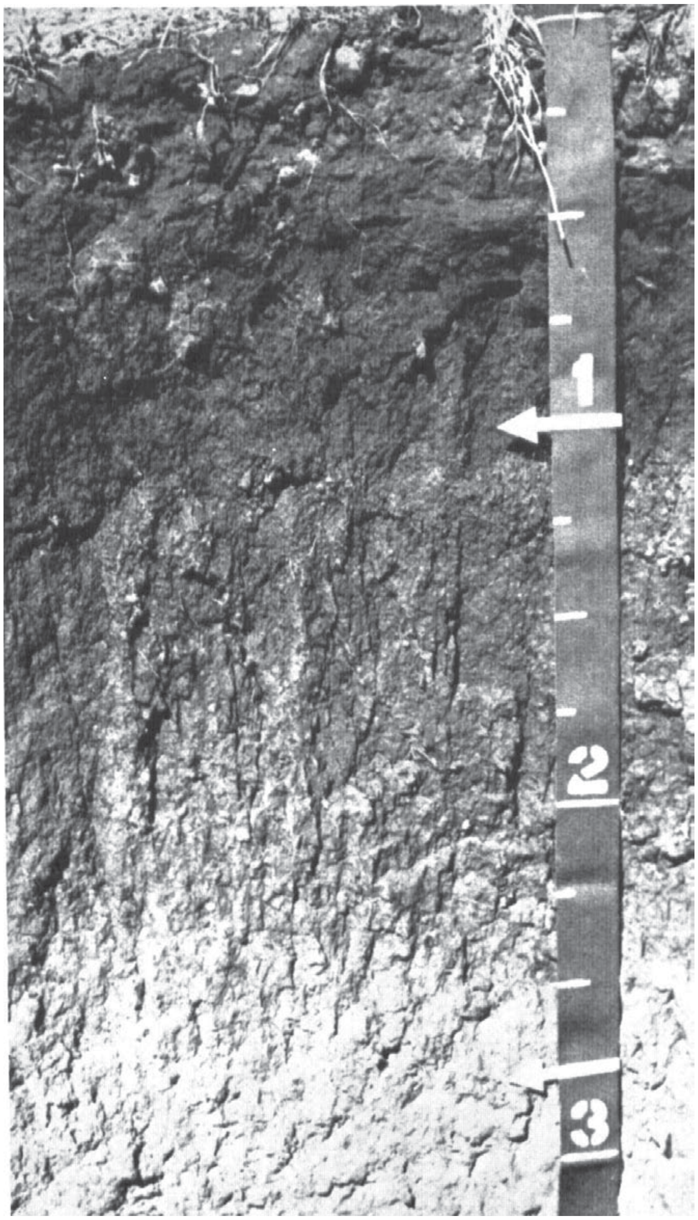

***Figure 11.*—Profile of Hastings silt loam. This deep, well-drained soil formed in loess.**

Hobbs soils have a high available water capacity. Permeability is moderate. Natural fertility is high, and the organic-matter content is moderate.

Nearly all areas of Hobbs soils are cultivated. Areas that are too narrow are in native grass.

Typical profile of Hobbs silt loam, occasionally flooded, in a cultivated field 0.7 mile south and 0.13 mile west of the northeast corner of sec. 18, T. 2 N., R. 10 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure parting to weak, fine and medium, granular; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 28 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, very friable; slightly acid; diffuse, smooth boundary.

AC—28 to 40 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, granular structure; slightly hard, very friable; slightly acid; diffuse, smooth boundary.

C—40 to 60 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure to massive; slightly hard, very friable; neutral.

The solum ranges from 25 to 60 inches in thickness. The A horizon is mainly grayish brown and gray and ranges from noncalcareous to slightly calcareous. In places the profile contains a lime layer less than 20 inches thick. The C horizon is commonly stratified with light- and dark-colored soil material.

Hobbs soils are associated with the Coly and Geary soils. They formed in material similar to the parent material of McCook, Humbarger, and Roxbury soils. They have a thicker A horizon than McCook soils. They are coarser textured than Humbarger soils. They do not have the high content of lime that is typical of Roxbury soils. They have a thicker A horizon than Coly soils. They differ from Geary soils in having a thicker A horizon, in not having a B horizon, and in having parent material that is less red.

Hobbs silt loam, occasionally flooded (0 to 3 percent slopes) (2Hb).—This soil is in long, narrow or moderately wide bottoms of upland drainageways. Slopes are slightly concave. Some areas are dissected by a meandering stream channel.

Included in mapping were a few small areas of McCook silt loam, Humbarger silt loam, and Roxbury silt loam. These inclusions are adjacent to outlets of some of the larger creeks as they emerge into the Republican River Valley.

This soil is moderately well drained, but it is flooded occasionally. The flood water is runoff from adjacent higher lying soils and overflow from stream channels. Flooding lasts for only a short period, but damage to crops is common. Runoff is slow.

The major crops grown are corn, grain sorghum, and alfalfa. Wheat is grown to a lesser extent. Some areas that are protected from flooding are irrigated. Corn and grain sorghum are the commonly irrigated crops. The soil is suited to trees and to use by wildlife. Capability units IIw-3 dryland, I-3 irrigated; Silty Overflow range site; Moderately Wet windbreak group.

Holdrege Series

The Holdrege series consists of deep, well-drained soils on uplands. These soils formed in silty loess. They are nearly level to moderately sloping.

In a typical profile, the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil is slightly hard, grayish-brown light silty clay loam in the upper part; hard, grayish-brown silty clay loam in the middle part; and slightly hard, pale-brown light silty clay loam in the lower part. The subsoil is about 20 inches thick. The underlying material, at a depth of 32 inches, is pale-brown, calcareous silt loam.

Holdrege soils have high available water capacity. Permeability is moderate. Where these soils are not eroded, they have a moderate organic-matter content and high natural fertility.

Most areas of Holdrege soils are cultivated. Many are irrigated. The soils are suited to most of the crops commonly grown in the county.

Typical profile of Holdrege silt loam, 0 to 1 percent slopes, in a cultivated field 0.3 mile west and 300 feet south of the northeast corner of sec. 1, T. 2 N., R. 10 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—6 to 12 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B1—12 to 17 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, friable; neutral; clear, smooth boundary.

B2t—17 to 26 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; neutral; clear, smooth boundary.

B3—26 to 32 inches, pale-brown (10YR 6/3) light silty clay loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure parting to weak, medium and coarse, subangular blocky; slightly hard, friable; slightly alkaline; clear, smooth boundary.

C1ca—32 to 48 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; soft, very friable; soft, white calcium carbonate segregations; most vertical cleavage planes are coated with calcium carbonate; moderately alkaline; gradual, smooth boundary.

C2—48 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; soft, very friable; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The A horizon ranges from 9 to 16 inches in thickness and from very dark grayish brown to grayish brown in color. The B horizon ranges from 15 to 24 inches in thickness. The B2t horizon is grayish brown or light brownish gray. The depth to carbonates ranges from 25 to 50 inches.

In mapping units HwB3 and HwC3, the surface layer is lighter colored and thinner than is defined in the range for the series. These differences, however, do not alter the usefulness or behavior of the soils.

Holdrege soils are associated with Hastings, Hord, Geary, and Crete soils. They have a finer textured B horizon than Hord soils, but one not so fine textured as that in Hastings and Crete soils. They formed in pale-brown Peoria loess, whereas Geary soils formed in light reddish-brown loess of the Loveland Formation.

Holdrege silt loam, 0 to 1 percent slopes (Ho).—This soil (fig. 12) is on loess uplands and is one of the best soils for cultivation in the county.

This soil has the profile described as representative for the Holdrege series. Included in mapping were a few small areas of the nearly level Hastings and Hord silt loams.

Crop production under dryland management is limited by a shortage of rainfall. Soil blowing is a hazard unless the soil is protected. Fertility maintenance and water management are concerns, particularly where the soil is irrigated. Runoff is very slow.

This soil is easily worked. The main crops are corn, wheat, grain sorghum, and alfalfa. A significant acreage is irrigated with water from deep wells. The soil is suitable for windbreak plantings and for use by wildlife. Capability units IIc–1 dryland, I–2 irrigated; Silty range site; Silty to Clayey windbreak group.

Holdrege silt loam, 1 to 3 percent slopes (HoA).—This soil is on uplands and in irregularly shaped areas that range from 10 to 200 acres in size.

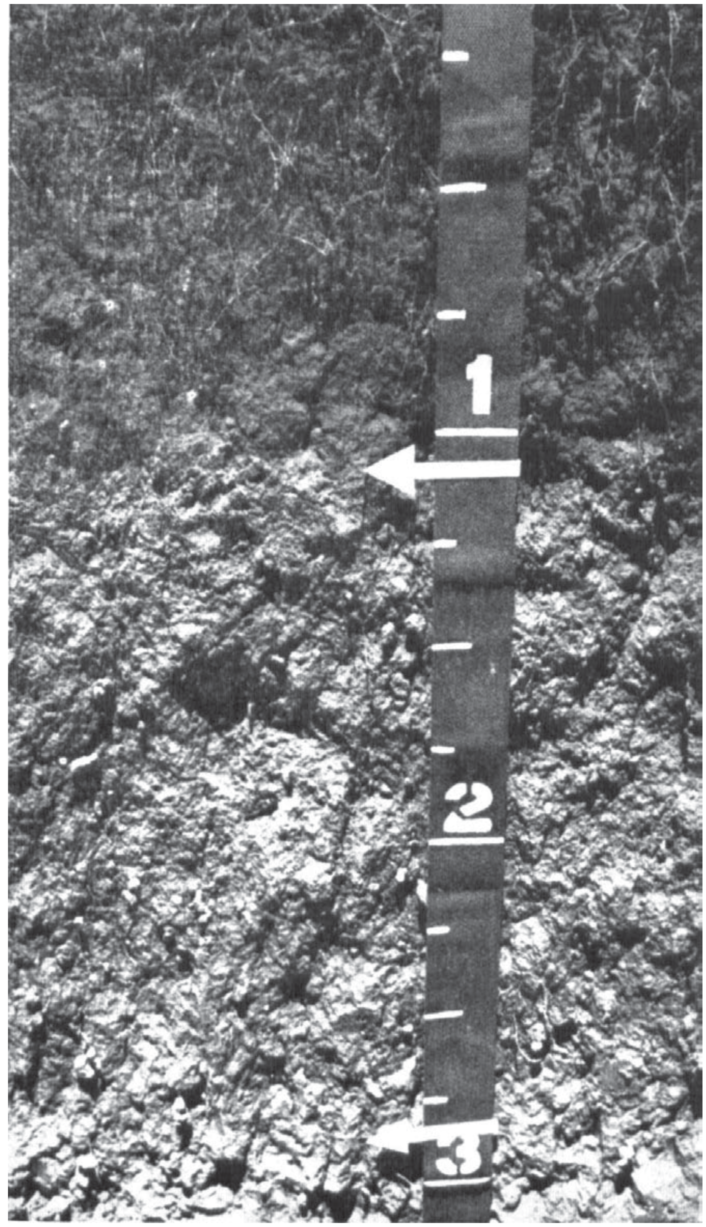

Figure 12.—Profile of Holdrege silt loam showing boundaries between surface layer, subsoil, and underlying material.

This soil has a slightly thinner profile than is described as typical for the Holdrege series. Included in mapping were small areas of eroded Holdrege soils and a few small areas of Hastings silt loam, 1 to 3 percent slopes.

This Holdrege soil is susceptible to water erosion and soil blowing. A high level of fertility has to be maintained. Runoff is slow.

Corn, wheat, grain sorghum, and alfalfa are the commonly grown crops. Many areas are irrigated with water from deep wells. The soil is easily worked. It is suited to trees and to use by upland wildlife. Capability units IIe–1 dryland, IIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holdrege silt loam, 1 to 3 percent slopes, eroded (HoA2).—This soil is on uplands and has both plane and convex slopes. Areas range from 10 to 100 acres in size.

This soil has a thinner profile than is described as typical for the series. Erosion has removed about half of the original surface layer. In places the rest of the surface layer has been mixed with the subsoil in tillage. Fertility is medium and the organic-matter content is moderately low. Included with this soil in mapping were a few areas of the uneroded Holdrege silt loam, 1 to 3 percent slopes.

Water erosion and soil blowing are the main hazards in cultivated areas. Maintaining fertility is essential. Water management is a concern in irrigated areas. Runoff is slow.

Wheat, grain sorghum, corn, and alfalfa are the most commonly grown crops. Some areas are irrigated with water from deep wells. The soil is suitable for windbreak plantings and for use by wildlife as areas for cover and as a source of food. Capability units IIe–1 dryland, IIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holdrege silt loam, 3 to 7 percent slopes (HoB).—This soil is on ridgetops and along upland drainageways. Slopes are short.

This soil has a profile similar to the one described as typical for the series, but the surface layer is slightly thinner. Included in mapping were a few small areas of Holdrege silt loam, 3 to 7 percent slopes, eroded, and Holdrege silt loam, 7 to 10 percent slopes.

In cultivated areas this soil is susceptible to water erosion and soil blowing. Fertility maintenance and water management are needed, especially in irrigated areas. Runoff is medium.

Although this soil is suitable for cultivated crops, most areas are in native grasses. Wheat, corn, grain sorghum, and alfalfa are suitable crops. The soil is also suited to trees and to use as wildlife habitat. Capability units IIIe–1 dryland, IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holdrege silt loam, 3 to 7 percent slopes, eroded (HoB2).—This soil is on narrow ridgetops and along upland drainageways. Slopes are short. Areas range from 10 to 80 acres in size.

The profile of this soil is similar to the one described as typical for the series, but the surface layer is thinner. Wind and water have removed the upper part of the surface layer, and tillage has mixed the remaining part with the upper part of the subsoil. Included with this soil in mapping were small areas of severely eroded Holdrege soils.

Soil blowing and water erosion are hazards. Increasing the organic-matter content and maintaining a high level of fertility are concerns in management. The soil is low in available phosphorus.

Nearly all areas are cultivated. Principal crops are corn, grain sorghum, wheat, and alfalfa. The soil is suited to windbreak plantings. Capability units IIIe–1 dryland, IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holdrege silt loam, 7 to 10 percent slopes (HoC).—This soil borders upland drainageways. Slopes are short.

The profile of this soil is similar to the one described as typical for the series, but the surface layer and subsoil are thinner. Included with this soil in mapping were small areas of Holdrege silt loam, 3 to 7 percent slopes.

Water erosion is a severe hazard. Unless protected by vegetation or organic matter, this Holdrege soil is subject to soil blowing in cultivated areas. Maintaining a high level of fertility is essential. Runoff is rapid.

Most areas are in native grass and are used for grazing. A few areas are cultivated, mainly to corn, wheat, grain sorghum, and alfalfa. Close-growing crops are better suited than row crops. The soil is suitable for windbreak plantings and for wildlife habitat. Capability units IVe–1 dryland, IVe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holdrege soils, 3 to 7 percent slopes, severely eroded (HwB3).—These soils are on divides and along upland drainageways.

These soils have a profile similar to the one described as typical for the Holdrege series, but the surface layer and subsoil are thinner and the surface layer is lighter colored. Water erosion and soil blowing have removed most of the original surface layer. Tillage has mixed the remaining surface layer and the upper part of the subsoil. The present surface layer is mainly silty clay loam, but in places is clay loam and silt loam. Included in mapping were a few small areas of Holdrege soils, 7 to 10 percent slopes, severely eroded, and Geary soils, 3 to 7 percent slopes, severely eroded.

The hazards of water erosion and soil blowing are severe. The organic-matter content and fertility are low. Improving and maintaining fertility are essential. The soil is low in available nitrogen and phosphorus. Runoff is medium.

Most areas are cultivated. Wheat, corn, grain sorghum, and alfalfa are the commonly grown crops. Large areas have been seeded to adapted native grasses and are used for pasture. The soils are suitable for trees and for use by wildlife. Capability unit IVe–8 dryland; Silty range site; Silty to Clayey windbreak group.

Holdrege soils, 7 to 10 percent slopes, severely eroded (HwC3).—These soils border upland drainageways. Slopes are short.

These soils have a profile that is similar to the one described as typical for the Holdrege series, but the surface layer and subsoil are thinner, and the surface layer is lighter colored. The original surface layer and the upper part of the subsoil have been removed by water erosion and soil blowing. The present surface layer is mainly silty clay loam, but in places is clay loam and silt loam. Included in mapping were a few small areas of Holdrege soils, 3 to 7 percent slopes, severely eroded, and Geary soils, 7 to 10 percent slopes, severely eroded.

The hazard of water erosion is severe. Gullies are common. The organic-matter content and fertility are low. Replenishing the supply of organic matter, increasing fertility, and improving tilth are important considerations in management. Runoff is rapid.

Nearly all areas are cultivated. A few have been seeded to adapted native grasses and are used for pasture. The soils are suited to trees and to use by wildlife. Capability unit IVe–8 dryland; Silty range site; Silty to Clayey windbreak group.

Hord Series

The Hord series consists of deep, well-drained soils on uplands and stream terraces. These soils formed in silty loess in the uplands and in loesslike alluvium on the stream terraces. They are nearly level and very gently sloping.

In a typical profile, the surface layer consists of two parts. The upper part is grayish-brown silt loam, and the lower part is gray silt loam. The subsoil is about 23 inches thick. The upper part is grayish-brown, soft silt loam; the middle part is grayish-brown, slightly hard light silty clay loam; and the lower part is light brownish-gray, slightly hard light silty clay loam. At a depth of 36 inches is pale-brown silt loam.

Hord soils have high available water capacity. Permeability is moderate. The organic-matter content is moderate, and natural fertility is high.

These soils are well suited to irrigation and are suited to all the crops commonly grown in the county. Nearly all of the acreage is cultivated.

Typical profile of Hord silt loam, 0 to 1 percent slopes, in a cultivated field 0.2 mile west and 50 feet north of the southeast corner of sec. 14, T. 4 N., R. 11 W.:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—5 to 13 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—13 to 18 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; soft, very friable; neutral; clear, smooth boundary.

B2—18 to 31 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; slightly hard, friable; neutral; clear, smooth boundary.

B3—31 to 36 inches, light brownish-gray (10YR 6/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; slightly hard, friable; neutral; clear, smooth boundary.

C—36 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; soft, very friable; calcareous; mildly alkaline.

The solum ranges from 35 to 48 inches in thickness. The A horizon ranges from 10 to 19 inches in thickness and is mainly gray, grayish brown, or dark grayish brown. The B2 horizon ranges from heavy silt loam to light silty clay loam and from grayish brown to light brownish gray. The depth to carbonates ranges from 35 to 48 inches.

Hord soils are associated with Holdrege and Hastings soils. Their B horizon is not so fine textured as that in Holdrege and Hastings soils.

Hord silt loam, 0 to 1 percent slopes (Hd).—This well-drained soil is on uplands. It has plane slopes.

This soil has the profile described as typical for the Hord series. Included in mapping were a few small areas of Hastings silt loam and Holdrege silt loam that have slopes of less than 1 percent.

Crop production under dryland management is limited by a shortage of rainfall. Soil blowing is a hazard unless the soil is adequately protected. Tilth is good, and fertility is high. Permeability is moderate. Runoff is slow. Water is released readily to plants.

This soil is easily worked and is well suited to cultivated crops. Nearly all the acreage is cultivated. A few small areas are in native grass. Corn, wheat, grain sorghum, and alfalfa are the major crops. Some areas are irrigated with water from deep wells. Capability units IIc–1 dryland, I–2 irrigated; Silty range site; Silty to Clayey windbreak group.

Hord silt loam, terrace, 0 to 1 percent slopes (2Hd).—This soil is on stream terraces of the Republican River and a few of the larger stream valleys. Slopes are plane.

This soil has a profile similar to the one described as typical for the series, but the underlying material contains pebbles and is coarsely stratified with medium-textured and moderately coarse textured soil material. Included in mapping were a few small areas of Roxbury silt loam.

Crop production under dryland management is limited by a shortage of rainfall. Soil blowing is a hazard unless the soil is protected by vegetation or organic matter. Fertility maintenance and water management are concerns in irrigated areas. Runoff is slow.

This soil is easily worked, and nearly all areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the commonly grown crops. A large percentage of the acreage is irrigated with water from the Bostwick Irrigation District Canal. Trees grow well in windbreaks, and wildlife use these areas for cover and as a source of food. Capability units IIc–1 dryland, I–2 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hord silt loam, terrace, 1 to 3 percent slopes (2HdA).—This soil is on stream terraces of the Republican River and a few of the larger tributary streams. Slopes are mostly plane; some are convex.

The profile of this soil is similar to the one described as typical for the Hord series, but it has a slightly thinner surface layer and contains pebbles in the underlying material. In addition, the underlying material is more stratified with medium-textured and moderately coarse textured soil material. Included in mapping were a few small areas of Hord silt loam, terrace, 0 to 1 percent slopes.

The soil is susceptible to soil blowing unless it is protected by vegetation or organic matter. Water erosion is a moderate hazard. Fertility maintenance and water management are needed, particularly in irrigated areas. Runoff is slow.

This soil is easily worked. Most areas are cultivated. Alfalfa, wheat, grain sorghum, and corn are the main crops. Some areas are irrigated with water from the Bostwick Irrigation District Canal. The soil is suited to trees and to use by wildlife. Capability units IIe–1 dryland, IIe–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Humbarger Series

The Humbarger series consists of deep, moderately well drained soils on bottom land of the Republican River Valley. These soils formed in medium-textured and moderately fine textured alluvium. They are nearly level, but seldom flooded. Depth to the water table ranges from 5 to 15 feet.

In a typical profile, the surface layer is about 21 inches thick. The upper part is dark grayish-brown silt loam about 5 inches thick, and the lower part is dark grayish-brown silty clay loam about 16 inches thick. The surface layer is underlain by a transitional layer of grayish-brown, hard silty clay loam that is 11 inches thick. The underlying material is grayish-brown loam in the upper part and light-gray fine sand in the lower part.

Humbarger soils have a high available water capacity. Permeability is moderately slow. The organic-matter content is moderate, and natural fertility is high.

Nearly all areas of Humbarger soils are cultivated. Many are irrigated. A few are in native grass.

Typical profile of Humbarger silt loam, in a cultivated field 0.24 mile south and 0.15 mile west of the northeast corner of sec. 17, T. 1 N., R. 9 W.:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, very friable; moderately alkaline; abrupt, smooth boundary.

A12—5 to 21 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; hard, friable; calcareous; moderately alkaline; clear, smooth boundary.

AC—21 to 32 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; hard, firm; calcareous; moderately alkaline; gradual, smooth boundary.

C1—32 to 52 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard, very friable; calcareous; abrupt, smooth boundary.

IIC2—52 to 60 inches, light-gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) when moist; single grain; loose; calcareous.

The solum ranges from 20 to 45 inches in thickness. The A horizon ranges from 12 to 27 inches in thickness and is most commonly dark grayish brown, dark gray, or grayish brown. The AC horizon ranges from heavy loam to silty clay loam. Carbonates are within a depth of 15 inches.

Humbarger soils are associated with Roxbury, McCook, and Gibbon soils. They are finer textured than Roxbury or McCook soils. They have a lower water table than Gibbon soils.

Humbarger silt loam (0 to 1 percent slopes) (Hu).—This soil is on bottom lands of the Republican River Valley. Slopes are plane.

Included in mapping were a few small areas of Gibbon soils that have a silt loam surface layer, and a few areas of McCook silt loam.

Soil blowing can be a hazard. Water erosion is a concern in management. Maintaining fertility is essential, particularly in irrigated areas. Available phosphorus is low. Runoff is slow.

Corn, grain sorghum, and alfalfa are the major crops grown. This soil is well suited to irrigated crops, windbreak plantings, and to use by wildlife. Capability units I–1 dryland, I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Inavale Series

The Inavale series consists of deep, excessively drained soils on bottom land of the Republican River Valley. These soils formed in loamy and sandy alluvium. They are nearly level to very gently sloping. Depth to the water table ranges from 5 to 20 feet.

In a typical profile, the surface layer is grayish-brown loamy fine sand about 8 inches thick. Next is a transitional layer of loose, light brownish-gray loamy sand about 9 inches thick. Below this and extending to a depth of 60 inches is light-gray fine sand.

Inavale soils have a low available water capacity. Permeability is rapid. Natural fertility is low, and the organic-matter content is low.

Most areas of Inavale soils are in native grasses. A few are cultivated, and these are better suited to irrigation than to dryland management.

Typical profile of Inavale loamy fine sand, 0 to 3 percent slopes, in native grass, near the middle of the southwest quarter of sec. 9, T. 1 N., R. 11 W.:

A—0 to 8 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, coarse, granular structure; loose; mildly alkaline; clear, smooth boundary.

AC—8 to 17 inches, light brownish-gray (10YR 6/2) loamy sand, grayish brown (10YR 5/2) when moist; single grain; loose; mildly alkaline; abrupt, smooth boundary.

C—17 to 60 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) when moist; single grain; loose; mildly alkaline.

The solum ranges from 10 to 30 inches in thickness. The A horizon ranges from 4 to 12 inches in thickness, from fine sandy loam to fine sand in texture, and from slightly acid to mildly alkaline in reaction. It is mainly grayish brown or light brownish gray. The AC and C horizons range from neutral to moderately alkaline.

Inavale soils are associated with Munjor, Munjor, slightly wet variant, and McCook soils. They do not contain lime, and they are coarser textured than Munjor or McCook soils. They are coarser textured and have a lower water table than Munjor, slightly wet variant soils.

Inavale fine sand, 0 to 3 percent slopes (If).—This soil has convex slopes and is slightly hummocky. It is in long, narrow areas on bottom lands of the Republican River Valley.

This soil has a profile similar to the one described as typical for the Inavale series, but the texture of the surface layer is fine sand. Included in mapping were small areas of Inavale loamy fine sand, 0 to 3 percent slopes.

Soil blowing is a hazard unless the soil is adequately protected. Keeping the grasses productive and healthy is the main concern in management. The soil is too coarse for satisfactory cultivation. It has low available water capacity and is excessively drained.

Nearly all areas are in native grass. This soil is suited to windbreak plantings and to use by wildlife. Capability unit VIe–5 dryland; Sands range site; Very Sandy windbreak group.

Inavale fine sandy loam, 0 to 3 percent slopes (In).—This soil has convex slopes and is slightly hummocky.

The profile of this soil is similar to the one described as typical for the Inavale series, but the surface layer is fine sandy loam. Included in mapping were a few small areas of Munjor fine sandy loam, 0 to 3 percent slopes, and a few areas of Inavale loamy fine sand, 0 to 3 percent slopes.

Soil blowing is the main hazard in cultivated areas. Because the available water capacity is low, this soil is droughty under dryland management. Permeability is rapid. Fertility maintenance and water management are concerns in irrigated areas.

This soil is easily worked. Most areas are cultivated. Corn and grain sorghum are the main irrigated crops, and wheat is the main dryland crop. This soil is also suited to grass and trees and to use by wildlife. Capability units

IIIe-3 dryland, IIIe-3 irrigated; Sandy range site; Sandy windbreak group.

Inavale loamy fine sand, 0 to 3 percent slopes (Ig).—This soil has convex slopes. Areas are long and narrow. Some are hummocky.

This soil has the profile described as typical for the Inavale series. Included in mapping were a few areas of Munjor soils that have a loamy fine sand surface layer; a few areas of Inavale fine sand, 0 to 3 percent slopes; and small areas where mixed sand and gravel are at the surface.

This soil is mostly in native grass. It is suited to cultivation, but soil blowing is a severe hazard. Good management of the grasses is needed in range areas. Because the available water capacity is low, the soil is droughty.

Wheat and grain sorghum are the crops best suited under dryland conditions. Corn and grain sorghum are suited where the soil is irrigated. Trees grow well in windbreaks, and wildlife use these areas for cover and as a source of food. Capability units IIIe-51 dryland, IVe-5 irrigated; Sands range site; Sandy windbreak group.

Kipson Series

The Kipson series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in material weathered from calcareous, chalky limestone. They are moderately sloping to steep.

In a typical profile, the surface layer is dark grayish-brown silt loam about 9 inches thick. Beneath this is a transition layer of slightly hard, light brownish-gray silt loam about 6 inches thick. At a depth of 15 inches is calcareous, silty, chalky limestone bedrock.

Kipson soils have low available water capacity and moderate permeability. Natural fertility is medium. The organic-matter content is moderate in the surface layer. Plant roots do not penetrate the limestone bedrock.

Typical profile of Kipson silt loam, 7 to 31 percent slopes, in native grasses, 0.3 mile east and 0.25 mile south of the northwest corner of sec. 25, T. 1 N., R. 11 W.:

A—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard, friable; many fine roots; calcareous; moderately alkaline; clear, smooth boundary.

AC—9 to 15 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; slightly hard, friable; calcareous; moderately alkaline; gradual, wavy boundary.

R—15 to 25 inches, light-gray (10YR 7/2), consolidated, silty, chalky limestone; calcareous.

The A horizon ranges from 6 to 12 inches in thickness. It is commonly dark grayish brown and grayish brown. The depth to chalky limestone bedrock ranges from 7 to 20 inches.

Kipson soils are associated with Wakeen soils and Rough stony land. They are shallow over bedrock, but Wakeen soils are moderately deep over similar bedrock. They are deeper over bedrock than Rough stony land, which has more outcrops of limestone.

Kipson silt loam, 7 to 31 percent slopes (KsD).—This soil is on the sides of upland drainageways. Slopes are plane and convex (fig. 13).

Included with this soil in mapping were some areas of Wakeen silt loam, 10 to 31 percent slopes, and small areas of Rough stony land where the soil is very shallow and bedrock is exposed at the surface.

This soil is droughty because it is shallow and has low available water capacity. Runoff is rapid. The underlying bedrock limits effective root penetration and water movement.

Almost all the acreage is in native grass and is used as range, to which the soil is best suited. This soil is also suited to trees and to use as wildlife habitat. Capability unit VIs-4 dryland; Shallow Limy range site; Shallow windbreak group.

Marsh

Marsh (M) is in areas where water is above the surface during most of the year. The water is 2 to 18 inches deep. The areas of Marsh in Webster County are 20 to 60 acres in size.

No soil profile has formed in areas of Marsh. The soil material ranges from medium to fine in texture and is dark colored and commonly mottled. In most places 1 to 3 inches of brownish, fibrous remains of partially decomposed plants are on the surface. Included in mapping were a few small areas of Wet alluvial land.

More than half the acreage is covered with vegetation, mainly cattails, rushes, tall sedges, willows, and other herbaceous and aquatic plants. Marsh is best suited to wetland wildlife habitat. It is too wet for cultivation, grazing, or trees. Capability unit VIIIw-1 dryland; Undesirable windbreak group; range site not assigned.

McCook Series

The McCook series consists of deep, medium-textured, well-drained soils on bottom lands of the Republican River Valley. These soils formed in silty alluvium. They are nearly level and very gently sloping and are seldom flooded. Depth to the water table ranges from 5 to 15 feet.

In a typical profile, the surface layer is gray silt loam about 12 inches thick. Beneath this is a transitional layer of light brownish-gray, soft silt loam 9 inches thick. The underlying material is light brownish-gray very fine sandy loam in the upper part, light-gray silt loam in the middle part, and light-gray loamy fine sand in the lower part.

McCook soils have a high available water capability, moderate permeability, moderate organic-matter content, and high natural fertility.

Almost all areas of McCook soils are cultivated, and many are irrigated. A few areas are in native or tame grass. The soils are well suited to windbreak plantings and to use by wildlife.

Typical profile of McCook silt loam, 0.3 mile south and 270 feet east of the northwest corner of sec. 12, T. 1 N., R. 11 W.:

A—0 to 12 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; soft, very friable; moderately alkaline; gradual, wavy boundary.

AC-12 to 21 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium and fine, granular structure; soft, very friable; calcareous; clear, smooth boundary.

C1—21 to 30 inches, light brownish-gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) when moist; massive; soft, very friable; calcareous; gradual, wavy boundary.

Figure 13.—**Landscape of Kipson silt loam, 7 to 31 percent slopes. This soil is shallow over silty, chalky limestone bedrock.**

C2—30 to 43 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; massive; soft, very friable; calcareous; abrupt, smooth boundary.

IIC3—43 to 60 inches, light-gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) when moist; single grain; loose; calcareous.

The A horizon ranges from 10 to 18 inches in thickness and from gray to dark grayish brown in color. It ranges from fine sandy loam to silt loam. The AC horizon ranges from 9 to 20 inches in thickness. The IIC horizon is at a depth of 40 to 72 inches. It ranges from loamy fine sand to mixed sand and gravel. In many places below a depth of 30 inches the soils are stratified with light- and dark-colored medium-textured and moderately coarse textured material. Carbonates are within a depth of 15 inches.

McCook soils are associated with Humbarger, Inavale, Munjor, and Roxbury soils. They are not so fine textured as Humbarger soils. They are finer textured than Inavale or Munjor soils. They have a thinner A horizon than Roxbury soils, which are on colluvial foot slopes.

McCook silt loam (0 to 3 percent slopes) (Mv).—This soil is on bottom land that is seldom flooded. Most areas are nearly level; a few are very gently sloping. They are elongated and range from 15 to 80 acres in size.

This soil has the profile described as typical for the McCook series (fig. 14). Included in mapping were a few small areas of Munjor fine sandy loam, 0 to 3 percent slopes, and Humbarger silt loam.

This McCook soil has few limitations. It is excellent for cultivated crops. If cultivated under dryland management, however, it can be droughty. Unless adequately protected, it is susceptible to soil blowing.

This soil is easy to work and is well suited to irrigation and to cultivated crops. It has high fertility and high available water capacity. Corn, wheat, grain sorghum, and alfalfa are the main crops. Trees grow well in windbreaks. Wildlife use the areas as a source of food. Capability units I–1 dryland, I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

McCook fine sandy loam (0 to 3 percent slopes) (Mp).—This soil has mostly convex slopes. Areas range from 5 to 60 acres in size and are commonly long and narrow.

Figure 14.—**Profile of McCook silt loam, an alluvial soil on bottom land. Lowest marker shows stratified light- and dark-colored material.**

This soil has a profile similar to the one described as typical for the series, but the surface layer is fine sandy loam. Included in mapping were areas of Munjor fine sandy loam, 0 to 3 percent slopes, and McCook silt loam.

Soil blowing is a hazard in cultivated fields. Fertility maintenance and water management are concerns in management in irrigated areas.

Most areas are cultivated. Only a few are in native grass. Wheat, corn, and grain sorghum are the principal crops. Alfalfa is grown to a lesser extent. Trees are suited, and wildlife use the areas as a source of food. Capability units IIe–3 dryland, IIe–3 irrigated; Silty Lowland range site; Sandy windbreak group.

Meadin Series

The Meadin series consists of excessively drained soils on uplands. These soils formed in loamy material 10 to 20 inches deep over coarse sand and gravel. They are moderately sloping to steep.

In a typical profile, the surface layer is dark grayish-brown loam about 6 inches thick. The transitional layer is soft, grayish-brown gravelly sandy loam 8 inches thick. At a depth of 14 inches is light-gray coarse sand and gravel.

Meadin soils have low available water capacity. Permeability is rapid in the transitional layer and very rapid in the underlying sand and gravel, Natural fertility is low, and the organic-matter content is low.

Nearly all areas of Meadin soils are in native grass and are used for grazing.

Typical profile of Meadin loam, 8 to 31 percent slopes, 0.2 mile east and 525 feet north of the southwest corner of sec. 16, T. 2 N., R. 12 W.:

A—0 to 6 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; soft, very friable; slightly acid; clear, wavy boundary.

AC—6 to 14 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; soft, very friable; neutral; diffuse, wavy boundary.

IIC—14 to 60 inches, light-gray (10YR 7/2) coarse sand and gravel, light brownish gray (10YR 6/2) when moist; single grain; loose.

The A horizon ranges from 6 to 16 inches in thickness and from dark grayish brown to dark gray in color. The depth to mixed sand and gravel ranges from 10 to 20 inches. In many areas the IIC horizon is stratified with loamy coarse sand. Reaction ranges from slightly acid to neutral throughout the profile.

Meadin soils are associated with Geary soils and Gravelly land. They are shallow over sand and gravel, whereas Geary soils are deep and formed in light reddish-brown loess. They are deeper over sand and gravel than Gravelly land.

Meadin loam, 8 to 31 percent slopes (MwD).—This soil borders upland drainageways. Slopes are convex and concave. Included in mapping were areas of Geary and Hobbs soils and small areas of Gravelly land.

This soil has low available water capacity. Runoff is medium to rapid, and permeability is rapid. The vegetative cover is fair in most areas but sparse in others.

Because of its low available water capacity and moderate to steep slopes, this soil is not suited to cultivation. It is droughty. Nearly all areas are in native grass. Capability unit VIs–4 dryland; Shallow to Gravel range site; Shallow windbreak group.

Munjor Series

The Munjor series consists of deep, well-drained soils on bottom land. These soils formed in alluvium along the Republican River and some of the major creeks. They are nearly level and very gently sloping. Depth to the water table ranges from 5 to 15 feet.

In a typical profile, the surface layer is grayish-brown fine sandy loam about 8 inches thick. The underlying material is light brownish-gray, slightly hard fine sandy loam to a depth of 41 inches. Below this it is pale-brown medium sand.

Munjor soils have a moderate available water capacity. Permeability is moderately rapid. The organic-matter content is moderately low. Fertility is medium and low. Most of the acreage is cultivated. All crops commonly grown in the county are suited.

Typical profile of Munjor fine sandy loam, 0 to 3 percent slopes, in a cultivated field 0.45 mile south and 0.3 mile west of the northeast corner of sec. 6, T. 1 N., R. 11 W.:

A—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, granular structure; slightly hard, very friable; mildly alkaline; clear, smooth boundary.

C1—8 to 20 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist; weak, medium, granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C2—20 to 41 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist; massive; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

IIC3—41 to 60 inches, pale-brown (10YR 6/3) medium sand, brown (10YR 5/3) when moist; single grain; loose; calcareous; moderately alkaline.

Depth to the coarse-textured stratum ranges from 28 to 50 inches. The A horizon ranges from 3 to 15 inches in thickness. The A horizon ranges from grayish brown to light brownish gray and brown and is fine sandy loam and loamy fine sand. The C1 and C2 horizons range from loamy sand to heavy silt loam in thin strata. Free carbonates are within a depth of 10 inches.

Munjor soils are associated with McCook, Inavale, Gibbon, and Munjor, slightly wet variant soils. They are coarser textured than McCook soils and are finer textured than Inavale soils. They are coarser textured and have a lower water table than Gibbon soils. They have a lower water table than Munjor, slightly wet variant soils.

Munjor fine sandy loam, 0 to 3 percent slopes (Mun).—This soil is on long, low ridges. Slopes are mainly convex.

This soil has the profile described as typical for the Munjor series. Included in mapping were a few small areas of Munjor loamy fine sand, 0 to 3 percent slopes; McCook fine sandy loam, and Inavale fine sandy loam, 0 to 3 percent slopes.

Soil blowing is the principal hazard. Lack of sufficient rainfall is a limitation under dryland management. Maintaining a high level of fertility is essential. Water management is a concern in irrigated areas. Legumes respond to applications of phosphorus.

This soil is easily worked. Most areas are cultivated. A few are in native grass. Wheat, corn, grain sorghum, and alfalfa are the major crops. This soil is suited to windbreak plantings and to use by wildlife. Capability units IIe-3 dryland, IIe-3 irrigated; Sandy Lowland range site; Sandy windbreak group.

Munjor loamy fine sand, 0 to 3 percent slopes (Mul).—This soil is on low ridges on bottom lands. Slopes are convex.

This soil has a profile similar to the one described as typical for the series, but the surface layer is loamy fine sand. Included in mapping were a few small areas of Munjor fine sandy loam, 0 to 3 percent slopes, and Inavale loamy fine sand, 0 to 3 percent slopes.

The hazard of soil blowing is severe. The lack of sufficient rainfall is a limitation under dryland management. Fertility is low. The organic-matter content is moderately low. Crops, particularly legumes, respond to phosphorus. Water management is a concern in irrigated areas.

Nearly all areas are cultivated. Some are irrigated. This soil is suitable for native grasses, windbreak plantings, and wildlife. Capability units IIIe-5 dryland, IIIe-5 irrigated; Sandy Lowland range site; Sandy windbreak group.

Munjor Series, Slightly Wet Variant

Munjor, slightly wet variant soils are deep, nearly level, somewhat poorly drained soils on the Republican River bottom land. These soils are moderately deep over sand. They formed in moderately coarse and coarse alluvium. The water table fluctuates seasonally between depths of 2 and 6 feet.

In a typical profile, the surface layer is light-gray fine sandy loam about 6 inches thick. The upper part of the underlying material is about 25 inches thick. The upper 6 inches is light-gray, soft fine sandy loam and the lower 19 inches is light brownish-gray, soft fine sandy loam. At a depth of about 31 inches is white medium sand. The soil is calcareous in all horizons above the sand.

Munjor, slightly wet variant soils have moderate available water capacity. Permeability is moderately rapid. Natural fertility is medium, and the organic-matter content is moderately low.

Most areas are cultivated. A few are in native grass. The soils are suited to irrigation.

Typical profile of Munjor fine sandy loam, slightly wet variant, 0.25 mile north and 100 feet east of the center of sec. 11, T. 1 N., R. 10 W.:

Ap—0 to 6 inches, light-gray (10YR 6/1) fine sandy loam, dark gray (10YR 4/1) when moist; weak, medium, granular structure; soft, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—6 to 12 inches, light-gray (10YR 6/1) fine sandy loam, gray (10YR 5/1) when moist; few, fine, faint, brownish-yellow (10YR 6/6) mottles; weak, coarse, granular structure; soft, very friable; calcareous; moderately alkaline; gradual, smooth boundary.

C2—12 to 31 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist; common, medium, distinct to prominent, brownish-yellow (10YR 6/6) mottles; massive; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

IIIC3—31 to 60 inches, white (10YR 8/2) medium sand, light gray (10YR 7/2) when moist; single grain; loose; moderately alkaline.

The A horizon ranges from 6 to 17 inches in thickness. The C1 and C2 horizons are stratified in places with light- and dark-colored material that ranges from silt loam to loamy fine sand. The IIIC3 horizon ranges from fine to medium and coarse sand.

Munjor, slightly wet variant soils are associated with Gibbon, Munjor, and Inavale soils. They are coarser textured than Gibbon soils. They have a higher water table than the well-drained Munjor soils. They are finer textured and have a higher water table than Inavale soils.

Munjor fine sandy loam, slightly wet variant (0 to 1 percent slopes) (2Mun).—This soil is on bottom land. Slopes are plane.

Included in mapping were a few small areas of Gibbon soils that have a very fine sandy loam surface layer.

The moderately high water table and the resulting wetness are the principal limitations. Wetness in spring sometimes delays tillage. Surface drainage is needed in some fields. Legumes respond to phosphorus applications. Fertility maintenance and water management are concerns in irrigated areas.

The main crops are corn, grain sorghum, and alfalfa. A few areas are in native grass. The soil is suited to trees and to use by wildlife. Capability units IIw–6 dryland, IIw–6 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Rough Broken Land, Loess

Rough broken land, loess (31 to 45 percent slopes) (RB) occupies very steep bluffs and canyons (fig. 15). Slopes break abruptly to intermittent channels and drainageways.

Rough broken land, loess, is silty, calcareous, grayish-brown and reddish loess. In places the surface layer is slightly darkened, otherwise there is little evidence of soil profile formation. Catsteps are common. Included in mapping were areas of Coly, Geary, and Hobbs soils. In places, inclusions make up as much as 20 percent of the mapping unit.

Rough broken land, loess, is excessively drained. Slopes are steep, and runoff is rapid and very rapid. Only a small amount of moisture enters the soil material; most of it runs off. Permeability is moderate. Available water capacity is high. Fertility is low, and the organic-matter content is low.

Rough broken land, loess, is in native grass. It is not suitable for cultivation. All but the steepest part is used for grazing. Some areas provide protection for livestock in the winter. This land is suited to trees, but in some places

Figure 15.—**Rough broken land, loess, occupies very steep bluffs and canyons.**

the trees have to be hand planted. Capability unit VIIe-1 dryland; Thin Loess range site; Silty to Clayey windbreak group.

Rough Stony Land

Rough stony land (7 to 45 percent slopes) (Rv) borders natural, intermittent drainage channels. Consolidated chalky limestone (fig. 16) is exposed at the surface in as much as 60 to 80 percent of the mapped areas.

Slopes are mainly convex. They are most commonly 7 to 45 percent, but range from 3 to 50 percent. The bedrock, where exposed at the surface, is weathered, calcareous, silty, chalky limestone that contains layers of hard limestone less than 2 inches thick. Inclusions of the very shallow and shallow Kipson soils make up 20 to 40 percent of the total acreage.

Rough stony land is excessively drained. Runoff is rapid and very rapid, depending on the steepness of slope. The available water capacity is low. Some water is held in the upper few inches of the chalky limestone. Natural fertility and the organic-matter content of the soil material are low.

Rough stony land is barren where the bedrock is exposed at the surface. The very shallow and shallow soils support a fair to sparse growth of native grass. The entire acreage is used for grazing. It is too shallow, too rough, and too steep for cultivation. Capability unit VIIs-3 dryland; Shallow Limy range site; Undesirable windbreak group.

Roxbury Series

The Roxbury series consists of deep, moderately well drained soils on bottom land. These soils formed in silty material on alluvial fans where tributary creeks enter the Republican River Valley. They are nearly level and very gently sloping. Depth to the water table ranges from 5 to 15 feet.

In a typical profile, the surface layer is 18 inches thick. The upper part is grayish-brown silt loam, and the lower part is grayish-brown very fine sandy loam. The subsoil is dark-gray, slightly hard silt loam about 14 inches thick. The underlying material is light brownish-gray silt loam in the upper part and light-gray silt loam in the lower part.

Figure 16.—Landscape of Rough stony land showing chalky limestone exposed at the surface.

Roxbury soils have high available water capacity. Permeability is moderate. Natural fertility is high, and the organic-matter content is moderate.

Nearly all areas are cultivated. A few are in native grass.

Typical profile of Roxbury silt loam 0.7 mile north and 725 feet west of the southeast corner of sec. 16, T. 1 N., R. 11 W.:

A11—0 to 9 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard, very friable; calcareous; abrupt, smooth boundary.

A12—9 to 18 inches, grayish-brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure parting to weak, medium, granular; soft, very friable; calcareous; clear, smooth boundary.

B2—18 to 32 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, medium, granular structure; slightly hard, very friable; calcareous; gradual, smooth boundary.

C1—32 to 48 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; few, medium, faint, reddish-brown (5YR 5/4) mottles; massive; soft, very friable; calcareous; gradual, smooth boundary.

C2—48 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; common, medium, distinct, reddish-yellow (5YR 6/6) mottles; massive; soft, very friable; calcareous.

The thickness of the solum ranges from 20 to 54 inches. The A horizon ranges from 10 to 24 inches in thickness and from grayish brown to dark grayish brown and dark gray in color. Free carbonates are within a depth of 15 inches.

Roxbury soils are associated with McCook and Humbarger soils and the terrace phase of the Hord soils. They have a thicker A horizon than McCook soils. They are not so fine textured as Humbarger soils. Lime is at a higher level in the profile in Roxbury soils than in Hord soils.

Roxbury silt loam (0 to 3 percent slopes) (Rc).—This soil is in fan-shaped areas at the mouth of streams as they emerge onto the Republican River bottom land. Slopes are both convex and plane.

Included in mapping were small areas of McCook silt loam; and Hord silt loam, terrace, 0 to 1 percent slopes.

This Roxbury soil is well suited to cultivated crops. Occasionally it is flooded for short periods. The additional water benefits crops if floodwaters are not rapid. In some areas where the flood hazard is severe, the soil should be protected. Capability units I–1 dryland, I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Sandy Alluvial Land

Sandy alluvial land (0 to 3 percent slopes) (Sx) consists of water deposited sand bars and sand flats within and adjacent to the Republican River.

Sandy alluvial land is stratified with moderately coarse, coarse, and very coarse textured soil material. It is commonly mottled. The material is too young for a profile to form, but it has been in place long enough for plants to have become established. Sandy alluvial land is frequently flooded. Shallow pools of water are common. The water table is at the surface or above the surface during periods of high streamflow and fluctuates between depths of 1 and 4 feet when the stream is dry.

The vegetation is mainly willows, cottonwood trees, and annual weeds. This land is not suitable for grazing because grass is sparse. It provides habitat for wildlife and is suitable for recreation. Capability unit VIIIw–1 dryland; Undesirable windbreak group; not placed in a range site.

Silty Alluvial Land

Silty alluvial land (0 to 3 percent slopes) (Sy) occupies narrow areas along intermittent and permanent flowing streams. Most areas are in meandering channels and are bordered by short but steep slopes.

Silty alluvial land is stratified dark- and light-colored material that is predominantly medium textured. It is alluvial in origin, having washed from the surrounding uplands. Included in mapping were a few small areas of Hobbs soils.

The available water capacity is high, and permeability is moderate. Areas are frequently flooded after heavy rainfall. Flooding occurs once or twice each year, mainly in spring.

The vegetation in the more stable areas consists of trees adjacent to the channel and a fair to good cover of grass in level areas and on short slopes.

Silty alluvial land is not suitable for farming because of the flood hazard. In addition, it is dissected by channels and is nearly impossible to cultivate. Practically all the acreage is used for grazing. Capability unit VIw–1 dryland; Silty Overflow range site; Moderately Wet windbreak group.

Wakeen Series

The Wakeen series consists of moderately deep, well-drained soils on uplands. These soils formed in material weathered from chalky limestone. They are gently sloping to steep.

In a typical profile, the surface layer is dark-gray silt loam about 8 inches thick. The subsoil is slightly hard, grayish-brown silt loam about 15 inches thick. The underlying material is light brownish-gray silt loam. At a depth of 32 inches is chalky limestone bedrock.

Wakeen soils have a moderate available water capacity. Permeability is moderate. Natural fertility is medium, and the organic-matter content is moderately low.

Most areas on the lower slopes are cultivated. The steeper slopes are in native grass and are used for grazing.

Typical profile of Wakeen silt loam, 10 to 31 percent slopes, 0.5 mile south and 225 feet east of the northwest corner of sec. 14, T. 1 N., R. 12 W.:

A—0 to 8 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; moderate, fine and medium, granular structure; slightly hard, very friable; calcareous; clear, smooth boundary.

B2—8 to 23 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, subangular blocky structure; slightly hard, friable; calcareous; a few mycelia threads of lime and some ped faces coated with lime; many worm casts; gradual, smooth boundary.

C—23 to 32 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, very friable; calcareous; much earthy lime and soft lumps of chalk in the lower part; gradual, wavy boundary.

R—32 to 42 inches, white (10YR 8/2) chalky limestone; fractured in upper part; calcareous.

The thickness of the solum ranges from 20 to 36 inches. The A horizon ranges from 7 to 20 inches in thickness. Carbonates are within a depth of 0 to 12 inches. The depth to the chalky limestone ranges from 20 to 40 inches.

Wakeen soils are associated with Kipson soils. In contrast with these soils, they are deeper over bedrock and have a B horizon.

Wakeen silt loam, 3 to 10 percent slopes (WcC).—This soil is on the sides of upland drainageways. It has plane and concave slopes.

This soil has a profile similar to the one described as typical for the series, but the surface layer and subsoil are slightly thicker. Included in mapping were a few small areas of Kipson soils, a few areas where chalky limestone bedrock is exposed at the surface, and a few eroded areas where the surface layer is mixed with the subsoil and is lighter colored than in the typical profile.

Water erosion is the main hazard. In cultivated areas, this soil is susceptible to soil blowing. Runoff is medium.

Most areas are in native grass. Only a few areas are cultivated. Wheat and grain sorghum are the main crops. Alfalfa is grown to a lesser extent. This soil is suited to native grasses and trees and to use by wildlife. Capability units IVe-1 dryland, IVe-1 irrigated; Silty range site; Silty to Clayey windbreak group.

Wakeen silt loam, 3 to 10 percent slopes, eroded (WcC2).—This soil is on the sides of upland drainageways. Slopes are plane and concave.

This soil has a profile similar to the one described as representative of the Wakeen series, but the surface layer is slightly thinner and lighter colored. Included in mapping were a few small areas of Kipson soils and a few places where chalky limestone crops out.

Water erosion and soil blowing have thinned the original surface layer. In places cultivation has mixed the rest of the surface layer and the upper part of the subsoil.

Erosion is the main hazard. Unless adequately protected, this soil is subject to soil blowing. Increasing the supply of organic matter and maintaining a high level of fertility are essential practices in management. Runoff is medium.

Nearly all areas are cultivated. A few are seeded to tame grass and used for pasture. Crops are mainly wheat and grain sorghum. A small acreage is in alfalfa. This soil is not irrigated. It is suited to tame grasses and windbreak plantings and to use by wildlife. Capability unit IVe-8 dryland; Silty range site; Silty to Clayey windbreak group.

Wakeen silt loam, 10 to 31 percent slopes (WcE).—This soil is on the sides of upland drainageways. Slopes are plane and concave.

This soil has the profile described as typical for the Wakeen series (fig. 17). Included in mapping were a few small areas of Kipson silt loam, 7 to 31 percent slopes, and Rough stony land.

This Wakeen soil has moderate available water capacity. Runoff is rapid. Controlling water erosion, conserving water, and keeping the vegetation healthy are the main concerns in management. The soil is too steep and the erosion hazard too severe for successful cultivation.

Practically all the acreage is in native grass and is used for grazing. This soil is suited to windbreak plantings and to use by wildlife. Capability unit VIe-1 dryland; Silty range site; Silty to Clayey windbreak group.

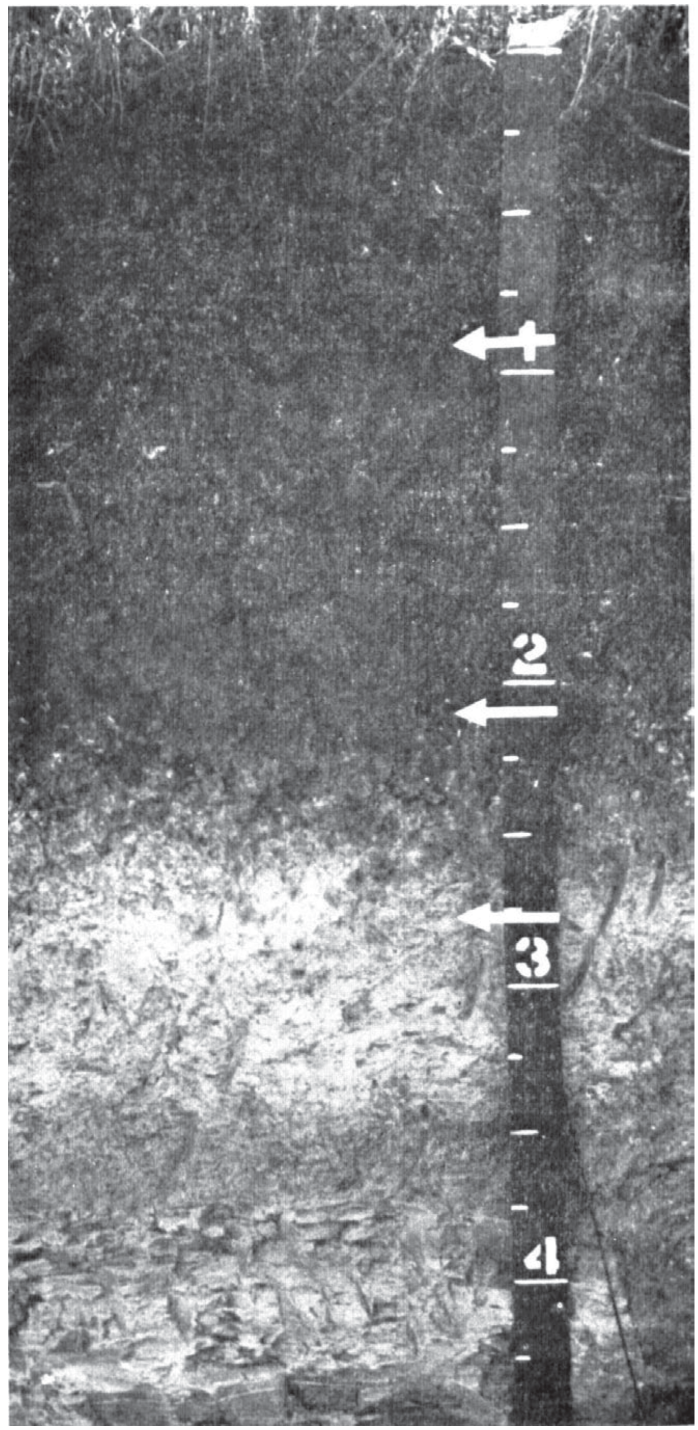

Figure 17.—**Profile of Wakeen silt loam showing chalky limestone bedrock at a depth of about 33 inches.**

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wx) is in depressions and in low lying flats on the Republican River bottom land and along Farmers Creek.

Wet alluvial land is permanently wet and consists of stream sediment that is deep, medium textured, and mottled. This sediment commonly contains strata that are light and dark in color and range from loam to silty clay in texture. Depth to the water table fluctuates. In some periods it is at the surface and in others it is at a depth of 24 inches. In many places an inch or more of organic matter is at the surface. Included in mapping were small areas of Marsh.

Wet alluvial land has poor natural drainage. Runoff is very slow. In a few areas the water table has been lowered by V-shaped ditches.

Unless adequately drained, this land is not suited to cultivated crops. Nearly all the acreage is used for grazing and for wildlife. Capability unit Vw-1, dryland; Wet Land range site; Very Wet windbreak group.

Use and Management of the Soils

This section suggests the kind of management needed for dryland and irrigated cultivated crops. It explains the capability classification of soils (*8*), describes the management of dryland and irrigated soils by capability units, and gives predicted yields of the commonly grown crops under two levels of management. This section also describes use and management of the soils for range, windbreaks, and wildlife.

Management of Soils for Crops [3]

Flooding of soils adjacent to streams and drainageways and loss of fertile topsoil caused by water erosion and soil blowing are the principal concerns in management. Nearly all the soils of the county are suitable for cropland, pasture, or range if soil limitations can be overcome and good management is used. Some soils have properties and an erosion hazard that make them poorly suited to cultivated crops. They are better suited to use as range, woodland, wildlife habitat, and recreational areas.

About 56 percent, or 206,000 acres, of Webster County is cultivated. According to the 1969 Nebraska Agricultural Statistics, 23,200 acres was irrigated.

Corn and grain sorghum are the principal irrigated crops, and wheat, grain sorghum, and alfalfa are the principal dryland crops. Other crops are oats, rye, soybeans, potatoes, and tame hay. Each year, some of the cropland is left fallow, used for temporary pasture, or planted to grasses and legumes.

The hazard of water erosion can be controlled by terraces, contour farming, land leveling, contour bench leveling, and grassed waterways. These practices are suited to Holdrege silt loam, 3 to 7 percent slopes, and to soils that have similar characteristics. They are most effective if used along with other good management practices. Crop residue on the surface or a protective cover of vegetation prevents the soil from sealing or crusting after an intense rain. Tall stubble left on the surface in winter catches drifting snow and replenishes the moisture supply in soils under dryland management.

The cropping system can be so managed that productive soils in areas where there is little or no erosion hazard are used for row crops, and the steeper, more eroded soils are used for hay and pasture. This practice reduces loss of soil through erosion.

The hazard of soil blowing on Inavale, Munjor, McCook, and similar soils can be reduced by protecting the soils from wind action. Stubble-mulch tillage for small grain, mulch planting for row crops, and narrow fields of alternating row crops and small grain crops help to reduce wind velocity on the soil surface.

Eliminating all but essential tillage and using tillage equipment that leaves maximum crop residue on the surface during seedbed preparation improves the soil, reduces soil loss, and lessens compaction.

To sustain a high production of crops and pasture grasses, the soils can be tested to determine the need for commercial fertilizers. The moisture content of the soil affects the amount of fertilizer needed. A slightly lower application rate is needed where the subsoil is dry or on a low rainfall site. Nitrogen fertilizer increases plant growth. Phosphorus and zinc are commonly needed on the eroded Geary, Holdrege, and Wakeen soils on uplands. Phosphorus is needed on the calcareous, somewhat poorly drained Gibbon soils and Munjor, slightly wet variant soils. Irrigated soils require larger amounts of fertilizer than nonirrigated soils because they are more productive.

Proper grading is needed for efficient use of the water by gravity irrigation systems. Water can be uniformly distributed, and waste water can be controlled. Sprinkler irrigation can be used on all soils. Furrows and borders can be on deep, level to gently sloping soils. A system that controls and manages the irrigation runoff from gently sloping fields helps to prevent loss of water through runoff and provides for reuse of the water.

Capability groups of soils

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when 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 horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, windbreaks, or engineering structures.

In the capability system, all kinds of soil are grouped at three levels, the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, 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.

[3] Prepared by E. O. PETERSON, conservation agronomist, Soil Conservation Service.

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

Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture or range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

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.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

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 productivity and other responses to management. 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, IIe–1 or VIs–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Webster County are described and suggestions for the use and management of the soils are given. The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils in a given series are in the unit. The capability unit designation for each soil in the county can be found in the "Guide to Mapping Units."

CAPABILITY UNIT I–1 DRYLAND, I–1 IRRIGATED

These units consist of deep, well drained and moderately well drained soils of the Humbarger, McCook, and Roxbury series. These are nearly level and very gently sloping soils on bottom lands. The surface layer and subsoil are medium textured to moderately fine textured. The underlying material is medium textured. The water table is below a depth of 5 feet.

These soils absorb water readily and are easy to work. Permeability is moderate to moderately slow. The available water capacity is high. Runoff is slow. The organic-matter content is high, and natural fertility is high.

Maintaining the organic-matter content and high fertility and controlling soil blowing are the principal concerns in management.

Dryland management.—Corn, grain sorghum, small grain, and alfalfa are suitable crops. Soybeans are grown on a limited acreage. The soils are well suited to windbreak plantings, and they provide food and cover for wildlife. Crop residue management and adequate fertilization are about all that is needed to maintain crop production. Keeping a cover of growing plants or organic matter on the surface helps to control soil blowing. Rotating row crops with small grain, hay, and pasture crops controls crop diseases and insects.

Irrigation management.—Corn, grain sorghum, alfalfa, and tame grasses for hay and pasture are suited to the irrigated soils of this unit. All types of irrigation systems are suitable, but for all except sprinklers, slight irregularities in the land surface commonly make it difficult to obtain uniform distribution of irrigation water. Applying irrigation water in sufficient amounts to serve the needs of the crops and at a rate that permits maximum absorption and minimum runoff is essential. Crop residue on the surface in winter helps control soil blowing.

CAPABILITY UNIT IIe–1 DRYLAND, IIe–1 IRRIGATED

These units consist of very gently sloping soils of the Hastings, Holdrege, and Hord series. These are deep, well-drained soils on uplands and stream terraces. They have a medium-textured surface layer and a moderately fine textured subsoil. In places the Holdrege soils are eroded.

These soils are easy to work, and they absorb water readily. Permeability is moderate to moderately slow. The available water capacity is high. Runoff is slow. The organic-matter content is moderate, and natural fertility is high.

Measures to control runoff are needed to reduce erosion and to increase soil moisture. Soil blowing is a hazard. Maintaining tilth, fertility, and organic-matter content is necessary on all cultivated fields.

Dryland management.—Corn, grain sorghum, small grain, soybeans, alfalfa, and hay are suitable crops. The soils are suited to windbreak plantings, and they provide food for wildlife. Terraces, contour farming, and grassed waterways help control runoff. A cropping system that keeps the soil covered with vegetation most of the time reduces moisture loss and soil blowing. Soil fertility can be maintained or increased by using commercial fertilizers and barnyard manure.

Irrigation management.—Corn and grain sorghum are the main irrigated crops grown on these soils. A small acreage of alfalfa is irrigated. For efficient gravity irrigation, leveling is needed. Leveling helps to distribute irrigation water evenly and prevents loss of fertilizer by leaching. Controlling and conserving irrigation runoff at the ends of the fields are essential factors in management. Crop residue on the surface increases the water intake rate and reduces the hazard of soil blowing.

CAPABILITY UNIT IIe-3 DRYLAND, IIe-3 IRRIGATED

In these units are soils of the McCook and Munjor series. These nearly level and very gently sloping soils are on bottom land. They are deep and well drained and have a moderately coarse textured surface layer. The underlying material is medium textured and moderately coarse textured. The water table is below a depth of 5 feet.

These soils are easy to work, and they release moisture readily to plants. The moderately coarse textured surface layer absorbs rainfall readily. Permeability is moderate to moderately rapid. The available water capacity is moderate to high. Runoff is slow. The organic-matter content is moderate to moderately low. Natural fertility is moderate to high.

These soils are subject to soil blowing and water erosion. Conserving moisture and maintaining fertility and the organic-matter content are necessary. These soils are somewhat droughty during dry periods.

Dryland management.—These soils are suited to corn, grain sorghum, small grain, alfalfa, and hay. They are also suited to trees and wildlife.

The hazards of water erosion and soil blowing can be reduced and the moisture conserved by stripcropping, stubble-mulch tillage, and a cropping system that keeps the soil covered with growing crops or crop residue most of the time. Row crops can be alternated with small grain and legumes. Terraces and contour farming can be used if needed, particularly in areas that are row cropped.

Irrigation management.—These soils are well suited to corn, grain sorghum, small grain, and alfalfa. The organic-matter content can be kept at a high level by growing small grain and legumes in the crop rotation, and by mulching practices that leave crop residue on the surface. Sprinklers, furrows, and borders can be used for irrigating. The high water intake rate of these soils makes it necessary to limit the length of irrigation runs. Controlling and reducing irrigation runoff at the end of the fields are essential for water conservation. Keeping a growing crop or organic matter on the surface helps to control soil blowing. For sustained crop production, the optimum use of commercial fertilizers and barnyard manure is needed.

CAPABILITY UNIT IIw-3 DRYLAND, I-3 IRRIGATED

Hobbs silt loam, occasionally flooded, is the only soil in these units. This soil is on bottoms of upland drainageways. It is deep, moderately well drained, and nearly level to gently sloping. The surface layer is medium textured. The underlying material is medium textured. Runoff from the surrounding upland occasionally floods this soil.

This soil is easy to work, and it releases water readily to plants. The organic-matter content is moderate. Natural fertility is high. Permeability is moderate, and available water capacity is high.

The major hazard is occasional flooding following heavy rainfall. During dry years, occasional minor flooding is beneficial to crops because it adds to the moisture supply. Flooding is of short duration, and crop damage is seldom severe. Maintaining a high level of fertility is essential.

Dryland management.—This soil is suited to corn, grain sorghum, small grain, and alfalfa. Occasional flooding in spring can limit production of small grain and alfalfa. This soil also is suited to windbreak plantings and wildlife.

In most areas diversions and drainage ditches reduce the flood hazard by intercepting runoff and preventing floodwater from spreading over a wide area. Maintaining drainage ditches and diversions is a concern in management.

Irrigation management.—Corn and sorghum are best suited to the irrigated soils of this unit. Where flooding is controlled, alfalfa and small grain are also suited.

An irrigation system that diverts or intercepts floodwaters is needed. Furrow and border irrigation systems are best suited. Sprinklers also can be used on these narrow soil areas. Land leveling helps provide surface drainage. Controlling and conserving irrigation runoff at the ends of the fields are essential practices in management. Adequate commercial fertilizer and mulch tillage are desirable for all irrigated crops.

CAPABILITY UNIT IIw-4 DRYLAND, IIw-4 IRRIGATED

Gibbon silty clay loam is the only soil in these units. It is deep, somewhat poorly drained, nearly level soil on bottom lands. The soil has a calcareous, moderately fine textured surface layer. Beneath this is medium-textured material. Below a depth of 3 feet, this soil is moderately coarse textured. The water table is at a depth of 2 to 6 feet and fluctuates seasonally. The soil is subirrigated.

This soil is difficult to work when moist because the surface layer is firm. Permeability is moderate, and available water capacity is high. Runoff is slow. The organic-matter content is moderate, and natural fertility is high.

Wetness is the main concern in management during seasons of above normal rainfall. It commonly delays tillage early in spring. In places soluble salts accumulate on the surface. Maintaining fertility and the organic-matter content is essential.

Dryland management.—This soil is suited to corn, grain sorghum, and alfalfa. It is not so well suited to small grain and alfalfa because the water level is high in spring. This soil is also suited to trees and wildlife.

Drainage ditches and tile drains help to control wetness and the level of the water table. Lowering the water table reduces salts accumulation on the surface in spring.

Irrigation management.—Corn, grain sorghum, and alfalfa are suited to the irrigated soils of this unit. Legume crops respond to phosphorus.

Land leveling is needed for adequate surface drainage if furrows and borders are used for irrigating. Excessive water application leaches nutrients to a depth below plant roots. Drainage ditches, tile drains, and diversions help to lower the water table.

CAPABILITY UNIT IIw-6 DRYLAND, IIw-6 IRRIGATED

Munjor fine sandy loam, slightly wet variant, the only soil in these units, is a nearly level soil on bottom land. It is deep over sand and is somewhat poorly drained. It is calcareous and moderately coarse textured in the surface layer and underlying material. Coarse-textured material is below depth of 31 inches. The water table is at a depth of 2 to 6 feet and fluctuates seasonally. This soil is subirrigated.

This soil is easy to work, and it releases moisture readily to plants. The moderately coarse textured surface layer absorbs water readily. Permeability is moderately rapid, and the available water capacity is moderate. Runoff is slow. The organic-matter content is moderately low, and natural fertility is medium.

The major concerns in management are wetness in spring and soil blowing late in summer and in fall. The organic-matter content and soil fertility need to be increased and maintained.

Dryland management.—Corn, grain sorghum, and alfalfa are suitable crops. Spring-sown small grain can also be grown, but the soil is wet at the time of seedbed preparation. Trees can be grown in windbreaks, and wildlife use the areas for food and cover.

Where suitable outlets are available, the water table can be lowered by installing drainage ditches or tile drains. Lowering the water table reduces the possibility of salts accumulating on the surface.

A cropping system that includes close-growing crops and alfalfa generally is suited to this soil. Planting alfalfa eliminates the need for tillage in spring and also reduces the hazard of soil blowing when the surface is dry. Returning crop residue to the soil helps to maintain and improve the organic-matter content and also helps to control soil blowing.

Irrigation management.—Corn, grain sorghum, and alfalfa are suited to the irrigated soils of this unit. Increased amounts of fertilizer are needed to offset the high production of irrigated crops. Land leveling is needed where furrows and borders are used for irrigating. Deep cuts are to be avoided if possible. Sprinklers are suitable for irrigating in areas where land leveling is not practical. Small but frequent applications of irrigation water are desirable.

CAPABILITY UNIT IIs-2 DRYLAND, IIs-2 IRRIGATED

Crete silt loam, 0 to 1 percent slopes, is the only soil in these units. This deep, moderately well drained soil has a claypan. It is in very slight depressions in the uplands. It has a medium-textured surface layer and a fine-textured subsoil.

The subsoil somewhat restricts the movement of air and water and the development of roots. Permeability is slow, and the available water capacity is high. Runoff is slow. The organic-matter content is moderate, and natural fertility is high.

The main concern in management is droughtiness in dry years. The subsoil absorbs moisture slowly and releases it slowly to plants. If the surface is bare, soil blowing is a hazard. Maintaining a high level of fertility is essential.

Dryland management.—Small grain, grain sorghum, corn, and alfalfa are suitable crops. Wheat is better suited than other crops because it matures before the weather becomes hot and dry. Grain sorghum is somewhat better suited than corn. Alfalfa grown for more than 3 or 4 successive years depletes the supply of moisture in the subsoil. If fertility can be kept at a high level by using commerical fertilizers and the soil is protected from soil blowing, row crops can be grown year after year.

Trees and windbreaks are suited, and wildlife use the areas for food and cover.

Irrigation management.—Corn, grain sorghum, and alfalfa are suitable crops on the irrigated soils of this unit. Except where sprinkler systems are used, slight land leveling is generally needed to prepare this soil for irrigation. If the subsoil is exposed during land leveling, undercutting and backfilling with 6 inches of topsoil can be considered. Commercial fertilizer or barnyard manure is needed on all crops under irrigation.

CAPABILITY UNIT IIc-1 DRYLAND, I-2 IRRIGATED

Nearly level soils of the Hastings, Holdrege, and Hord series are in these units. They are deep, well-drained soils on uplands and stream terraces. They have a medium-textured surface layer and a moderately fine textured subsoil.

These soils are easy to till, and they absorb water readily. They have high available water capacity. Permeability is moderate to moderately slow. Runoff is slow. The organic-matter content and natural fertility are high.

Conserving moisture and maintaining a balance between moisture and fertility are the main concerns in management. Soil blowing is a secondary concern.

Dryland management.—Corn, small grain, grain sorghum, and alfalfa are the most suitable crops. Wheat and grain sorghum are consistently the most satisfactory crops. Corn and alfalfa are satisfactory crops in years when moisture is favorable. Trees are suited, and wildlife use the areas for food and cover. Stubble-mulch tillage and periodic summer fallow help to conserve moisture for crops.

Irrigation management.—Corn, grain sorghum, alfalfa, and tame grasses for hay and pasture are suited to the irrigated soils of this unit. All types of irrigation are suitable, but for all except sprinklers, land leveling is needed to obtain uniform distribution of water. Applying irrigation water in sufficient amounts to serve the needs of the crop at a rate that permits maximum absorption and minimum runoff is essential. Crop residue on the surface during the winter reduces the risk of soil blowing.

CAPABILITY UNIT IIIe-1 DRYLAND, IIIe-1 IRRIGATED

These units consist of gently sloping, slightly or moderately eroded soils of the Geary and Holdrege series. These are deep, well-drained soils on uplands. They have a medium-textured surface layer and a moderately fine textured subsoil.

The soils are easy to work, and they release water readily to plants. Permeability is moderate, and available water capacity is high. Runoff is medium. The organic-matter content is moderate, and natural fertility is medium to high.

Water erosion and soil blowing are the principal hazards in cultivated areas. Conserving moisture and maintaining good tilth, high fertility, and a high organic-matter content are concerns in management. Limited rainfall in summer can damage dryland crops.

Dryland management.—Corn, grain sorghum, small grain, and alfalfa are suitable crops. Trees grow well in windbreaks, and wildlife use the areas for food and cover.

Terraces, grassed waterways, contour farming, and a mulch of crop residue reduce runoff and help control erosion. A cropping system that keeps the soil covered with crops or crop residue most of the time conserves moisture and helps to control soil blowing and water erosion. In a good cropping system, the years of consecutive row crops are limited and close-growing crops and legumes, such as small grain and alfalfa, are included in the rotation. Mulch tillage during seedbed preparation is desirable for erosion control. Commercial fertilizer or barnyard manure is needed to maintain a high level of fertility.

Irrigation management.—Alfalfa and grasses are well suited to irrigation on these soils. Corn and grain sorghum are suited where erosion control is practiced. Terraces, contour irrigation, waterways, and the maximum use of crop residue on the surface are needed for erosion control in all irrigated areas.

Soil fertility can be maintained and improved by using manure and commercial fertilizer. Sprinklers are used for irrigating. Slopes make it difficult to control soil erosion caused by rainfall and irrigation water. The rate at which irrigation water is applied is to be no higher than the intake rate of the soil. Furrow or border irrigation can be used if land leveling has been extensive enough to keep runoff and erosion at a minimum. Contour bench leveling is suitable on the lower gradients.

CAPABLITY UNIT IIIe-3 DRYLAND, IIIe-3 IRRIGATED

Inavale fine sandy loam, 0 to 3 percent slopes, is the only soil in these units. It is a deep, excessively drained soil on bottom land. The surface layer is moderately coarse textured and the underlying material is coarse textured. In places the topography is hummocky.

This soil is easy to work, and it releases water readily to plants. The organic-matter content is low, and natural fertility is low. Runoff is slow. Permeability is rapid, and available water capacity is low.

This soil is droughty and subject to soil blowing. To a lesser extent it is subject to water erosion. Conserving moisture, maintaining the organic-matter content, and increasing fertility are concerns in management.

Dryland management.—Corn, grain sorghum, small grain, and alfalfa are suitable crops. Narrow, alternate fields of row crops and small grain, mulch tillage, and a cropping system that keeps residue on the surface most of the time, reduce the hazards of soil blowing and water erosion and also conserve moisture.

Certain trees can be planted in windbreaks. Wildlife use the areas for cover and nesting and as a source of food.

Irrigation management.—Suitable crops for these soils under irrigation are corn, small grain, grain sorghum, alfalfa, and tame grasses.

Furrow or border irrigation is suitable. Sprinklers are suitable in areas where land leveling is impractical. Irrigation water is best managed on leveled fields. Deep cuts in leveling that expose the sandy underlying material are to be avoided. Frequent irrigation is needed. Excessive irrigation is to be avoided because it leaches nutrients to a depth below plant roots in coarse underlying material. Controlling irrigation runoff is a good water conservation practice. The use of commercial fertilizer and barnyard manure maintains and improves fertility.

CAPABILITY UNIT IIIe-5 DRYLAND, IIIe-5 IRRIGATED

Munjor loamy fine sand, 0 to 3 percent slopes, is the only soil in these units. It is a deep, nearly level to very gently sloping, well-drained soil on bottom land. The surface layer is coarse textured, and the underlying material is moderately coarse textured. The topography is hummocky in places.

The coarse-textured surface layer absorbs water readily. Permeability is moderately rapid, and available water capacity is moderate. Runoff is very slow. The organic-matter content is moderately low, and natural fertility is low.

This soil is subject to soil blowing. Conserving moisture, maintaining organic-matter content, and improving fertility are essential in management.

Dryland management.—Corn, grain sorghum, small grain, and alfalfa are suitable crops. Small grain and the first cutting of alfalfa are the most dependable crops because they mature in spring when rainfall is highest. This soil is suited to windbreak plantings, and it provides food for wildlife.

A cropping system that keeps the surface covered with crop residue most of the time reduces the hazard of soil blowing, conserves moisture, replenishes the supply of organic matter, and improves fertility. Limiting the number of years of successive row crops and including close-growing crops and legumes in the rotation protect the soil and conserve moisture. Alternate narrow strips of close-growing row crops and narrow windbreaks reduce the hazard of soil blowing.

Irrigation management.—Corn and alfalfa are suitable irrigated crops. Small grain, grasses, and legumes can also be grown. Furrows, borders, and sprinklers can be used for irrigating. Land leveling is needed if furrows or borders are used. Deep cuts in leveling that expose the sandy underlying material are to be avoided. Frequent, light irrigation is needed. Excessive applications of water leach nutrients below the depth of most roots. Cover crops and crop residue on the surface help to control soil blowing.

CAPABILITY UNIT IIIe-51 DRYLAND, IVe-5 IRRIGATED

Inavale loamy fine sand, 0 to 3 percent slopes, is the only soil in these units. It is a deep, excessively drained soil on bottom lands. It is nearly level and very gently sloping and in some places is hummocky. The surface layer and underlying material are coarse textured.

Water enters this soil rapidly. Permeability is rapid, and available water capacity is low. Runoff is slow. The organic-matter content is low, and natural fertility is low.

Unless this soil is adequately protected, soil blowing is a severe hazard. Because of low available water capacity, the soil is droughty. The major concern in management is reducing the hazard of soil blowing. Conserving moisture and improving organic-matter content and fertility are secondary concerns.

Dryland management.—Corn, grain sorghum, small grain, and alfalfa are suitable crops. Small grain and first-cutting alfalfa are generally the most dependable crops because they grow and mature in spring when rainfall is highest. This soil is suited to trees and wildlife habitat.

A cropping system that keeps the soil covered with crop residue most of the time helps to reduce soil blowing. One that limits the number of years of successive row crops and includes some close-growing crops and legumes protects the soil and conserves moisture. Planting alternate narrow strips of close-growing crops and row crops and using narrow windbreaks help to control soil blowing. Commercial fertilizer and barnyard manure help to improve and maintain soil fertility.

Irrigation management.—Corn, grain sorghum, and alfalfa are suitable crops under irrigation.

All types of irrigation systems can be used. Because intake rate is high, the sprinkler system is best suited. Land leveling is needed for furrow and border systems. Deep cuts in leveling that expose the fine sand underlying material are to be avoided. A cover of growing crops or crop residue is needed to help control soil blowing. Frequent, light irrigation is needed. Excessive water leaches fertilizer below the depth of most plant roots.

CAPABILITY UNIT IIIw-2 DRYLAND, IIs-21 IRRIGATED

Fillmore silt loam is the only soil in these units. This deep, poorly drained soil has a claypan. It is nearly level and is in shallow depressions on the uplands. The surface layer is medium textured, and the subsoil is fine textured. This soil is occasionally flooded by runoff from the surrounding higher lying soils.

Permeability is slow, and the available water capacity is high. The organic-matter content is moderate, and natural fertility is high.

Excessive wetness in spring is the main limitation. It delays tillage and retards crop growth. A complete crop loss, however, is not common. Soil blowing is a limitation if the surface is not adequately protected. Maintaining fertility is also a concern in management.

Dryland management.—Small grain, corn, grain sorghum, and alfalfa are suitable crops, particularly wheat and grain sorghum. A suitable cropping system is 3 or 4 years of row crops followed by a small grain and a legume. Installing terraces and diversions on the adjoining higher lying soils helps to control excessive wetness. Keeping the soil covered with a growing crop or organic matter helps to control soil blowing.

Some species of trees are suited. Wildlife use these areas for cover and nesting and as a source of food.

Irrigation management.—Corn, grain sorghum, and alfalfa are suited to the irrigated soils of this unit. Small grain is also suited. Alfalfa helps to open the subsoil and thus increases the rate at which water moves through the soil. Because the intake rate is slow, longer irrigation periods are necessary. Management that reduces and controls excessive irrigation runoff is needed. Keeping the soil covered with a growing crop or organic matter helps to control soil blowing.

CAPABILITY UNIT IVe-1 DRYLAND, IVe-1 IRRIGATED

In these units are the uneroded, moderately sloping Geary and Holdrege soils, and the uneroded, gently to moderately sloping Wakeen soil. These soils are on uplands. They have a medium-textured surface layer and a medium-textured and moderately fine textured subsoil. Chalky limestone bedrock is at a depth of less than 3 feet in the Wakeen soil.

These soils are easy to work, and they absorb and release water readily to plants. Permeability is moderate. The available water capacity is high in Geary and Holdrege soils, and moderate in Wakeen soils. Runoff is medium. The organic-matter content is moderate. Geary soils and the Wakeen soil have medium natural fertility, whereas Holdrege soils have high natural fertility.

The principal hazard is water erosion. Consequently, these soils are poorly suited to cultivation. Controlling runoff and soil blowing and maintaining fertility are concerns in management.

Dryland management.—Alfalfa, grasses, and wheat are suitable crops. The use of these soils for grain sorghum and corn should be limited. Terraces, grassed waterways, contour farming, mulch tillage, and the use of crop residue are needed to supplement the cropping system.

These soils are suited to pasture, range, windbreak plantings, wildlife, and recreational areas. Leaving a protective cover of grass on the soil after the grazing season reduces the hazard of water erosion on rangeland.

Irrigation management.—These irrigated soils are suited to alfalfa and grasses. They are also suited to corn and grain sorghum if erosion control is practiced. Terraces, contour farming, grassed waterways, and crop residue on the surface help to control erosion. Soil fertility can be improved and maintained by the use of commercial fertilizer and barnyard manure.

The sprinkler system is the best system for irrigating these soils. Because slopes are steep, water erosion caused by rainfall and irrigation is difficult to control. Slopes of more than 8 percent are not suited to irrigation. Irrigation water is to be applied at a carefully controlled rate that does not exceed the intake rate of the soil. If contour bench leveling is installed, furrows and borders can be used for irrigating.

CAPABILITY UNIT IVe-8 DRYLAND

This unit consists of gently sloping and moderately sloping, severely eroded soils of the Coly, Geary, Holdrege, and Wakeen series. These are deep and moderately deep, well-drained soils on uplands. They have a medium-textured and moderately fine textured surface layer and subsoil. Most of the original surface layer and part of the subsoil have been removed mainly by water erosion. Chalky limestone bedrock is at a depth of about 3 feet in the Wakeen soils.

Available water capacity is moderate in the Wakeen soil and high in the rest. All release water readily to plants. Permeability is moderate. Runoff is medium to rapid. The organic-matter content is low, and fertility is low.

The major concerns in management are controlling water erosion and improving fertility. Because the erosion hazard is severe, the use of these soils for cultivated crops is marginal. Increasing the supply of organic matter is essential. Where these soils are cultivated, soil blowing is a hazard.

Alfalfa, grass, and wheat are close-growing crops and are best suited to soils in this capability unit. A cropping system that limits corn and grain sorghum to 1 year, alternating with small grain, alfalfa, and hay, reduces the hazard of erosion. Terraces, contour farming, grassed waterways, crop residue on the surface, and mulch tillage can be used to supplement the cropping practices on these soils.

Soils in this unit are suited to pasture, range, windbreak plantings, wildlife, and recreational areas. The hazard of water erosion can be reduced by converting the entire acreage to grassland. Leaving a cover of grass on the soil after the grazing season helps to reduce the hazard of water erosion.

These soils are not suited to irrigation because the erosion hazard is too severe.

CAPABILITY UNIT Vw-1 DRYLAND

Only Wet alluvial land is in this unit. It is deep, nearly level, medium-textured to fine-textured soil material in depressions and on flat areas of bottom land. It is wet most of the year. The water table fluctuates seasonally from the surface to a depth of 24 inches.

Natural drainage is very poor. Permeability is moderate to very slow. There is little or no runoff.

The major hazard is excessive wetness. This land is not suited to cultivation because it is too wet. Drainage in most areas is not practical. Where the soil is used for wetland wildlife, drainage is not desirable.

Wet alluvial land is used mainly for hay or permanent pasture. Proper stocking and deferred grazing help maintain grass production and prevent the development of boggy areas. Bogs form in pastures and on ranges that are grazed when the water level is at or near the surface. In some areas adjacent to streams, there is little grass because of the dense tree cover. Increasing grass production by seeding to reed canarygrass and similar grasses is a possibility.

This land type is well suited to wildlife. It is also suited to certain species of trees.

CAPABILITY UNIT VIe-1 DRYLAND

The only soil in this unit is Wakeen silt loam, 10 to 31 percent slopes. This is a moderately deep, well-drained soil on uplands. It has a medium-textured surface layer and subsoil. Chalky limestone bedrock is at a depth of about 3 feet.

Permeability is moderate, and available water capacity is moderate. Water is released readily to plants. Runoff is rapid. The organic-matter content is moderate, and natural fertility is medium.

This soil is subject to severe water erosion. Conserving surface water and keeping the grass healthy are concerns in management.

This soil is not suited to cultivation because it is too steep and the hazard of erosion is too great. Cultivated areas can be seeded to native grass and converted to range. Good management is needed in the seeded areas to establish and maintain a good grass cover.

Stockwater dams, erosion control structures, and flood detention reservoirs can be built on the bottoms of the drainageways. This soil is also suited to windbreak plantings and to wildlife and recreational areas.

CAPABILITY UNIT VIe-5 DRYLAND

Inavale fine sand, 0 to 3 percent slopes, the only soil in this unit, is a deep nearly level to very gently sloping, excessively drained soil on bottom land. It has a coarse-textured surface layer and coarse-textured underlying material. Some areas are hummocky.

The coarse-textured surface layer absorbs water readily. Runoff is slow. Permeability is rapid. The available water capacity is low. The organic-matter content is low, and natural fertility is low.

This soil is droughty. If it is overgrazed or the surface is not protected, the hazard of soil blowing is severe. Good range management is needed.

This soil is not suited to cultivated crops because it is too coarse textured and too droughty. A few areas are cultivated, but crops are poor. Cultivated areas can be reseeded to native grass and converted to range. Under good management, fair to good stands of grass can be established.

This soil is also suited to windbreak plantings and wildlife.

CAPABILITY UNIT VIe-9 DRYLAND

This unit consists of soils of the Coly, Geary, and Hobbs series. These soils are on slopes and bottoms of upland drainageways. The Coly and Geary soils are deep, well drained, and moderately steep to steep. They are medium textured in the surface layer and medium to moderately fine textured in the subsoil and underlying material. The deep, nearly level to very gently sloping, moderately well drained Hobbs soils are on the bottoms of the drainageways and are occasionally flooded. They are medium textured in the surface layer and underlying material.

Permeability is moderate. Runoff on the sides of the drainageways is rapid. The available water capacity is high, and moisture is released readily to plants. The organic-matter content is low in Coly soils and high in Geary and Hobbs soils.

These soils are subject to severe water erosion. The soils on bottoms are subject to occasional flooding. Proper range management is needed to keep the grasses healthy and vigorous.

These soils are too steep to be suited to cultivated crops. They are better suited to grazing. Cultivated areas can be seeded to native grass and converted to range. These soils are also suited to windbreak plantings and to wildlife and recreational areas.

Stockwater dams, erosion control structures, and flood detention structures can be built on the bottoms of the drainageways.

CAPABILITY UNIT VIw-1 DRYLAND

This unit consists only of Silty alluvial land. This land is on frequently flooded, narrow bottom land along intermittent and permanent streams. It is nearly level and very gently sloping. The soil material is deep, stratified, predominantly medium textured sediment washed from surrounding uplands.

Permeability is moderate, and available water capacity is high.

The major hazard is frequent flooding in spring and inaccessibility because of the entrenched stream channels.

Silty alluvial land is not suited to cultivation because it is broken into small areas by deeply entrenched stream channels and is frequently flooded. It is better suited to range, windbreak plantings, wildlife, and recreation.

Nearly all areas are used for range and grazed by livestock. Proper range management helps to maintain the vigor of the grasses. In many areas, grass is sparse because of the numerous native trees.

Erosion control structures can be built on carefully selected sites. Large floodwater detention structures can reduce flooding on the areas below the structures.

CAPABILITY UNIT VIs-4 DRYLAND

In this unit are the shallow soils of the Kipson and Meadin series. These moderately sloping to steep soils are on uplands. They are excessively drained and somewhat excessively drained. They have a medium-textured surface layer and medium to moderately coarse textured underlying material. Kipson soils have chalky limestone bedrock at a depth of 7 to 20 inches. Meadin soils have mixed sand and gravel at a depth of 10 to 20 inches.

Permeability is moderate to rapid. Available water capacity is low. Runoff is rapid on Kipson soils and slow on Meadin soils. The organic-matter content is moderate to low. Natural fertility is medium to low.

The principal hazard is droughtiness. Soil blowing is a hazard where the vegetation is sparse or destroyed. Improving the stand of grasses and keeping them vigorous are the main concerns in management.

These soils are suited to range, and most of the acreage is used for this purpose. They are well suited to wildlife and recreational areas. Trees can be grown in the bottoms of some of the drainageways. Hand planting is needed on some of the steeper slopes. Cultivated areas can be seeded to a mixture of native grasses and converted to range. Grazing can be controlled on both native grass and seeded areas so that at least half of each year's growth is left on the surface as mulch.

CAPABILITY UNIT VIIe-1 DRYLAND

Only Rough broken land, loess, is in this unit. It is deep, medium textured, and excessively drained, and is on very steep bluffs and in canyon areas. Catsteps are common.

Permeability is moderate, and available water capacity is high. Runoff is very rapid; only a small amount of water enters the soil.

This land is not suitable for cultivation, because it is too steep and erodible. It is suited to range, windbreak plantings, and wildlife.

Most of the acreage is used for grazing. Maintaining a good cover of vigorous grass reduces the hazard of water erosion and conserves moisture on the very steep slopes. Stockwater dams and erosion control structures can be built in bottoms of drainageways.

CAPABILITY UNIT VIIs-3 DRYLAND

This unit consists of Gravelly land and Rough stony land. Both are gently sloping to very steep, very shallow, and excessively drained, and are on uplands. Gravelly land is coarse sand and gravel that is slightly darkened by organic matter in the upper few inches. Rough stony land is very shallow to shallow soil material over chalky limestone and limestone outcrops.

Runoff is very slow on Gravelly land and rapid on Rough stony land. Available water capacity is very low.

The major concerns in management are improving and protecting the grass. These areas are not suited to cultivated crops or trees. They are only suited to range and to wildlife and recreational areas.

Stockwater dams can be built in some areas to provide water for livestock and wildlife.

CAPABILITY UNIT VIIIw-1 DRYLAND

Only Marsh and Sandy alluvial land are in this unit. Marsh is on bottom land where water is at or above the surface most of the year. The soil material ranges from medium textured to fine textured. Sandy alluvial land is water-deposited sand bars and sand flats along the Republican River. It is stratified with moderately coarse textured to very coarse textured sediment. It is frequently flooded. The water table is at or above the surface during periods of high streamflow and at a depth of 1 to 4 feet when the stream is dry.

These areas are not suited to cultivated crops, grazing, or tree plantings. They are suited to wildlife and recreational uses.

Predicted Yields

Predicted average acre yields for the principal crops grown on the arable soils in Webster County are shown in table 2. The predictions are based on information furnished by farmers, ranchers, representatives of the Extension Service and Soil Conservation Service, and others familiar with the soils of the county. The yields represent averages obtained by using tried and proven, modern methods. During periods when rainfall is above average, yields of dryfarmed crops are higher than those listed in the table. Yields are lower than those listed when crops are damaged by hail, disease, insects, or other unpredictable causes. Yields in table 2 are listed under two levels of management. Those in columns A can be expected under average management. Those in columns B represent yields that can be expected under a high level of management.

It is assumed that under average management—

1. Moderate amounts of fertilizer and lime are used, but the nitrogen content of the soil is medium.
2. Organic matter is not always returned to the soil, and the soil is not always kept in good tilth.
3. Erosion control practices are not adequate.
4. Certified seed is not always used.
5. Weeds, insects, and diseases are not adequately controlled.

It is assumed that under high level management—

1. Lime, phosphorus, and nitrogen are applied in quantities indicated by results from soil tests and field experience.
2. Crop residue is returned to the soil to maintain the organic-matter content and to improve tilth.
3. The soils are drained where necessary, and erosion is controlled.
4. Certified seed is used, and plant population is adequate.
5. Weeds, insects, and diseases are controlled.
6. Tillage is adequate and timely.
7. Crops are grown in a suitable sequence.

Management of Soils for Range [4]

Range makes up about 43 percent of the acreage in Webster County. It occurs as scattered areas throughout the county, except for some concentrated areas along the Republican River. The largest areas are in the Holdrege-Coly-Geary and Geary-Holdrege-Kipson soil associations. The soils used for range are generally not suited to cultivation.

The raising of livestock, mainly cow and calf herds, and selling the calves in fall as feeders are the largest farming enterprises in the county.

[4] Prepared by PETER N. JENSEN, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal crops*

[Only arable soils are listed. Dashes indicate that the soil is not suited to the specified crop or that the soil is not generally irrigated]

Soil	Corn				Wheat		Grain sorghum				Alfalfa			
	Dryland		Irrigated		Dryland		Dryland		Irrigated		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Coly silt loam, 3 to 10 percent slopes	----	----	----	----	5	10	8	15	----	----	----	----	----	----
Crete silt loam, 0 to 1 percent slopes	18	27	88	124	22	30	29	45	102	117	1.5	2.0	3.4	4.5
Fillmore silt loam	12	21	76	105	17	26	20	30	84	100	1.5	2.0	3.4	4.5
Geary silt loam, 3 to 7 percent slopes	14	23	83	104	16	24	25	42	85	100	1.4	2.0	2.6	3.1
Geary silt loam, 7 to 10 percent slopes	14	23	45	70	16	24	25	42	55	75	1.4	2.0	2.6	3.1
Geary soils, 3 to 7 percent slopes, severely eroded	8	16	----	----	10	16	12	24	----	----	.8	1.5	----	----
Geary soils, 7 to 10 percent slopes, severely eroded	----	----	----	----	8	12	10	20	----	----	.6	1.2	----	----
Gibbon silty clay loam	43	52	96	128	12	20	46	57	100	116	3.7	4.8	4.6	5.4
Hastings silt loam, 0 to 1 percent slopes	20	30	96	128	22	30	31	46	106	120	1.8	2.3	3.6	4.7
Hastings silt loam, 1 to 3 percent slopes	18	28	91	120	20	28	29	44	98	112	1.6	2.1	3.4	4.5
Hobbs silt loam, occasionally flooded	26	34	85	118	15	22	30	45	100	109	2.5	3.0	4.5	5.3
Holdrege silt loam, 0 to 1 percent slopes	24	33	98	130	22	30	35	50	108	122	2.0	2.5	4.2	5.4
Holdrege silt loam, 1 to 3 percent slopes	22	31	93	122	20	28	33	48	100	114	1.8	2.3	4.0	5.2
Holdrege silt loam, 1 to 3 percent slopes, eroded	22	31	93	122	20	28	33	48	100	114	1.8	2.3	4.0	5.2
Holdrege silt loam, 3 to 7 percent slopes	16	25	83	104	16	24	25	42	85	100	1.4	2.0	2.7	3.2
Holdrege silt loam, 3 to 7 percent slopes, eroded	16	25	80	100	16	24	25	42	80	95	1.4	2.0	2.7	3.2
Holdrege silt loam, 7 to 10 percent slopes	16	25	50	75	16	24	25	42	55	75	1.4	2.0	2.7	3.2
Holdrege soils, 3 to 7 percent slopes, severely eroded	10	20	----	----	12	20	17	35	----	----	1.0	1.8	----	----
Holdrege soils, 7 to 10 percent slopes, severely eroded	8	18	----	----	10	18	17	35	----	----	1.0	1.8	----	----
Hord silt loam, 0 to 1 percent slopes	26	35	100	132	22	30	40	55	110	124	2.3	2.8	4.4	5.6
Hord silt loam, terrace, 0 to 1 percent slopes	26	35	100	132	22	30	40	55	110	124	2.3	2.8	4.4	5.6
Hord silt loam, terrace, 1 to 3 percent slopes	24	33	95	124	22	30	35	50	102	116	2.0	2.5	4.2	5.4
Humbarger silt loam	41	50	88	121	20	28	46	57	101	116	3.7	4.5	4.6	5.4
Inavale loamy fine sand, 0 to 3 percent slopes	9	18	38	62	6	12	12	22	48	70	.4	.8	1.6	3.3
Inavale fine sandy loam, 0 to 3 percent slopes	12	22	42	70	7	14	14	28	50	70	.4	.9	1.6	3.0
McCook silt loam	46	55	90	123	20	28	48	60	103	118	3.7	4.5	4.8	5.6
McCook fine sandy loam	41	50	88	120	18	25	43	54	98	112	3.3	4.0	4.2	5.4
Munjor fine sandy loam, 0 to 3 percent slopes	25	38	68	105	11	20	32	45	68	105	2.4	3.2	3.5	4.3
Munjor loamy fine sand, 0 to 3 percent slopes	12	25	44	84	8	14	16	30	60	81	.5	.9	1.8	3.5
Munjor fine sandy loam, slightly wet variant	35	46	----	----	12	20	40	52	----	----	3.0	4.0	----	----
Roxbury silt loam	28	37	90	123	22	30	40	55	103	118	2.8	3.5	5.2	6.0
Wakeen silt loam, 3 to 10 percent slopes	15	25	83	104	15	24	25	42	85	100	1.4	2.0	2.7	3.2
Wakeen silt loam, 3 to 10 percent slopes, eroded	----	----	----	----	10	16	12	25	----	----	1.0	1.5	----	----

Range sites and condition classes

Different kinds of range produce different kinds and amounts of native grass. For proper range management, an operator needs to know the different kinds of soil, or range sites, in his holding and the native plants that grow on each site. Management can then favor the growth of the best forage plants on each kind of soil.

Range sites are distinctive kinds of range that differ in their ability to produce a significantly different kind and amount of climax or original vegetation. A significant difference is one great enough to require some variation in management, such as a different stocking rate. Climax vegetation is the combination of plants that originally grew on a given site. Ordinarily, it is the most productive combination of range plants on a site.

Range condition is classified according to the percent of vegetation on the site that is original, or climax, vegetation. This classification is used in comparing the kind and amount of present vegetation with that which the site can produce. Changes in range condition result mainly from changes in the intensity of grazing and from drought.

Climax vegetation can be altered by intensive grazing. Livestock graze selectively. They constantly seek the more palatable and nutritious plants. Plants react to grazing in one of three ways. They decrease, increase, and invade. Decreaser and increaser plants are climax plants. Generally, *decreasers* are the most heavily grazed and, consequently, the first to be injured by overgrazing. *Increasers* withstand grazing better because they are less palatable to livestock. They increase under grazing and replace the decreasers. *Invaders* are weeds that become established after the climax vegetation has been reduced by grazing.

Range condition indicates the degree to which the composition of the existing plant community differs from the potential, or the climax, vegetation. Four classes are recognized. The condition is *excellent* if 76 to 100 percent of the vegetation is climax; *good* if 51 to 75 percent is climax; *fair* if 26 to 50 percent is climax; and *poor* if 0 to 25 percent is climax.

Management that maintains or improves range condition is needed on all range land, regardless of other practices used. Such management includes proper grazing use, deferred grazing, and planned grazing systems. The proper distribution of livestock in a pasture can be improved by correctly locating fences, livestock water developments, and salting facilities.

Range seeding establishes native grasses by seeding or reseeding either wild harvest or improved strains on land suitable for use as range. Soils, such as Coly and Hobbs soils, and Wakeen silt loam, 10 to 31 percent slopes, that are still being used as cropland can be range seeded. The most important grasses used in seed mixtures include big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama (fig. 18). No special care other than management of grazing is needed to maintain forage composition.

Descriptions of range sites

The 14 range sites in Webster County are described in the paragraphs that follow. The descriptions include the topography in each site, a brief description of the mapping units in each site, the dominant vegetation on a site in excellent condition, the dominant vegetation on a site in poor condition, and the total annual production in pounds per acre, air-dry weight, for years when rainfall is average and the site is in excellent range condition.

The names of the soil series and land types in a range site are given in the description of the range site, but this does not mean that all the soils of a given series are in that site. To find the names of all the soils in any given site, refer to the Guide to Mapping Units at the back of this survey. Likewise, the range site to which each soil has been assigned can be determined by referring to the Guide to Mapping Units. Marsh and Sandy alluvial land are not assigned to a range site because the vegetation on these land types is not stable.

WET LAND RANGE SITE

This site is nearly level and is on bottom lands of the Republican River and along Farmers Creek. It consists entirely of Wet alluvial land. The water table fluctuates within a depth of 2 feet most of the year and is generally at the surface during the early part of the growing season. The soil ranges widely in texture and is generally calcareous at the surface. The high water table affects the kind of vegetation that grows on this site.

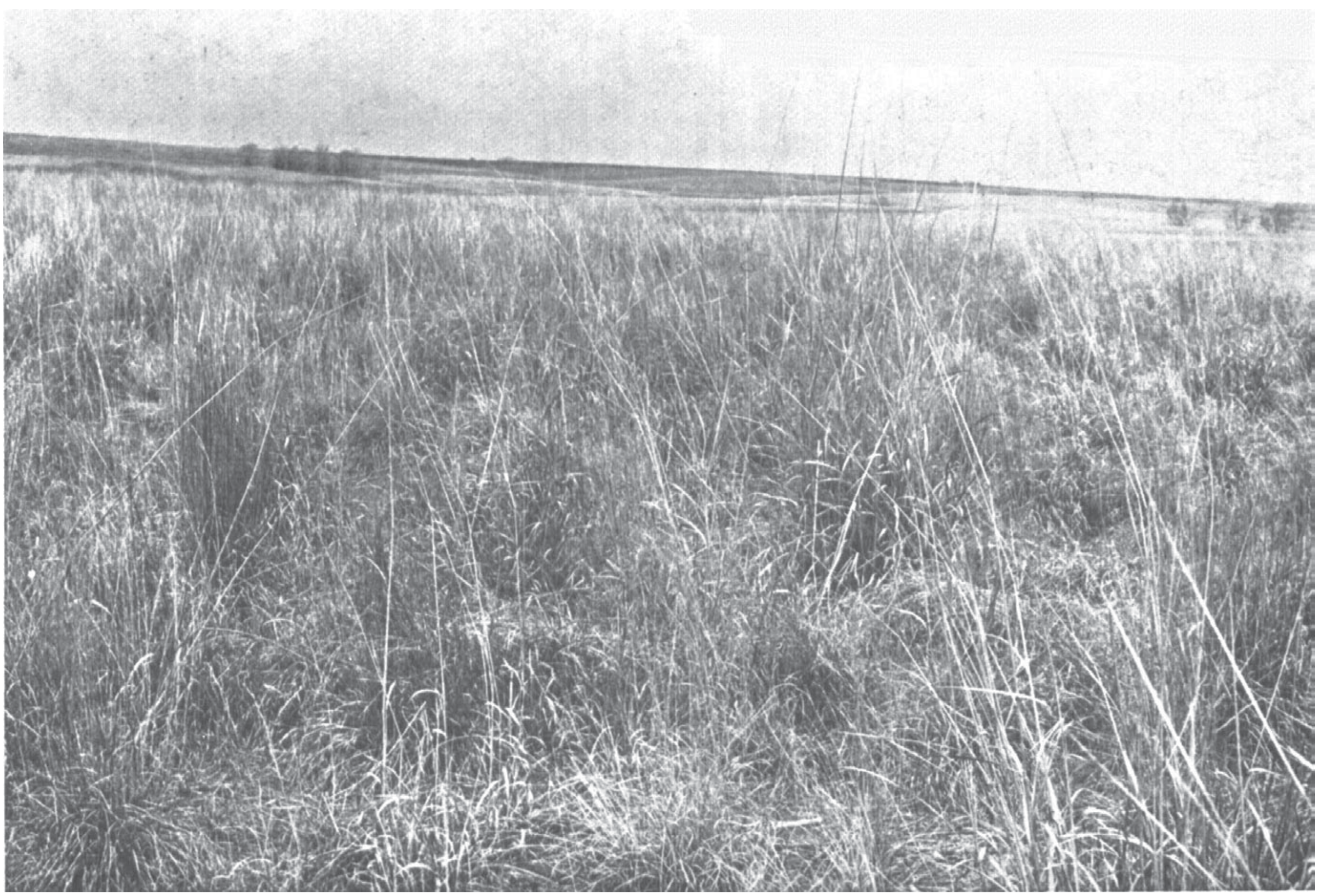

Figure 18.—**Five-year-old stand of native grasses on a Holdrege soil. The dominant grasses are big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama.**

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as prairie cordgrass and reedgrass, and the remaining 35 percent is other perennial grasses and forbs. Varieties of sedge are the principal increasers. The typical plant community on range in poor condition consists of Kentucky bluegrass, willows, and sparse amounts of prairie cordgrass and varieties of sedge.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 6,000 to 7,000 pounds per acre.

SUBIRRIGATED RANGE SITE

This site is on bottom land. It consists of those soils of the Gibbon and Munjor series that have a water table at a depth of 2 to 6 feet. The soils are deep and range widely in texture. They are calcareous at the surface. The moderately high water table affects the kind of vegetation that grows on this site.

At least 75 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, prairie cordgrass, and Canada wildrye, and the remaining 25 percent is other perennial grasses and forbs. Western wheatgrass and varieties of sedge are the principal increasers. The typical plant community on range in poor condition consists of Kentucky bluegrass, foxtail barley, blue verbena, and sparse amounts of western wheatgrass and varieties of sedge.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 5,000 to 6,000 pounds per acre.

SILTY OVERFLOW RANGE SITE

This site is nearly level or very gently sloping and is on bottom lands. It consists of soils of the Hobbs series and Silty alluvial land. All are occasionally or frequently flooded. The surface layer and underlying material range from silt loam to silty clay loam. Water from periodic overflow, runoff from higher lying soils, high available water capacity, and moderate permeability affect the kind of vegetation that grows on this site.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, and Canada wildrye, and the remaining 35 percent is other perennial grasses and forbs. Western wheatgrass, side-oats grama, and varieties of sedge are the principal increasers. The typical plant community on range in poor condition, consists of Kentucky bluegrass, Baldwin ironweed, western wheatgrass, and blue grama.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 4,000 to 4,500 pounds per acre.

CLAYEY OVERFLOW RANGE SITE

This site is nearly level and is in upland depressions. Fillmore silt loam is the only soil in this site. The surface layer is silt loam, and the subsoil is silty clay. This soil is subject to occasional flooding by runoff from higher elevations. Natural drainage is poor. Excess water and slow permeability affect the kind of vegetation that grows on this site.

At least 50 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, Canada wildrye, indiangrass, little bluestem, and switchgrass, and the remaining 50 percent is other perennial grasses and forbs. Blue grama, buffalograss, western wheatgrass, and varieties of sedge are the principal increasers. The typical plant community on range in poor condition, consists of western ragweed, Kentucky bluegrass, Baldwin ironweed, western wheatgrass, blue grama, and buffalograss.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,500 to 3,500 pounds per acre.

SANDY LOWLAND RANGE SITE

This site is nearly level and very gently sloping and is on bottom lands. It consists of well-drained soils of the Munjor series. The surface layer ranges from fine sandy loam to loamy fine sand, and the underlying material is fine sandy loam and fine sand. A water table at a depth of 6 to 10 feet affects the kind of vegetation that grows on this site.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as sand bluestem, indiangrass, switchgrass, little bluestem, needle-and-thread, and Canada wildrye, and the remaining 30 percent is other perennial grasses and forbs. Prairie sandreed, blue grama, sand dropseed, western wheatgrass, and varieties of sedge are the principal increasers. The typical plant community on range in poor condition consists of sand dropseed, blue grama, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,000 to 4,000 pounds per acre.

SILTY LOWLAND RANGE SITE

This site is nearly level and very gently sloping and is on bottom lands or stream terraces. It consists of well-drained soils of the Hord, Humbarger, McCook, and Roxbury series. These soils have a surface layer of silt loam or fine sandy loam. The subsoil and underlying material range from very fine sandy loam to silty clay loam. In some places loamy fine sand and fine sand are below a depth of 40 inches. Additional moisture from runoff, high available water capacity, and moderate or moderately slow permeability affect the kind of vegetation that grows on this site.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, little bluestem, switchgrass, needle-and-thread, and Canada wildrye, and the remaining 30 percent is other perennial grasses and forbs. Blue grama, sand dropseed, side-oats grama, and western wheatgrass are the principal increasers. The typical plant community on range in poor condition consists of Kentucky bluegrass, western wheatgrass, blue grama, Baldwin ironweed, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,500 to 4,500 pounds per acre.

SANDS RANGE SITE

This site is nearly level and very gently sloping and is on bottom land. It consists of those soils of the Inavale series that have a loamy fine sand or fine sand surface layer. The underlying material is fine sand. Soil permeability is rapid. The deep storage of moisture, which is readily given up to plants, affects the kind of vegetation that grows on this site.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as indiangrass, sand bluestem, sand lovegrass, switchgrass, prairie junegrass, and Canada wildrye, and the remaining 40 percent is other perennial grasses and forbs. Blue grama, little bluestem, needle-and-thread, prairie sandreed, sand dropseed, and varieties of sedge are the principal increasers. The typical plant community on range in poor condition consists of sand dropseed, blue grama, western ragweed, and annuals.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,500 to 3,000 pounds per acre.

SANDY RANGE SITE

This site is on bottom land. It consists entirely of Inavale fine sandy loam, 0 to 3 percent slopes. The soil is deep and excessively drained. The underlying material is fine sand. The available water capacity is low. Rapid permeability and excessive drainage affect the kind of vegetation that grows on this site.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as indiangrass, little bluestem, sand bluestem, switchgrass, and needle-and-thread; and the remaining 35 percent is other perennial grasses and forbs. Prairie sandreed, blue grama, sand dropseed, and western wheatgrass are the principal increasers. Blue grama, sand dropseed, sand paspalum, and western wheatgrass are the last climax grasses to disappear in a deteriorated range. The typical plant community on range in poor condition consists of blue grama, sand dropseed, sand paspalum, windmillgrass, and tumblegrass.

If rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,500 to 3,000 pounds per acre.

SILTY RANGE SITE

This site is nearly level to steep and is on uplands. It consists of soils of the Geary, Hastings, Holdrege, Hord, and Wakeen series. All are deep soils except Wakeen, which is moderately deep. The surface layer, subsoil, and underlying material range from silt loam to silty clay loam. Moderate to moderately slow permeability and a moderate to high available water capacity affect the kind of vegetation that grows on this site.

At least 55 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass, and the remaining 45 percent is other perennial grasses and forbs. Blue grama, buffalograss, side-oats grama, and western wheatgrass are the principal increasers. The typical plant community on range in poor condition consists of blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 3,000 to 3,500 pounds per acre.

CLAYEY RANGE SITE

This site is on uplands. It consists entirely of Crete silt loam, 0 to 1 percent slopes. This deep, somewhat poorly drained soil has a silty clay subsoil and silt loam underlying material. The slow permeability of the clayey subsoil affects the kind of vegetation that grows on this site.

At least 45 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, Canada wildrye, indiangrass, little bluestem, and switchgrass; the remaining 55 percent is other perennial grasses and forbs. Blue grama, buffalograss, tall dropseed, and western wheatgrass are the principal increasers. The typical plant community on range in poor condition consists of buffalograss, blue grama, blue verbena, western wheatgrass, and cool-season annual grasses.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,500 to 3,000 pounds per acre.

LIMY UPLAND RANGE SITE

This site is gently sloping to steep and is on uplands. This site consists of soils of the Coly series. These soils are deep, well drained, and have a silt loam texture throughout the profile. They formed in loess and are limy at or near the surface. The ability of these soils to absorb water easily and release it readily to plants and their limy condition affect the kind of vegetation that grows on this site.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, and indiangrass, and the remaining 40 percent is other perennial grasses and forbs. Blue grama, buffalograss, and side-oats grama are the principal increasers. The typical plant community on range in poor condition consists of blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,000 to 2,500 pounds per acre.

SHALLOW TO GRAVEL RANGE SITE

This site is gently sloping to steep and is on stream terrace breaks and uplands. It consists of Meadin loam, 8 to 31 percent slopes, and Gravelly land. The soil is very shallow and shallow over mixed sand and gravel and is excessively drained. Permeability in the underlying material is moderately rapid to rapid. The kind of vegetation that grows on this site is affected by the low and very low available water capacity, which makes the soils droughty, and the sand and gravel underlying material, which limits effective root development.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, sand bluestem, little bluestem, side-oats grama, and prairie sandreed, and the remaining 40 percent is other perennial grasses and forbs. Blue grama, sand dropseed, western wheatgrass, and varieties of sedge are the principal increasers. The typical plant community on range in poor condition consists of blue grama, sand dropseed, broom snakeweed, western ragweed, and plains pricklypear.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 1,500 to 2,000 pounds per acre.

SHALLOW LIMY RANGE SITE

This site is moderately sloping to steep and is on uplands. It consists of Kipson silt loam, 7 to 31 percent slopes, and Rough stony land. The soil material is very shallow or shallow over limestone bedrock. The surface layer is mainly silt loam. Runoff is medium to very rapid. The kind of vegetation that grows on this site is affected by the low and very low available water capacity, the droughty nature of the soil, and the depth to bedrock, which limits effective root development.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, side-oats grama, switchgrass, and plains muhly, and the remaining 30 percent is other perennial grasses and forbs. Blue grama, hairy grama, and sand dropseed are the principal increasers. The typical plant community on range in poor condition consists of blue grama, hairy grama, sand dropseed, broom snakeweed, and plains pricklypear.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 2,000 to 2,500 pounds per acre.

THIN LOESS RANGE SITE

This site is very steep and on uplands. It consists entirely of Rough broken land, loess. The soil material is very weakly developed, silty, and well drained. There are many catsteps. The kind of vegetation that grows on this site is affected by steep slopes, excessive runoff, lack of soil development, and limy conditions.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, side-oats grama, switchgrass, and plains muhly, and the remaining 35 percent is other perennial grasses and forbs. Blue grama, sand dropseed, and western wheatgrass are the principal increasers. The typical plant community on range in poor condition consists of blue grama, sand dropseed, broom snakeweed, and various annuals.

If the rainfall is average and the site is in excellent condition, the total annual production of air-dry herbage is 1,500 to 2,500 pounds per acre.

Management of Soils for Windbreaks[5]

Native woodland in Webster County is limited to narrow strips along the larger streams. The most extensive stand is on bottom lands of the Republican River on McCook and Munjor soils. This stand is dominantly an even-aged stand of cottonwood and an understory of boxelder. Forested strips are along Oak, Liberty, Indian, Crooked, Willow, Elm, Beaver, and Walnut Creeks and the Little Blue River. Typical soils supporting this growth are Hobbs, Hord, and McCook soils.

Some of the smaller streams south of the Republican River have limited amounts of native timber. These stands grow mostly on Silty alluvial land and Hobbs soils. The species vary from stream to stream but generally are cottonwood, boxelder, American elm, green ash, hackberry, willow, and native shrubs.

A small area of bluffs south of the Republican River is made up mainly of Rough broken land, loess, which supports a stand of scrubby bur oak. Buffaloberry, skunkbush sumac, smooth sumac, American plum, and coralberry grow in the Silty alluvial land of the canyon floor.

Native trees and shrubs contribute a great deal to the natural beauty of the Webster County landscape, and their presence benefits wildlife by providing food and cover. Other economic value is limited. Native trees provide some shelter for livestock. Some are used for poles and posts, and a few are used for fuel.

The most important use of trees in Webster County is for windbreaks. Because of the scarcity of native trees and the severe extremes of weather, windbreaks are needed in the county for farmstead, livestock, and soil protection.

The landowner who plants a windbreak is compensated for his time and expense. Windbreaks help to reduce home heating costs, control snow drifting (fig. 19), provide shelter for livestock, improve conditions for wildlife, and beautify the home and countryside. Munjor, Inavale, and other soils that are subject to soil blowing can benefit significantly from the protection of field windbreaks.

Though trees are not easily established in the county, the observance of basic rules of tree culture can result in a high degree of tree survival. Healthy seedlings of an adapted species, properly planted on a prepared site and maintained in good condition, can survive and grow well. They require care after planting if they are to survive.

Management of windbreaks can be planned more effectively if soils are grouped according to those characteristics that affect growth of trees. The soils of Webster County have been assigned to four windbreak groups. The soils in each group are about the same in suitability for specified trees, potential productivity, and management requirements.

Table 3 shows the relative vigor and the expected height, by windbreak groups, of trees at 20 years of age that are suitable for windbreaks in this county. Detailed tree measurements were taken on soils of the major windbreak groups.

The ratings given in table 3 are based on observations of the general vigor and condition of the trees. A rating of *excellent* indicates that the trees are growing well, the leaves have good color, there are no dead branches in the upper part of the crown, and there is no indication of damage by fungi or insects. A rating of *good* indicates that the trees are growing moderately well, there are only a few dead branches and some die-back in the upper part of the crown, and there is slight indication of damage by fungi or insects. A rating of *fair* indicates that at least half of the trees have a significant number of dead branches in the upper part of the crown, that about one-fourth of the trees are dead, the growth has slowed significantly, and that there are indications of moderate damage by fungi or insects. A rating of *poor* indicates that the remaining living trees have had severe die-back, more than one-fourth of the trees in the stand are dead, and there are indications of severe damage by fungi or insects.

The conifers, cedar and pine, are best suited to windbreaks. Measurements show that eastern redcedar and ponderosa pine, both native Nebraska species, are the most reliable windbreak species. Both are rated high in vigor and survival. They hold their leaves through the winter, thereby providing maximum protection when it is most needed.

Table 3 also shows several broadleaf trees that are well suited to windbreaks. The best are honeylocust, green ash, hackberry, and mulberry. Suitable shrubs are lilac, bush honeysuckle, American plum, and chokecherry.

[5] Prepared by GEORGE W. ALLEY and JAMES W. CARR, JR., foresters, Soil Conservation Service.

Figure 19.—A conifer, such as eastern redcedar shown here, can be included in every windbreak. Conifers trap snow within the windbreak. The area this windbreak was designed to protect is relatively free of snow.

TABLE 3.—*Relative vigor and estimated height, by*

[Very Wet, Shallow, and Undesirable windbreak groups are not listed because the

Windbreak group	Eastern red cedar		Ponderosa pine		Green ash		Hackberry	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Ft.		*Ft.*		*Ft.*		*Ft.*
Silty to clayey	Excellent	19	Excellent	22	Good	22	Good	22
Sandy	Excellent	19	Excellent	25	Excellent	24	Good	21
Very sandy	Excellent	19	Excellent	27	Excellent	23	Fair	16
Moderately wet	Excellent	18	Poor	(2)	Good	21	Good	(1)

1 Sufficient data unavailable.
2 Most of the trees are dead or dying.

Eastern redcedar can be expected to grow slightly less than a foot a year. It reaches a height of 25 to 35 feet at maturity. Ponderosa pine and broadleaf trees grow slightly faster and are generally somewhat taller at maturity.

Rate of growth in a windbreak varies widely with the soil and moisture conditions. Soil fertility, exposure, and arrangement of species within the planting have a marked effect on growth. Some species grow faster than others. Some make an early fast growth but tend to die young. This is sometimes true of cottonwood. Siberian elm and Russian-olive are vigorous early growers. They can, however, spread where they are not wanted and can be short lived. Boxelder and mulberry commonly freeze back in severe weather, and green ash is susceptible to damage by borers.

The intended purpose of the windbreak should be considered. Specific information on design, establishment, and care of windbreaks is available from the Soil Conservation Service and Extension Service forester serving the county.

The windbreak groups in Webster County are described briefly in the paragraphs that follow. The names of the soils series in a windbreak group are given in the description of the group, but this does not mean that all the soils of a given series appear in the group. To find the names of all the soils in any given group, refer to the Guide to Mapping Units at the back of this survey.

SILTY TO CLAYEY WINDBREAK GROUP

This group consists of those soils of the Coly, Crete, Geary, Hastings, Holdrege, Hord, Humbarger, McCook, Roxbury, and Wakeen series that have a medium textured and moderately fine textured surface layer. Rough broken land, loess is also in this group. These soils are nearly level to very steep and are on uplands, bottom land, and stream terraces. All are deep except for Wakeen soils, which are moderately deep. The subsoil and underlying material are mainly medium textured and moderately fine textured. Crete soils have a fine-textured, claypan subsoil.

These soils generally are good for tree plantings and have a good capability for survival and growth of adapted species. Droughtiness and moisture competition from weeds and grass are the principal hazards. Water erosion is a hazard on the gently sloping to very steep soils. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, ponderosa pine, Rocky Mountain juniper, Austrian pine, Scotch pine
Low broadleaf—Russian mulberry
Tall broadleaf—hackberry, honeylocust, bur oak, green ash, boxelder
Shrubs—lilac, cotoneaster, honeysuckle, chokecherry, American plum

SANDY WINDBREAK GROUP

This group consists of soils in the Inavale, McCook, and Munjor series. These deep, nearly level and very gently sloping soils are on bottom land. The surface layer ranges from moderately coarse textured to coarse textured.

These soils are suited to tree plantings if soil blowing is controlled by maintaining strips of sod or other vegetation between the tree rows. Cultivation generally needs to be restricted to the tree rows. Drought and moisture competition from grass and weeds are hazards. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine
Low broadleaf—Russian mulberry, boxelder
Tall broadleaf—honeylocust, green ash
Shrubs—lilac, cotoneaster, skunkbush sumac, American plum

VERY SANDY WINDBREAK GROUP

The only soil in this group is Inavale fine sand, 0 to 3 percent slopes. This nearly level and very gently sloping coarse-textured soil is on bottom land. Permeability is rapid, and available water capacity is low.

This soil is so loose that trees are to be planted in shallow furrows and not cultivated. Young seedlings can be blown over during high winds and covered by drifting sand. The following trees are suitable for planting.

Confers—eastern redcedar, Rocky Mountain juniper, Austrian pine, Scotch pine, ponderosa pine

MODERATELY WET WINDBREAK GROUP

This group consists of Silty alluvial land, soils of the Hobbs, Fillmore, and Gibbon series, and the Munjor, slightly wet variant soils. All are occasionally flooded or have a moderately high water table. These deep soils are in upland depressions, drainageways, and on bottom lands.

windbreak groups, of specified trees at 20 years of age

need for windbreaks on these soils is uncommon in Webster County]

Honeylocust		Cottonwood		Russian-olive		Boxelder		Russian mulberry	
Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
	Ft.		*Ft.*		*Ft.*		*Ft.*		*Ft.*
Excellent	25	Fair	50	Fair	17	(1)	(1)	Excellent	20
Good	22	Good	48	Fair	23	Excellent	24	Excellent	15
Good	16	Excellent	45	Fair	17	Fair	17	Good	17
Good	(1)	Good	52	Poor	(2)	Excellent	18	Excellent	27

They are nearly level to very gently sloping. They have a surface layer that ranges from moderately fine textured to moderately coarse textured. The subsoil of the Fillmore soil is fine textured. The other soils have underlying material that is medium textured to moderately coarse textured.

These are good soils for tree plantings if the species selected can tolerate occasional wetness. Establishment of trees during wet years, cultivation between the tree rows, and moisture competition from the abundant and persistent herbaceous vegetation are concerns in management. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Austrian pine
Low broadleafs—Russian mulberry
Tall broadleafs—honeylocust, green ash, cottonwood, golden willow, white willow
Shrubs—redosier dogwood, buffaloberry, chokecherry, American plum

VERY WET WINDBREAK GROUP

Wet alluvial land is the only mapping unit in this group. It is nearly level and very gently sloping. The water table fluctuates seasonally within a depth of 2 feet. The soil material is fine textured to medium textured.

Only those trees and shrubs that are tolerant of a high water table are suitable for planting.

Low broadleaf—diamond willow
Tall broadleaf—white willow, golden willow, cottonwood
Shrubs—redosier dogwood, buffaloberry

SHALLOW WINDBREAK GROUP

This group consists of soils in the Kipson and Meadin series. These moderately sloping to moderately steep soils are 10 to 20 inches deep over bedrock or mixed sand and gravel. They have a medium-textured surface layer. The available water capacity is low. Drainage is somewhat excessive to excessive.

A limited root zone and a low available water capacity are the main hazards. Drought damages trees during most years. The conifer eastern redcedar is the only species suitable for planting.

UNDESIRABLE WINDBREAK GROUP

This group consists of Gravelly land, Marsh, Rough stony land, and Sandy alluvial land. These land types have features that cover a wide range in soil depth, texture, wetness, slopes, and permeability.

The soil material in these land types is too shallow, too wet, or too gravelly for tree planting machinery. It is also too droughty or too wet for good survival and growth of most trees and shrubs. Willows and cottonwoods grow fairly well in areas of Marsh and Sandy alluvial land.

If the trees are hand planted, some areas are suitable for species that are tolerant of droughtiness. Some trees can be planted in recreational areas, and some can be planted for wildlife.

Management of Soils for Wildlife[6]

Wildlife management requires a knowledge of soils and the kind of vegetation they are capable of producing. The kind, amount, and distribution of vegetation largely determine the kind and number of wildlife that can be produced and maintained.

Soil characteristics affect the wildlife carrying capacity of an area. Fertile soils generally produce more wildlife. Water drained from such soils usually produce more fish than water from infertile soils.

Soil topography affects wildlife through its influence on how land can be used. Rough, steep land presents hazards to livestock and is impractical to cultivate. Undisturbed vegetation on these sites is beneficial to wildlife and where such cover is lacking, it can often be developed.

Permeability and rate of water infiltration are important soil characteristics in the construction of ponds for fish and in developing and maintaining wetland habitat for waterfowl. Marsh areas are suited to the development of aquatic and semiaquatic habitat for waterfowl and some furbearers.

Soils that have the largest wildlife populations do not rate highest on the potential for producing wildlife (see table 4). The better soils for farming are intensively managed for maximum crop production rather than for wildlife.

In table 4 the soil associations are rated for major wildlife habitat and kinds of habitat are rated for kinds of game. For the locations of the associations refer to the General Soil Map. For information on the kinds of vegetation that can be produced on the soils in each association, refer to Descriptions of the Soils. The ratings *well suited*, *suited*, *poorly suited*, and *unsuited* are based on the potential of the soils in the association for producing the kinds of vegetation needed for wildlife habitat. A rating of *high* or *medium* indicates that the specified kind of vegetation is considered essential habitat for that particular kind of game.

The Hastings-Hord-Holdrege association, the Holdrege-Coly-Geary association, and the Hord association provide some of the best habitat for pheasants in Webster County. Production of sorghum, corn, wheat, and alfalfa provides an excellent supply of food for this species and wheatfields provide nesting areas that are generally undisturbed until after the peak of the pheasant hatch has passed.

Soils in the Hastings-Hord-Holdrege association and the Hord association are nearly level and very gently sloping. Thus, odd areas suitable for producing permanent wildlife cover are scarce. Fields are generally large and good interspersion of different habitat types is lacking. The Holdrege-Coly-Geary association has steeper slopes and, therefore, a better interspersion of habitat types. This soil association also has numerous sites suitable for constructing dams and ponds. Some of these ponds are suitable for producing fish. The amount of clay, however, held in suspension in the water is a limitation.

The Meadin-Geary association is limited in size and is important mainly for wildlife that require a grassland type of habitat. Production of crops on the better soils provides a food supply of waste grain for some species of wildlife. Where the nature of the soil and topography is such that crops cannot be grown or cattle grazed, natural vegetation provides good wildlife habitat.

Some of the better bobwhite quail habitat in Webster County is found in the Geary-Holdrege-Kipson association. The topography of this association provides odd

[6] Prepared by ROBERT J. LEMAIRE, conservation biologist, and JAMES W. CARR, JR., forester, Soil Conservation Service.

TABLE 4.—*Soil associations rated for major kinds of wildlife habitat, and wildlife habitat rated for kinds of game*

SOIL ASSOCIATION RATINGS FOR KINDS OF HABITAT

Soil associations	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat
1. Hastings-Hord-Holdrege	Well suited	Well suited	Well suited	
2. Holdrege-Coly-Geary	Well suited	Well suited	Well suited	
3. Meadin-Geary	Well suited to poorly suited.	Well suited to poorly suited.	Well suited to poorly suited.	
4. Geary-Holdrege-Kipson	Well suited to poorly suited.	Well suited to suited	Well suited to unsuited	
5. McCook-Munjor-Gibbon	Well suited	Well suited	Well suited to poorly suited.	Suited.
6. Hord	Well suited	Well suited	Well suited	

WILDLIFE HABITAT RATINGS FOR KINDS OF GAME

Kinds of game	Woody plants		Herbaceous plants		Grain and seed crops	
	Food	*Cover*	*Food*	*Cover*	*Food*	*Cover*
Pheasant	Low	High	High	High	High	High.
Bobwhite quail	Low	High	High	High	High	Low.
Deer	High	High	Medium [1]	Low	High	Low.
Waterfowl					High [2]	

[1] Medium for white-tailed deer; high for mule deer.
[2] For dabbling ducks and geese, principally in spring and fall.

areas of natural vegetation in various stages of plant succession that supply both food and cover. The production of wheat and alfalfa in relatively small fields interspersed with pasture and wooded draws further enhances the habitat of this association for quail.

Although water is scarce for some furbearers, the Geary-Holdrege-Kipson association is suitable habitat for raccoon, coyote, and opossum. Squirrels and cottontail rabbits are adequately provided for by the wooded areas in the deeper draws. These areas also provide suitable conditions for deer.

The most important fishery in Webster County is in McCook-Munjor-Gibbon association, on the Republican River. Channel catfish is the most important species taken. Bullhead and carp are also found here. The river provides fishing throughout its entire length in this county, but the diversion dam just west of Guide Rock is a preferred spot. The highly productive bottom land of this soil association provides food and cover for a number of nongame and game species. The latter includes deer, bobwhite quail, pheasants, squirrels, and cottontail rabbits. Furbearers, such as mink and muskrat, also inhabit the area. Marshy areas in this association and the river are used by waterfowl primarily during spring and fall migrations. The main east to west highway through Webster County passes through this association. This transportation route enhances opportunities for developing outdoor recreation facilities by providing convenient access. The timber, water, and wildlife provide excellent opportunities for using land in this association for outdoor recreation. There are also some historic sites that add interest to using the land for recreation enterprises.

Wildlife is a product of soil and water, and each individual area has a certain capacity for the production of this resource, which is dependent on the habitat provided. Where grassland is put into crop production, there is a loss of cover for some kinds of animals. In turn, an improved food supply is made available for others.

Where trees and shrubs are planted for field and farmstead windbreaks another requirement of some species of wildlife is met. Construction of farm ponds can provide additional opportunities for improving habitat for wildlife. Herbaceous and woody plantings around ponds supply cover for wildlife, and proper stocking and management produce sustained annual quantities of fish.

Some areas of land are more suited to wildlife production than to the production of crops. By protecting existing natural cover or by establishing needed cover, conditions are improved for the production and maintenance of any wildlife species.

Developing habitat for wildlife requires proper location and distribution of vegetation. Technical assistance in planning wildlife developments and determining which species of plants to use can be obtained from the Soil Conservation Service in Red Cloud, Nebr. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, the Bureau of Sport Fisheries and Wildlife, and from the Federal Extension Service. The Soil Conservation Service provides technical assistance in planning and applying conservation measures for developing outdoor recreational facilities.

Engineering Uses of Soils [7]

This section is useful to those who need information about soils used as structural material or as foundations

[7] This section was prepared by JOHN E. OVERING, area engineer, and HARRY E. PADEN, soil scientist, Soil Conservation Service, with the assistance of ROBERT J. FREDERICKSON, civil engineer, Soil Conservation Service and WILLIAM J. RAMSEY, Division of Materials and Tests, Nebraska Department of Roads.

upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are particle size, permeability, shear strength, compressibility, compaction characteristics, and plasticity. Site conditions, such as depth to the water table, depth to sand and gravel, and topography, are also important. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this survey can help in determining—

1. Possible residential, industrial, commercial, and recreational sites.
2. Preliminary routes for highways, underground utilities, and airport locations.
3. Possible sites for drainage systems, irrigation systems, farm ponds, and sewage and feedlot runoff disposal systems.
4. Sites for borrow materials for highway embankment and for highway subbase, base, and surface courses.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, results of engineering laboratory tests on soil samples; estimated soil properties significant to engineering; and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 6 and 7, and it also can be used to make other useful maps.

The engineering interpretations reported here do not eliminate the need for detailed field investigations at the site of specific engineering works. This is particularly important in areas involving heavy loads, and where excavations are deeper than the depths of layers here reported. The estimates generally are to a depth of 5 feet and interpretations normally do not apply to greater depths.

Small areas of other soils are included in the mapping units. The soil map is useful in planning foundation investigations and indicating the kind of problems that may be expected. All the soils of Webster County but Kipson and Wakeen soils are deep enough that bedrock does not affect their use.

Terms in this publication are those used by soil scientists and are defined in the Glossary. Engineering terminology is explained under Engineering Classification Systems and Engineering Interpretations of Soils.

Engineering classification systems

Soils are classified in order that people can communicate in common terms. Two systems of soil classification widely used for engineering purposes are described in the following paragraphs. The relationship between these two classification systems and the USDA textural classification is indicated in table 6.

In the AASHO system (*1*), seven groups of soils are classified on the basis of field performance.

The groups are classified from A–1, sands and gravel that have a high bearing capacity, to A–7, clays that have low bearing capacity when wet. A–1, A–2, and A–3 soils are mostly sand and gravel mixtures, while A–4 through A–7 soils are mostly silt-clay mixtures. The probable performance of the soil on the site is indicated by a group index number.

A sand-silt-clay soil is further classified by identifying the silt-clay portion. Thus, an A–2–4 soil is an A–2 sand that has an A–4 type of silt-clay mixture.

The group index number, shown in parentheses in table 5 ranges from 0 to 20 and is a rating of field performance of the soil. Thus, an A–2–4 (0) soil is one of the best for highway construction. A group index number of 20 would be one of the least desirable soils for highway location or construction.

The Nebraska Department of Roads uses a group index of −4 to 32 instead of 0 to 20. This enlarged group index bracket allows the plastic and nonplastic fine-grained soil in sands to be evaluated and the effect of a high clay content, a group index greater than 20, to be determined.

Many organizations, including the Soil Conservation Service, U.S. Bureau of Reclamation, Corps of Engineers, and other engineers, use the Unified system (*9*). Soils are classified generally as coarse grained, fine grained, and organic or peat.

Fine-grained soils are classified according to plasticity characteristics. Coarse-grained soils are classified primarily according to gradation, and organic soils are classified according to odor and plasticity change after oven drying.

Combinations of letters are used to identify soil materials and certain properties in the Unified System. G is used for gravel, S for sand, C for clay, M for silt, W for well graded, P for poorly graded, L for low liquid limit, and H for high liquid limit.

Two letters are combined to classify the soil; for example, SP is a sand, poorly graded; CL is a clay of low plasticity; and GC is a gravel-clay mixture. There are twelve possible inorganic classifications, and three possible organic classifications. Organic (OL and OH) and peat (Pt) soils are uncommon in Nebraska.

In tables 5 and 6, the soils of Webster County are classified as SP, SW, SP–SM, SP–SC, SM, ML, CL, and CH. Soils that have borderline characteristics of two classifications are given a dual classification.

Engineering test data

Table 5 shows engineering test data for nine soil series, represented by 23 soil samples. The tests were made by the Division of Materials and Tests, Nebraska Department of Roads, according to standard procedures of the American Association of State Highway Officials.

Each soil listed in table 5 was sampled at only one location, and the data given for the soil are those at the location. From one location to another, a soil can differ considerably in characteristics that affect engineering. Even where soils are sampled at more than one location, the test data probably do not show the widest range in characteristics.

Moisture-density, or compaction, data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed maximum dry density. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state, and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

The mechanical analysis was made by a combination of the sieve and hydrometer methods. The engineering classifications in the last two columns of table 5 are based on data obtained by mechanical analysis and on tests to determine the liquid limit and plastic limit.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 6. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Depth to sand, or mixed sand and gravel, or bedrock is distance from the surface of the soil to the upper surface of the sand, or mixed sand and gravel, or rock layer.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms take into account relative 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 the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary. The AASHO and Unified engineering classifications are also given in this table.

The estimates in table 6 were based on the engineering test data in table 5 and on other information obtained in the county during the survey. The data are listed by strata that have properties significant to engineering. These data include the textural classification of the United States Department of Agriculture and the AASHO and Unified engineering classifications. Also listed for each layer are the percentages of material that will pass a No. 4 sieve, a No. 10 sieve, a No. 40 sieve, a No. 200 sieve, and the percent finer than 0.002 millimeter as determined by the hydrometer method. Estimates of the percentage passing the sieves are based on the assumption that material up to and including 3 inches in diameter equals 100 percent. There are no soils in Webster County that have a significant percentage of coarse materials greater than 3 inches.

In the AASHO and Unified systems, soil particles retained on the number 200 sieve are classified as sand and gravel. Silt and clay particles will pass through this sieve. The range of values shown in table 6 for the percentage of soil finer than 0.002 millimeter represents the estimated clay fraction of the soil. Silt and clay particles affect such properties as strength, permeability, compaction, and shrink-well potential.

In tables 5 and 6 the clay percentage is based on an analysis that uses the hydrometer method (AASHO Designation T–88). This can give results that differ slightly from those obtained with the pipette method used by SCS soil scientists to obtain results with standard soil survey procedures.

Permeability is that quality of a moist soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

A generalized rating for shrink-swell potential is given in table 6. Several soils, such as those in the Crete, Fillmore, and Hastings series, have moderate to high shrink-swell potential. Generally, soils with a high clay content undergo a volume change when the soil moisture is changed. Clean sands and gravels undergo little or no volume change on wetting or drying.

Soil dispersion is not a serious problem because few areas contain enough salts to produce moderate dispersion. Salinity is generally not a problem.

Reaction of a soil is the degree of acidity or alkalinity, expressed as a pH value or reaction class. A soil with a value of 7.0 is neutral; one with a lower value is acid, and a soil with a pH greater than 7.0 is alkaline. In Webster County, soil materials which have approximate pH values greater than 7.8 or less than 6.3 need to be investigated for potential corrosive hazard to metal structures. The reaction for most horizons of the typical profile is in the section Descriptions of the Soils. Soils used as construction materials, when moist or wet, need to be tested for corrosive potential.

TABLE 5.—*Engineering*

[Tests performed by the Nebraska Department of Roads in cooperation with U.S. Department of Commerce, Bureau of Public

Soil name and location	Parent material	Report number	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			Inches	*Pounds/cubic foot*	*Percent*
Coly silt loam:					
0.6 mile north and 130 feet west of southeast corner of section 23, T. 4 N., R. 11 W. (Modal profile).	Peoria loess.	S63-8420	0-7	98	22
		S63-8421	11-60	106	19
Crete silt loam:					
0.12 mile east and 180 feet south of northwest corner of section 16, T. 4 N., R. 11 W. (Modal profile).	Peoria loess.	S63-8417	0-7	105	19
		S63-8418	13-23	94	25
		S63-8419	35-60	104	20
Geary silt loam:					
0.25 mile west and 50 feet south of northeast corner of section 2, T. 1 N., R. 10 W. (Minimal development).	Loveland loess.	S63-8424	0-8	104	19
		S63-8425	28-60	112	17
Hastings silt loam:					
0.42 mile north and 54 feet east of southwest corner of section 26, T. 4 N., R. 10 W. (Modal profile).	Peoria loess.	S63-8429	5-12	102	20
		S63-8430	16-21	96	24
		S63-8431	33-60	104	21
Holdrege silt loam:					
0.3 mile south and 190 feet west of northwest corner of section 2, T. 1 N., R. 10 W. (Maximal development).	Peoria loess.	S63-8437	0-16	107	18
		S63-8438	22-30	97	23
		S63-8439	36-60	104	20
Hord silt loam, terrace:					
0.3 mile north, 400 feet east, and 400 feet north of southwest corner of section 21, T. 4 N., R. 12 W. (Minimal development).	Alluvium.	S63-8426	7-18	106	19
		S63-8427	28-37	109	16
		S63-8428	37-60	103	20
Kipson silt loam:					
0.3 mile east and 0.25 mile south of northwest corner of section 25, T. 1 N., R. 11 W. (Modal profile).	Niobrara chalkrock.	S63-8422	0-9	102	20
		S63-8423	15-60	103	22
McCook silt loam:					
0.3 mile south and 250 feet east of northwest corner of section 12, T. 1 N., R. 11 W. (Modal profile).	Mixed alluvium.	S63-8432	0-12	108	17
		S63-8433	12-21	108	22
		S63-8434	43-60	108	15
Meadin loam:					
0.2 mile east and 525 feet north of southwest corner of section 16, T. 2 N., R. 12 W. (Modal profile).	Pleistocene sand and gravel.	S63-8435	0-14	120	12
		S63-8436	14-60	115	11

[1] Based on AASHO Designation: T 99-57, Method A (*1*).

[2] Mechanical analysis according to AASHO Designation: T 88-57(1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser

test data

Roads (BPR), in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—							
1 in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO	Unified [3]
										Percent			
------	------	--------	--------	--------	99	94	50	29	23	46	21	A-7-6(14)	ML or CL
------	100	97	95	96	95	92	54	28	17	40	17	A-6(11)	CL
------	------	--------	--------	--------	99	90	43	26	19	32	10	A-4(8)	ML or CL
------	------	--------	--------	--------	99	95	63	47	43	61	41	A-7-6(20)	CH
------	------	--------	--------	--------	99	94	56	30	23	42	18	A-7-6(12)	ML or CL
------	------	--------	100	99	94	84	41	24	22	38	17	A-6(11)	CL
------	------	--------	100	95	80	66	40	25	23	43	23	A-7-6(14)	CL
------	------	--------	--------	--------	100	91	55	31	24	37	15	A-6(10)	CL
------	------	--------	--------	--------	100	94	64	47	44	60	37	A-7-6(20)	CH
------	------	99	99	98	97	89	54	24	15	39	14	A-6(10)	ML or CL
------	------	--------	--------	100	99	93	33	18	16	36	12	A-6(9)	ML or CL
------	------	--------	--------	100	99	90	64	44	38	59	34	A-7-6(20)	CH
------	------	--------	100	99	98	90	51	22	13	38	14	A-6(10)	ML or CL
------	------	--------	--------	--------	99	90	47	24	19	37	13	A-6(9)	ML or CL
------	------	--------	--------	--------	98	90	35	17	13	29	6	A-4(8)	ML or CL
------	------	--------	--------	--------	99	87	58	33	24	38	17	A-6(11)	CL
------	------	100	99	97	78	68	29	16	11	41	14	A-7-6(10)	ML or CL
------	------	96	89	77	61	56	45	34	24	35	14	A-6(10)	CL
------	------	--------	--------	100	93	75	28	13	11	31	7	A-4(8)	ML or CL
------	------	--------	100	99	97	88	55	27	20	39	16	A-6(10)	CL
------	------	--------	100	99	49	19	4	3	2	[4] NP	[4] NP	A-4(3)	SM
100	94	89	87	78	44	32	15	9	7	23	4	A-4(2)	SM
------	------	98	93	55	5	3	2	0	0	NP	NP	A-3(0)	SW or SP

than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-SC and ML-SM.

[4] Nonplastic.

TABLE 6.—*Estimates of soil*

[An asterisk in the first column indicates that a least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear in the first column of

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Sand or mixed sand and gravel or bedrock	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified [1]	Classification: AASHO [1]
	Feet	*Feet*	*Inches*			
*Coly: CbCW, CH. For Hobbs part of CH, see Hobbs series.	>10	>10	0–10	Silt loam	ML or CL	A–4 or A–6
			10–60	Silt loam	ML or CL	A–4 or A–6
Crete: Ce	>10	>10	0–14	Silt loam	ML or CL	A–6 or A–4
			14–38	Silty clay, silty clay loam	CH	A–7
			38–60	Silt loam	ML or CL	A–6 or A–7
Fillmore: Fm	>10	>10	0–10	Silt loam	ML or CL	A–6 or A–4
			10–42	Silty clay, silty clay loam	CH	A–7
			42–60	Silt loam	ML or CL	A–6 or A–7
*Geary: GsB, GsC, GsB3, GsC3, GH. For Hobbs part of GH, see Hobbs series.	>10	>10	0–12	Silt loam	CL	A–6
			12–34	Silty clay loam	CL	A–7
			34–64	Silt loam	CL	A–6
Gibbon: Gg	2–6	>6	0–18	Silty clay loam	CL or ML	A–7
			18–26	Silt loam	ML or CL	A–6 or A–4
			26–36	Very fine sandy loam	ML	A–4
			36–60	Fine sandy loam	SM or ML	A–2 or A–4
Gravelly land: Gv[2]	>10	0–1		Sand and gravel	SP, SW, SP–SM, SP–SC	A–3 or A–2
Hastings: Hs, HsA	>10	>10	0–12	Silt loam	CL or ML	A–4 or A–6
			12–36	Silty clay loam	CH or CL	A–6 or A–7
			36–60	Silt loam	ML or CL	A–4 or A–6
Hobbs: 2Hb	>8	>10	0–72	Silt loam	ML or CL	A–4 or A–6
Holdrege: Ho, HoA, HoA2, HoB, HoB2, HoC, HwB3, HwC3.	>10	>10	0–12	Silt loam	CL or ML	A–4 or A–6
			12–32	Silty clay loam	CH or CL	A–6 or A–7
			32–60	Silt loam	CL or ML	A–4 or A–6
Hord: Hd, 2Hd, 2HdA	>10	>6	0–18	Silt loam	CL or ML	A–4 or A–6
			18–36	Silty clay loam	CL or ML	A–6, A–7 or A–4.
			36–60	Silt loam	ML or CL	A–4 or A–6
Humbarger: Hu	5–15	>5	0–5	Silt loam	ML or CL	A–4 or A–6
			5–32	Silty clay loam	CL or ML	A–6 or A–4
			32–52	Loam	CL, ML or SM	A–4 or A–6 or A–2
			52–60	Fine sand	SM, SP–SM, or SP.	A–3 or A–2
Inavale:						
If	5–20	3–6	0–60	Fine sand	SM, SP–SM, or SP.	A–3 or A–2
Ig	5–20	0–1	0–8	Loamy fine sand	SM, SP–SM	A–2
			8–17	Loamy sand	SM, SP–SM	A–2
			17–60	Fine sand	SM, SP–SM, or SP.	A–3 or A–2
In	5–20	3–6	0–8	Fine sandy loam	SM or ML	A–4 or A–2
			8–17	Loamy sand	SM or SP–SM	A–2
			17–60	Fine sand	SM, SP–SM or SP.	A–3 or A–2
Kipson: KsD	>10	½–2	0–15	Silt loam	ML or CL	A–4 or A–7
			15–25	Chalky limestone.		

See footnotes at end of table.

properties significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions this table. Symbol > means more than, < means less than]

Percentage passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
				Percent	*Inches/hour*	*Inches/inch of soil*	
100	98–100	93–100	85–100	17–27	0. 63–2. 00	0. 22–0. 24	Moderate.
100	92–100	95–100	90–98	17–27	0–63–2. 00	0. 20–0. 22	Moderate.
100	98–100	90–100	85–100	13–27	0. 63–2. 00	0. 22–0. 24	Moderate.
-------------	100	95–100	89–100	40–60	0. 06–0. 20	0. 11–0. 13	High.
100	98–100	90–100	85–100	18–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	90–100	85–100	10–22	0. 63–2. 00	0. 22–0. 24	Moderate.
-------------	100	95–100	90–100	40–60	0. 06–0. 20	0. 11–0. 13	High.
100	98 100	90–100	85–100	18–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	90–100	85–100	18–27	0. 63–2. 00	0. 22–0. 24	Moderate.
100	98–100	93–100	90–100	17–35	0. 63–2. 00	0. 18–0. 20	Moderate.
100	98–100	90–100	70–100	20–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	70–100	27–35	0. 20–0. 63	0. 21–0. 23	Moderate.
100	98–100	90–100	70–100	17–27	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	90–100	50–80	7–18	0. 63–2. 00	0. 17–0. 19	Low.
100	98–100	95–100	18–74	3–15	2. 00–6. 30	0. 14–0. 16	Low.
100	80–95	50–80	3–12	0	>2. 0	0. 02–0. 06	Very low.
100	98–100	95–100	85–100	17–27	0. 63–2. 00	0. 22–0. 24	Moderate.
100	98–100	95–100	90–100	35–45	0. 20–0. 63	0. 18–0. 20	High.
100	98–100	95–100	85–100	15–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	85–100	5–20	0. 63–2. 00	0. 20–0. 24	Low to moderate.
100	98–100	95–100	85–100	15–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	95–100	90–100	17–35	0. 63–2. 00	0. 18–0. 20	Moderate to high.
100	98–100	95–100	85–100	12–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	85–100	15–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	93–100	85–100	17–35	0. 63–2. 00	0. 18–0. 20	Moderate.
100	98–100	95–100	85–100	15–27	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	95–100	90–100	15–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	93–100	84–100	30–38	0. 20–0. 63	0. 18–0. 20	Moderate.
90–100	83–100	70–100	48–77	7–27	0. 63–2. 00	0. 17–0. 19	Low to moderate.
100	99–100	90–100	4–29	3–15	6. 30–20. 0	0. 05–0. 07	Very low.
100	99–100	90–100	4–29	0–3	6. 30–20. 0	0. 05–0. 09	Very low.
100	100	80–100	11–35	2–5	6. 30–20. 0	0. 10–0. 12	Low.
100	93–100	65–95	5–14	1–2	6. 30–20. 0	0. 09–0. 11	Low.
100	99–100	90–100	4–22	0–3	6. 30–20. 0	0. 05–0. 07	Very low.
100	98–100	85–95	18–57	5–10	2. 00–6. 30	0. 16–0. 18	Low.
100	93–100	65–95	5–14	1–2	6. 30–20. 0	0. 09–0. 11	Very low.
100	99–100	90–100	4–29	0–3	6. 30–20. 0	0. 05–0. 07	Very low.
100	98–100	95–100	75–100	10–18	0. 63–2. 00	0. 22–0. 24	Moderate.

TABLE 6.—*Estimates of soil*

Soil series and map symbols	Depth to—		Depth from surface (typical profile)	Classification		
	Seasonal high water table	Sand or mixed sand and gravel or bedrock		Dominant USDA texture	Unified [1]	AASHO [1]
	Feet	*Feet*	*Inches*			
Marsh: M. No valid estimates can be made. Seasonal high water table to 2 inches above surface.						
McCook:						
Mv	5–15	3–6	0–12	Silt loam	ML or CL	A–4 or A–6
			12–21	Silt loam	CL or ML	A–4 or A–6
			21–43	Silt loam and very fine sandy loam.	CL or ML	A–4
			43–60	Loamy fine sand	SM	A–2 or A–4
Mp	5–15	3–6	0–12	Fine sandy loam	ML or SM	A–4 or A–2
			12–21	Silt loam	CL or ML	A–4 or A–6
			21–43	Silt loam and very fine sandy loam.	CL or ML	A–4
			43–60	Loamy fine sand	SM	A–2 or A–4
Meadin: MwD [2]	10	1–3	0–6	Loam	SM or ML	A–4 or A–2
			6–14	Gravelly sandy loam	SM	A–2 or A–4
			14–60	Sand and gravel	SP, SW or SM	A–3 or A–2
Munjor:						
Mun	5–15	3–6	0–8	Fine sandy loam	SM or ML	A–4 or A–2
			8–41	Fine sandy loam	SM or ML	A–4 or A–2
			41–60	Medium sand	SM, SP–SM, or SP	A–3 or A–2
Mul	5–15	3–6	0–8	Loamy fine sand	SM or SP–SM	A–2 or A–4
			8–41	Fine sandy loam	SM or ML	A–4 or A–2
			41–60	Medium sand	SM, SP–SM, or SP	A–3 or A–2
Munjor, slightly wet variant: 2Mun.	2–6	3–6	0–12	Fine sandy loam	SM or ML	A–4 or A–2
			12–31	Fine sandy loam	SM or ML	A–4 or A–2
			31–60	Medium sand	SM, SP–SM, or SP	A–3 or A–2
Rough broken land, loess: RB. No valid estimates can be made.	>10	>10				
Rough stony land: Rv [2]. No valid estimates can be made.	>10	0–1				
Roxbury: Rc	5–15	>10	0–62	Silt loam	ML or CL	A–4 or A–6
Sandy alluvial land: Sx. No valid estimates can be made.						
Silty alluvial land: Sy. No valid estimates can be made.						
Wakeen: WcC, WcC2, WcE	>10	2–4	0–32	Silt loam	ML or CL	A–4, A–6 or A–7
			32–42	Chalky limestone.		
Wet alluvial land: Wx. No valid estimates can be made.						

If two or more classifications are shown, the classification listed first is considered to be the most common.

properties significant in engineering—Continued

Percentage passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
				Percent	*Inches/hour*	*Inches/inch of soil*	
100	98–100	95–100	85–100	10–24	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	95–100	85–100	17–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	85–100	10–24	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	80–100	11–50	2–5	6. 30–20. 0	0. 08–0. 10	Low.
100	98–100	85–95	18–57	5–10	2. 00–6. 30	0. 16–0. 18	Low.
100	98–100	95–100	85–100	15–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	85–100	10–24	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	80–100	11–45	2–5	6. 30–20. 0	0. 08–0. 10	Low.
89–100	83–100	75–95	40–77	7–17	0. 63–2. 00	0. 20–0. 22	Low.
93–100	89–100	75–90	12–50	3–15	2. 00–6. 30	0. 12–0. 14	Low.
90–100	85–98	40–85	2–15	0–2	20. 0	0. 02–0. 04	None.
100	98–100	85–95	18–57	2–10	2. 00–6. 30	0. 16–0. 18	Low.
100	98–100	85–95	18–57	2–10	2. 00–6. 30	0. 16–0. 18	Low.
100	99–100	65–95	4–45	0–5	6. 30–20. 0	0. 05–0. 07	Very low.
100	98–100	80–100	11–39	1–3	6. 30–20. 0	0. 10–0. 12	Low.
100	98–100	85–95	18–57	2–10	2. 00–6. 30	0. 15–0. 17	Low.
100	99–100	65–95	4–29	0–3	6. 30–20. 0	0. 05–0. 07	Very low.
100	98–100	85–95	18–57	2–10	2. 00–6. 30	0. 16–0. 18	Low.
100	98–100	85–95	18–57	2–10	2. 00–6. 30	0. 16–0. 18	Low.
100	99–100	85–95	4–45	0–5	6. 30–20. 0	0. 05–0. 07	Very low.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 20–0. 24	Low to moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 20–0. 24	Low to moderate.

[2] In places these soils have 0 to 5 percent material greater than 3 inches in diameter.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

Soil series and map symbols	Suitability as source of— Topsoil	Sand or mixed sand and gravel	Road subgrade: Paved surface	Road subgrade: Gravel surface	Road fill	Soil features affecting— Highway location	Foundations
*Coly: CbCW, CH. For Hobbs part of CH, see Hobbs series.	Fair: low fertility.	(1)	Fair	Good to fair.	Fair: slopes; moderate shrink-swell potential.	Susceptible to frost action; highly erodible, gentle to steep slopes; deep cuts and high fills required; good drainage.	Bearing value depends on density and moisture; subject to high consolidation if loaded and wetted.
Crete: Ce	Good	(1)	Poor	Good	Poor: high shrink-swell potential.	Susceptible to frost action; erodible slopes; high shrink-swell potential; good drainage below a depth of 3 feet.	Fair bearing value; high shrink-swell potential.
Fillmore: Fm	Fair: poor drainage.	(1)	Poor	Good	Poor: high shrink-swell potential.	Susceptible to frost action; in places requires minimum fills because of ponding; erodible slopes; high shrink-swell potential.	Fair bearing value; high shrink-swell potential.
*Geary: GsB, GsC, GsB3, GsC3, GH. For Hobbs part of GH, see Hobbs series.	Fair to poor: slopes and severely eroded areas low in fertility.	(1)	Poor	Good	Fair to poor: moderate to high shrink-swell potential.	Susceptible to frost action; erodible, gentle to steep slopes; good drainage.	Fair bearing value; moderate shrink-swell potential.

See footnotes at end of table.

interpretations

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

Soil features affecting—Continued						Soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Moderate seepage potential; gentle to steep slopes.	Fair stability; impervious; good workability; erodible slopes.	Rapid surface runoff; moderate permeability.	(2)	Erodible slopes; low fertility; requires intensive conservation measures.	Low fertility; requires intensive conservation measures.	Severe: slopes.	Severe: moderate permeability; slopes, sealing or lining required.
Low seepage potential.	Good to fair stability; impervious if properly compacted.	Somewhat poor drainage; slow permeability.	High available water capacity; slow permeability.	No limitations.	(2)	Severe: slow permeability above a depth of 3 feet.	Slight for excavations less than 3 feet deep.
Low seepage potential.	Good to fair stability; impervious if properly compacted.	Poor drainage; slow permeability; ponded areas.	High available water capacity; susceptible to ponding; slow permeability.	(2)	(2)	Severe: slow permeability; ponding.	Slight if protected from ponding.
Low to moderate seepage potential.	Fair to good stability; erodible slopes; impervious if properly compacted.	Good drainage; moderate permeability; medium to rapid surface runoff.	(2)	Low fertility; requires conservation measures.	Erodible; low fertility; requires intensive conservation measures.	Moderate: moderate permeability; slopes.	Severe: slopes. Moderate if gradient is more nearly level and soil material is compacted.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
Gibbon: Gg	Fair: silty clay loam.	Fair to poor.	Poor	Good to fair.	Fair: moderate shrink-swell potential.	Surface soil susceptible to frost action in places; water table at depth of 2 to 6 feet; requires minimum fills; erodible slopes.	Fair bearing value; water table at a depth of 2 to 6 feet; moderate to low shrink-swell potential.
Gravelly land: Gv	Poor: very coarse textured.	Good for sand.	Good	Poor	Good	Very low susceptibility to frost action; good drainage; vibratory compaction required; sand needs to be confined for strength.	Good bearing value; no shrink-swell potential.
Hastings: Hs, HsA	Good	(1)	Fair to poor.	Good	Fair to poor: high to moderate shrink-swell potential.	Susceptible to frost action; erodible; good drainage below a depth of 3 feet.	Bearing value depends on density and moisture; subject to consolidation if loaded and wetted.
Hobbs: 2Hb	Good	(1)	Fair to poor.	Good	Fair	Susceptible to frost action; in places flooding requires minimum fills; erodible; compaction required for strength; good drainage.	Bearing value depends on density and moisture; subject to consolidation if loaded and wetted.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Water table at depth of 2 to 6 feet; suitable for dug-out excavation.	Fair stability; water table at depth of 2 to 6 feet; erodible slopes.	Somewhat poor drainage; moderate permeability; water table at depth of 2 to 6 feet.	High available water capacity; water table at a depth of 2 to 6 feet.	(2)	(2)	Severe: water table at a depth of 2 to 6 feet.	Severe: water table at a depth of 2 to 6 feet.
(2)	Good stability if confined; highly pervious.	(2)	(2)	(2)	(2)	Severe: in places seepage causes contamination of the underground water supply.	Severe: very rapid permeability; minimum operating depth cannot be maintained without lining.
Low seepage potential above a depth of 3 feet.	Good stability if compaction is properly controlled; impervious if compacted; good workability.	Moderately good drainage; moderately slow permeability.	High available water capacity; moderately slow intake rate.	Moderate erodibility on HsA.	Moderate erodibility on HsA; low fertility where subsoil exposed.	Moderate: moderately slow permeability.	Slight for excavations not exceeding a depth of 3 feet; compaction or sealing required below a depth of 3 feet.
Moderate seepage potential.	Good stability; impervious if compacted; good workability.	Moderately good drainage; moderate permeability; subject to occasional flooding.	High available water capacity; susceptible to occasional flooding.	(2)	Moderate erodibility.	Slight if protected from overflow.	Severe: moderate permeability; occasional flooding; diking and lining lagoons is practical.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade: Paved surface	Road subgrade: Gravel surface	Road fill	Highway location	Foundations
Holdrege: Ho, HoA, HoA2, HoB, HoB2, HoC, HwB3, HwC3.	Good to poor: severely eroded units have low fertility.	(1)	Fair to poor.	Good to fair.	Fair to poor: moderate shrink-swell potential.	Susceptible to frost action; erodible slopes; good drainage below a depth of 2½ feet; consolidation possible if wetted when loaded.	Bearing value depends on density and moisture; subject to consolidation if loaded and wetted.
Hord: Hd, 2Hd, 2HdA	Good	(1)	Fair to poor.	Good to fair.	Fair to poor: moderate shrink-swell potential.	Susceptible to frost action; erodible slopes; good drainage; requires compaction control.	Bearing value depends on density and moisture; subject to consolidation if loaded and wetted.
Humbarger: Hu	Good	Poor: check site for desired gradation.	Fair to poor.	Good to fair.	Fair to good: moderate shrink-swell potential.	Susceptible to frost action; erodible slopes; good drainage; requires compaction control.	Fair bearing value; low to moderate shrink-swell potential; check site for seepage and depth to water.
Inavale: If, Ig, In	Poor	Fair for fine sand; check site for desired gradation.	Good	Poor	Good	Very low susceptibility to frost action; highly erodible slopes; good drainage; good strength if compacted.	Good bearing value if confined; check site for depth to water; low to very low shrink-swell potential.
Kipson: KsD	Poor: shallow.	(1)	(3)	(3)	(3)	(3)	(3)

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Low seepage potential if upper 2½ feet is not disturbed.	Good stability; impervious if compacted.	Good drainage; moderate permeability below 2½ feet.	High available water capacity; steeper slopes not suited for irrigation.	High fertility; erodible slopes.	Intensive conservation required on steeper slopes.	Moderate: moderate permeability; severe for steeper grades.	Severe: sealing or lining required on lesser slopes; lagoons not practical on steeper slopes.
Moderate seepage potential.	Good stability; impervious if compacted; erodible slopes.	Good drainage; moderate permeability.	High available water capacity.	Moderate erodibility on 2Hd and 2HdA.	Moderate erodibility on 2Hd and 2HdA.	Moderate: moderate permeability.	Moderate: moderate permeability; requires compaction or sealing to maintain water depth.
Moderate seepage potential for upper 2½ feet.	Fair to good stability; erodible slopes; upper 4½ feet impervious if compacted.	Moderately good drainage; moderately slow permeability.	High available water capacity.	(2)	(2)	Moderate: moderately slow permeability.	Slight to moderate: moderately slow permeability; severe if excavation exceeds a depth of 2½ feet; requires compaction or lining.
High seepage potential.	Good stability if confined; low compressibility; erodible slopes; highly pervious.	Excessive drainage; rapid permeability.	Low available water capacity; susceptible to soil blowing; low fertility.	(2)	(2)	Slight for a filter; severe if contamination of the underground water supply is possible.	Severe: rapid permeability; requires lining to function properly.
(3)	(3)	Somewhat excessive drainage; moderate permeability; medium to rapid surface runoff.	(2)	(3)	(3)	Severe: bedrock at a depth of 10 to 20 inches; slopes.	Severe: bedrock at a depth of 10 to 20 inches; slopes.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade: Paved surface	Road subgrade: Gravel surface	Road fill	Highway location	Foundations
Marsh: M. No valid estimates can be made.							
McCook: Mv, Mp	Good	Check site for depth to and variability of fine sand.	Fair to poor.	Good to fair.	Fair to good.	Susceptible to frost action; erodible slopes; consolidation depends on density; compaction requires close control for strength.	Bearing value depends on density at site; low to moderate shrink-swell potential; check site for seepage and depth to water.
Meadin: MwD	Poor: shallow.	Good for sand; fair to poor for gravel.	Good below a depth of ½ foot.	Fair	Good	Low susceptibility to frost action; highly erodible slopes; fills require confining for stability; good drainage.	Good bearing value if confined; good drainage; moderately steep to steep slopes; low shrink-swell potential.
Munjor: Mun, Mul	Good	Fair for sand; check site for gradation desired.	Fair to good.	Fair	Good	Susceptible to frost action; highly erodible slopes; good drainage; good strength if properly compacted.	Good bearing value; check site for seepage potential and depth to water; low shrink-swell potential.
Munjor, slightly wet variant: 2Mun.	Good	Fair for sand; check site for gradation desired.	Fair	Fair	Good	Susceptible to frost action; highly erodible; water table at depth of 2 to 6 feet; in places requires minimum fills.	Good bearing value; water table at a depth of 2 to 6 feet; low shrink-swell potential.

See footnotes at end of table.

interpretations—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
High seepage potential.	Fair stability; good workability; impervious if compacted.	Good drainage; moderate permeability; sand at 3 to 6 feet.	High available water capacity.	(2)	(2)	Slight for soil; severe if contamination of the underground water supply is possible.	Severe: permeability of the soil below a depth of 4 feet requires sealing or lining for lagoon to function.
High seepage potential.	Fair to good stability; low compressibility; good drainage; steep grades.	Excessive drainage; moderately rapid to rapid permeability.	(2)	Sand and gravel at a depth of 14 inches; requires intensive conservation measures.	Requires intensive conservation measures.	Severe: slopes;	Severe: slopes; moderately rapid and rapid permeability requires lining for lagoon to function.
High seepage potential.	Fair stability; erodible slopes; in places requires toe drains.	Good drainage; moderately rapid permeability.	Moderate available water capacity; susceptible to soil blowing.	(2)	(2)	Slight; severe if contamination of the underground water supply is possible.	Severe: moderately rapid permeability; lining is required to provide proper functioning of lagoon.
May be used for dugouts; water table at depth of 2 to 6 feet.	Good stability; erodible slopes; in places requires seepage control; water table at depth of 2 to 6 feet.	Somewhat poor drainage; moderately rapid permeability; water table at a depth of 2 to 6 feet.	Moderate available water capacity; water table at a depth of 2 to 6 feet; susceptible to soil blowing.	(2)	(2)	Severe: water table at depth of 2 to 6 feet.	Severe: water table at depth of 2 to 6 feet.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil features affecting—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
Rough broken land, loess: RB. No valid estimates can be made.							
Rough stony land: Rv. No valid estimates can be made.							
Roxbury: Rc	Good		Fair to poor.	Good to fair.	Fair	Susceptible to frost action; in places flooding requires minimum fills; erodible slopes; compaction needed for strength; good drainage.	Bearing value depends on density and moisture; subject to consolidation if loaded and wetted.
Sandy alluvial land: Sx. No valid estimates can be made.							
Silty alluvial land: Sy. No valid estimates can be made.							
Wakeen: WcC, WcC2, WcE.	Good to fair: steep slopes in some places.	(1)	(3)	(3)	(3)	(3)	(3)
Wet alluvial land: Wx. No valid estimates can be made.							

[1] Sand and gravel is generally not available.
[2] Because of position, slope, or soil characteristics, this practice or structure is generally not needed or applicable.

interpretations—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Moderate seepage potential.	Good stability; impervious if compacted; good workability.	Moderately good drainage; moderate permeability; infrequently flooded.	High available water capacity.	(2)	Moderate erodibility.	Slight to moderate: moderate permeability.	Moderate; moderate permeability.
Moderate seepage where bedrock exposed; gently sloping to steep slopes.	(3)	Good drainage; moderate permeability.	Moderate permeability; slopes of 3 to 7 percent are suited.	(3)	(3)	Severe: bedrock at a depth of 20 to 40 inches; slopes.	Severe: bedrock at a depth of 20 to 40 inches; slopes.

[3] See the section Engineering Interpretations of Soils for use of material from the Niobrara Formation.

Engineering interpretations of soils

Table 7 indicates a general interpretation of the soils for their use in engineering. This table is a guide to planning and further investigation of the soils. Onsite determinations of the soils for type, quantities, and engineering properties are important.

In table 7, topsoil is rated *good, fair* or *poor*, depending on depth, fertility, organic matter, erosiveness, workability, and on soil remaining after removing the topsoil. Topsoil is used to cover road and dam embankments, on excavated slopes, and on gardens and lawns.

Several soils in Webster County are a source of sand and gravel. Meadin, Inavale, McCook, and Gravelly land are examples of a source of sand. Exploration is needed to determine the quality, gradation, and depth to the sand and gravel. Operational sandpits are a guide to locating sources of sand and gravel.

The estimated interpretations in table 7 are based on the engineering properties of soils shown in table 6, on test data for soils in this survey area and others in nearby or adjoining areas, and on the experience of engineers and soil scientists with the soils of Webster County. In table 7, ratings are used to summarize limitations or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties generally favorable for the rated use, or in other words, limitations that are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation and special designs. For some uses, the rating of severe is divided to obtain ratings of severe and very severe. *Very severe* means one or more soil properties so unfavorable for a particular use that overcoming the limitations is most difficult and costly and commonly not practical for the rated use.

Soil suitability is rated by the terms *good, fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and the content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit. Several soils in Webster County are a source of sand and gravel. Meadin, Inavale, McCook soils, and Gravelly land are examples of a source of sand. Exploration is needed to determine the quantity, gradation, and depth to the sand and gravel.

Sands and gravels are rated *good* to *fair* for road subgrades under pavement and *poor* for gravel road subgrades. Silt and clay on the road subgrade surface are more stable for gravel surfacing. Thus, for paved roads, soils in AASHO classes A–1 and A–3 are rated *good;* A–2, *good* to *fair;* A–4, *fair* to *poor;* and A–6 or A–7, *poor*. For most soils the road subgrade and road fill use the same classification for paved roads because the engineering requirements are approximately the same.

Ratings for use of soil as road fill include suitability as embankment, as a foundation for embankments, erodibility of cut slopes, and potential frost action.

Highway locations are described according to potential problems of frost heave, shrink swell, erodibility of cut and fill slopes, and location of water table and possible flooding or ponding. Frost action is caused by the expansion of freezing water in silt-clay soils, which, in turn, increases maintenance of paved roads. A high water table can contribute to potential frost action or frost heave.

Foundations are rated generally on bearing capacity or load-carrying capacity. Most soils have a high bearing capacity when dry. Some of the windblown soils are subject to high consolidation when saturated under load. Sands and gravels have high bearing capacity when confined. (See AASHO classifications.) Specific values for bearing capacity, for example, pounds per square inch, should not be assigned to estimated values as expressed in table 7. Wet excavations for buildings may be a problem. Therefore, depth to water should be determined for building sites. The potential for shrink swell, as shown in table 6 is important to foundations. The possibility of seepage into foundations or excavations is indicated.

For reservoir areas, potential seepage in the soil and the use of soil for embankments are described. A high water table indicates the possibility of excavating a dugout for a water supply. A low or deep water table indicates the need for sealing or lining a pond. It also indicates that construction of a fill may be easier because of a drier foundation.

Embankments, dikes, and levees are used to control surface water. They are subject to erosion by water and soil blowing. They are subject to horizontal seepage if not properly compacted or if constructed of clean sands. Some soils are subject to shrinking and cracking as they dry. Dikes and levees constructed with sandy soils need flat slopes for stability. Steeper slopes are used for dikes and levees constructed with clay soil because the fill is relatively impervious to water. Embankments are subject to seepage and compressibility. These factors are rated in table 7. Workability includes hauling and compaction characteristics. Potential seepage depends on moisture, gradation, and compaction of the fill. Two methods of compaction are required for soils in Webster County. See table 5 for test results giving maximum dry densities for particular samples. Soils containing approximately 15 percent or less of silt and clay particles should have compaction controlled by the relative density test, which is equivalent to the use of vibratory rather than sheepsfoot rollers. Erodibility of fill slopes is also described.

Agricultural drainage depends on the depth to the water table, available outlets, and permeability of the various soil layers.

Suitability of soils for irrigation is affected by factors, such as available water capacity, permeability, water intake rate, steepness of slopes, and possible limiting depths of leveling cuts.[8] The ratings for available water capacity are limited to the top 5 feet of soil. The rating is *high* if the soil will hold more than 9 inches of water; *moderate* if the soil holds 6 to 9 inches; *low* if the soil holds 3 to 6 inches; and *very low* if the soil holds less than 3 inches. Intake rate is the rate of movement of water into the soil. The intake rate is affected by the permeability and existing moisture of the various soil layers being irrigated. Intake rate is related to permeability. A permeability range is given in table 6. The intake rate is *rapid* if the soil takes in over 2 inches of water per hour; *moderate* if the rate is from 0.5 to 2 inches per hour, and *slow* if less than 0.5 inch per hour.

Use of the soils for terraces, diversions, and grassed waterways is described according to the hazard of soil blowing and water erosion, difficulty of establishing vegetation, and fertility. Maintenance costs of terraces and diversions are greater where siltation occurs from higher elevations. Depth to erodible sands limits cut depths for diversion alinement. Rough topography and steep slopes are factors in terrace and diversion alinement. Some soils listed in table 7 require more intensive measures.

The limitations for use of soils as sewage filter fields and sewage lagoons are rated in table 7. Use of soils for sewage disposal can also be related to table 6, including soil classification and values for permeability and available water capacity. For filter fields, soil limitations are *slight*, *moderate* or *severe*. *Slight* indicates good infiltration without contaminating the underground water; *moderate* indicates a finer grained soil that has a lower intake rate; *severe* indicates a high water table or an impervious soil.

For sewage lagoons, water must be retained in the lagoon for aerobic decomposition of the fresh sewage to occur. Thus, an impervious soil is desired for constructing this facility. The probability of a soil requiring sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber liner or compacted soil as a liner is indicated. A lagoon constructed in sandy material that has a high water table (*severe*) would be the least desirable for sewage disposal. A sewage filter field or disposal lagoon needs to be located so as not to contaminate wells that furnish domestic water supply or stock water. Other factors, such as steepness of slope and possibility of flooding, need to be considered in sewage treatment.

Bedrock, at or near the surface in Webster County, is part of the Niobrara and Ogallala Formations. The Ogallala Formation is in small areas, and engineering data are not given herein. The chalk rock (Smoky Hill member of the Niobrara Formation) has been used as construction (*3*) and foundation material. Densities of 48 to 88 pounds per cubic foot at 28 to 34 percent moisture have been obtained by using heavy rolling equipment. The resulting fills have good shear strength and are relatively impermeable. Chalk may have small amounts of gypsum and bentonite included which affect the performance of water retention structures. Proper compaction control of the chalk and use of soil material with chalk can offset the effects of gypsum and bentonite. The test data in table 5, for Kipson soil at depths of 15 to 60 inches are not representative of chalk as found in place. The soils above the rock are shallow to moderately deep and erodible and require intensive conservation measures. Diversions, if constructed of chalk, require compaction control as described above. Grassed waterways are erodible and weathered chalk has low fertility.

[8] Further information on soil use for irrigation is contained in *Irrigation Guide for Nebraska*. 1971. Soil Conservation Service, USDA.

Formation and Classification of the Soils

This section tells how the factors of soil formation have affected the development of soils in Webster County. It also explains the soil classification system currently used and classifies each soil series according to that system.

Factors of Soil Formation

Soil is formed by the physical and chemical weathering of parent materials. The characteristics of the soil are determined by the interaction of five factors of soil formation. Each of these factors modifies the effect of the others. The five interacting factors are (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil 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. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown. The five factors of soil formation are described in the following paragraphs.

Parent material

The soils of Webster County formed in several kinds of parent material—alluvium, loess, water-deposited sand, and gravel and residuum weathered from chalky limestone.

The alluvium consists of moderately fine textured to coarse textured valley sediment recently washed from uplands and deposited on flood plains and stream terraces. Soils of the Gibbon, Hobbs, Hord, Humbarger, Inavale, McCook, Munjor, and Roxbury series formed in alluvium.

Peoria Loess is a pale-brown silty material transported by wind. The thickness of the deposit ranges from a few feet to as much as 50 feet. In this county, soils that formed in Peoria Loess range from somewhat excessively drained to poorly drained. They are in the Coly, Holdrege, Hastings, Crete, and Fillmore series.

Another kind of loess in this county is Loveland Loess, a light reddish-brown material. It is older and more oxidized than Peoria Loess, and it contains slightly more sand. Loveland Loess generally underlies the Peoria Loess. It is at the surface in rather large areas in the northeastern part and the southern half of the county. Soils of the Geary series developed in Loveland Loess.

Water-deposited sand and gravel of Pleistocene age occurs as a heterogenous mixture. Shallow soils of the Meadin series formed in loess overlying this kind of sand and gravel. They occur on valley sides along tributaries to the Republican River. Meadin soils are excessively drained.

The limestone residuum in this county weathered from the chalky limestone of the Niobrara Formation. Soils of the Kipson and Wakeen series formed in this material. Kipson soils are shallow, somewhat excessively drained soils. Wakeen soils are moderately deep and well drained. Almost all areas of these soils are south of the Republican River Valley.

Climate

Climate directly affects the weathering of parent material through rainfall, temperature, and wind. Water received as rainfall moves through the drainageways and continually shifts, sorts, and reworks unconsolidated material of all kinds. This sediment is deposited, picked up, and redeposited many times over by flowing streams. The alluvial soils in this county are examples of soils formed in water-deposited sediment. Alternate freezing and thawing hasten mechanical disintegration of parent material. Summer heat and humidity speed chemical weathering. Wind transfers soil material from one place to another. The extensive deposits of loess in this county are examples of the importance of wind as a depositor of soil material.

Climate affects the soils indirectly through its influences on vegetation and the kinds of animal life that can be sustained. The primary source of the organic matter in a soil is vegetation. Animals that live in the soil help to convert dead leaves, stems, roots, and other plant remains to usable organic matter. Burrowing animals help to mix the various layers of soil.

The climate of Webster County is characterized by moderately long and cold winters, cool springs with considerable precipitation, warm summers with many thunderstorms, and mild autumns with occasional rainy periods. The climate is fairly uniform throughout the county, and differences in the soils from one part of the county to another cannot be attributed to differences in climate. There are wide seasonal variations in temperature and in the amount of rainfall. The temperature commonly falls below 0°F. in winter and soars to nearly 100° in summer. The annual average precipitation is 24.9 inches.

Plant and animal life

The soils of this county formed under short, mid, and tall grasses. This kind of vegetation provides an abundant supply of organic matter that affects the physical and chemical properties of the soils. The fibrous roots of these grasses penetrate the soil, make it porous, and encourage development of granular structure. The plant roots take up minerals in solution from the lower parts of the soil and eventually return them to the surface layer in the form of organic matter.

Micro-organisms are an important link in the transformation of undecomposed organic matter into humus. The action of bacteria and various kinds of fungi causes the decay of dead leaves and other organic matter. Earthworms and small burrowing animals help to mix humus with the soil. Decayed organic matter gradually changes the physical and chemical composition of the surface layer.

Relief

Relief, or lay of the land, influences the formation of a soil through its effect on runoff and drainage. Runoff is more rapid on steep and very steep slopes than on milder slopes. Steep soils are generally more severely eroded than the less sloping soils. They are not so strongly developed, even though the parent material is similar; less water percolates through the soil; plant growth is less vigorous; soil horizons are thinner and less distinct; and lime is not so deeply leached.

The most strongly developed soils in this county occur in nearly level areas or in shallow depressions where there is little or no runoff. They are generally characterized by a leached subsurface horizon and a very firm, clayey subsoil.

Time

The time required for soil formation depends largely on the parent material. Some acid soils in the more humid regions form in a relatively short time; soils that form in freshly exposed limestone, for example, take a much longer time. The finer the texture of the parent material, the longer the time needed for soil formation. The finer textures retard the downward movement of water, which is necessary in the process of soil formation.

The youngest soils in Webster County formed in alluvium. They have little or no horizon development because the parent material has been in place for only a short time. The soils on uplands are much older and have been in place long enough for genetic profiles to form and for horizons to have accumulated some thickness.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge to farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*5*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*4*) and was adopted in 1965 (*7*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of the county by family, subgroup, and order, according to the current system, as of May, 1972.

Following are brief descriptions of each of the categories in the current system.

ORDER.— Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. The two exceptions are the Entisols and Histosols, which occur in many different climates. Table 8 shows that the two soil orders recognized in Webster County are Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling.

Mollisols formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling.

SUBORDER.—Each order is divided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a fragipan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and others called integrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrate outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY.—Families are established within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

TABLE 8.—*Soils classified according to the current system of classification*

Series	Family	Subgroup	Order
Coly	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Crete	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Geary [1]	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Gibbon	Fine-silty, mixed (calcareous), mesic	Typic Haplaquolls	Mollisols.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Holdrege [2]	Fine-silty, mixed, mesic	Typic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Humbarger	Fine-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols.
Inavale	Mixed, mesic	Typic Ustipsamments	Entisols.
Kipson	Loamy, mixed, mesic, shallow	Udorthentic Haplustolls	Mollisols.
McCook	Fine-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Meadin	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Munjor	Coarse-loamy, mixed (calcareous), mesic	Typic Ustifluvents	Entisols.
Roxbury	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Wakeen	Fine-silty, carbonatic, mesic	Typic Haplustolls	Mollisols.

[1] The Geary soil in mapping units GsB3 and GsC3 is a taxadjunct to the Geary series because the surface layer is lighter colored than defined in the range for the series.

[2] The Holdrege soil in mapping units HwB3 and HwC3 is a taxadjunct to the Holdrege series because the surface layer is lighter colored and thinner than is defined in the range for the series.

General Nature of the County

The first settlers arrived in the Webster County area early in spring in 1870 and built protective stockades near Guide Rock and at Red Cloud. By the beginning of winter there were settlers all along the Republican River Valley, where fuel and water were plentiful. Settlement was accelerated by the Homestead Act, which entitled a settler to 160 acres of land for $1.25 an acre. The county was established in April 1871.

Farming was the earliest occupation. In the early years most of the crops and the livestock products were consumed locally. Settlement was rapid following years when crops were good, but after periods of drought, some of the settlers moved away. In 1880, the population of the county was 7,104. In 1920, it reached a peak of 12,008. It has since declined, and in 1970, the population was 6,477.

Physiography, Relief, and Drainage

Webster County is in the Great Plains physiographic province. The northern tier of townships are in the Loess Plains part, and 75 percent of the southern townships are in the Rolling Plains and Breaks parts of the physiographic province.

The county was once mantled to varying depths by silty loess that formed a broad, rolling plain. The original landform has been changed by the entrenchment of the Republican River. The Republican River flows eastward across the southern part of the county and is now 200 to 300 feet below the upland plain. Tributaries of the river extend north and south almost at right angles to its valley.

The four major landforms of Webster County are the upland plain in the northern part of the county, the rolling uplands north of the Republican River Valley, the Republican River Valley, and the hilly uplands south of the Republican River Valley.

The elevation of Webster County ranges from about 2,060 feet in the northwestern part of the county to about 1,650 feet at Guide Rock. The general slope is toward the southeast. The elevation at Bladen and Blue Hill is about 2,000 feet, and at Red Cloud it is about 1,700 feet.

The principal drainageways in the county are the Republican and Little Blue Rivers. The three southern tiers of townships are drained by the Republican River and its tributaries. The Little Blue River enters the county from the west, 4 miles south of the northwest corner. Flow is east and north, and it leaves the county north of Bladen. The northern tier of townships are drained by the Little Blue River. The divide between the Republican River and the Little Blue River watersheds is about 6 miles south of the northern boundary of the county.

Water Supply

The region north of the Republican River Valley has an adequate supply of water for domestic use and for livestock. The water supply for pump irrigation is uncertain. Some places have no water-saturated sands and gravel, and in other places this material is at a depth of 50 feet or more. The depth to the static water level is up to 200 feet.

The bottom land along the Republican River Valley has a plentiful supply of ground water. The depth to the static water level is less than 60 feet. Conditions are also favorable for infiltration of precipitation or for direct recharge from streamflow.

The region south of the Republican River Valley has very little underground water. It is underlain by chalky limestone bedrock. This region has poor infiltration and is highly susceptible to loss of ground water by natural discharge from springs along valley sides.

The number of irrigation wells in Webster County on January 1, 1970, was 197. These were used to irrigate 23,200 acres in 1969. Water from the Bostwick Irrigation District was used to irrigate 6,248 acres in 1970. This water is from a reservoir above an upstream dam on the Republican River in Harlan County, Nebraska. Almost all of this acreage is on stream terraces and on bottom land along the Republican River.

Transportation and Markets

U.S. Highway 281 crosses the county from north to south, and U.S. Highway 136 from east to west. State Highway 4 runs east and west across the northern part of the county. State Highway 78 runs north and south across the eastern part of the county.

In all but the rougher parts of the county, there are rural roads on most section lines. Many of these roads are graveled. Rural mail routes reach all parts of the county.

The Burlington Northern Railroad crosses the southern part of the county and north to Hastings through Blue Hill. There is also a branch line west through Bladen.

Red Cloud has an airport and a lighted runway. At the present time the runway is sod and is used only by private planes.

Livestock auctions are held each week in Red Cloud and Blue Hill. The cattle and hogs are shipped by truck to larger markets. Livestock not sold at local auction are marketed in Omaha, St. Joseph, Kansas City, and other large markets.

Most of the poultry and dairy products are marketed locally. Grain and feed products not used or stored on the farms are sold to local grain elevator operators, who transport them by rail or truck to large markets. Some of the grain is stored in local elevators.

Climate[9]

Webster County, in south-central Nebraska, is near the center of the United States. It is in the southernmost tier of counties in Nebraska and is bordered on the south by Kansas. The climate is typical of that near the center of a large continent. It is characterized by warm summers, cold winters, and moderate rainfall that is highly variable in amount.

The absence of climatological barriers to the north and the south permits rather large temperature changes as the wind shifts to or from those directions. The changes are more pronounced during the winter season than in the summer, when the large land mass to the north has warmed

[9] Prepared by RICHARD E. MYERS, State climatologist for Nebraska, National Weather Service.

up and is no longer a source of cold air. Air masses that have their origin over the Pacific Ocean arrive in this region comparatively mild and dry because they are modified as they move over the Rocky Mountains. Nearly all the moisture that falls in this area is carried in on warm moist winds from the Gulf of Mexico or the Caribbean.

Generally, more than three-fourths of the annual precipitation falls during the period April through September, or the active growing season. Precipitation early in spring is the slow, steady type and is well distributed. Later, most of the rainfall occurs during erratic thunderstorms, and by the latter part of May nearly all of the precipitation comes in this manner. Heavy rains sometimes fall in one locality while a spot nearby receives little or no rainfall. This poor distribution causes local drought.

Farming practices are designed to lessen the effects of the droughty periods to some extent. Sorghum is grown extensively on soils that are not irrigated. It has a high resistance to the hot summer weather and is better adapted than corn to the poorly distributed rainfall that occurs late in summer. The sorghum is semidormant during droughts and resumes growth when precipitation is received. Summer fallow to minimize the effects of moisture deficiency is a common practice in areas where winter wheat is grown. Irrigation is used to supplement precipitation on over one-third of the acreage planted to corn.

Warm, humid air generally is brought in on the prevailing southerly winds during the summer, but on some occasions the area is invaded by air originating over the desert regions of the southwestern United States. Air of this type occurred frequently in the drought years of 1934 and 1936. When air from this source is present, temperatures soar to well over 100°F., and the humidity is extremely low. The moisture stress placed on corn under these conditions is capable of damaging the plant and reducing the yield, even if adequate moisture is available in the root zone.

Thunderstorms in spring and early in summer are severe at times and may be accompanied by local downpours, hail, damaging winds, or an occasional tornado. Much of the acreage where slopes are steep is used for pasture to protect against the serious soil erosion that is associated with the downpours. Hailstorms probably cause more damage than any other type of storms. The hail generally is small, ranging from the size of peas to the size of walnuts, but occasionally stones the size of golf balls or baseballs are reported. When the small stones are driven horizontally by high winds they do great damage to crops. The larger stones, which fall more vertically, injure or kill livestock and damage property. Hailstorms generally affect small areas, are of short duration, and cause damage in an extremely variable and spotted pattern. Hailstorms in June and early in July do the most damage to wheat, because the grain is headed and filling at that time. These early storms strip the leaves from the corn, sometimes nearly to the bare stalk. If the storm is followed by favorable weather conditions, however, the young corn plants make a remarkable recovery. The storms are less frequent after the middle of July, but those that do occur inflict a greater amount or permanent damage to the corn.

As the fall season progresses, showers become light and less frequent. Table 9 shows that the average monthly precipitation decreases from 2.8 inches in September to 1.17 inches in October and to 0.79 inch in November. The drier weather, combined with abundance of sunshine, is favorable to the maturing crops and aids in their harvest. An exceptionally dry fall sometimes causes corn ears to fall from their stalks, and it may cause slow germination and growth of the winter wheat. In most years sufficient moisture is present for the wheat to make suitable growth before winter, and in good years it furnishes pasture for cattle.

Precipitation in winter generally is light, and most of it falls as snow, but there are also several periods of rain or freezing rain. The snow often arrives with strong northerly winds and sharply falling temperatures, and it frequently piles into drifts before the wind subsides. The snow cover generally remains only a short time, and the ground is bare before the arrival of new snow. Table 9 shows the average number of days per month on which there is 1 inch or more snow cover. Generally, there are only 36 such days per year, but during the winter of 1948–49, there were 88. In the following winter there were only 7. Generally in the winter, cattle can obtain much of their feed from cured pasture grass, cornstalk fields, and sorghum stubble. By the latter part of March, most of the precipitation falls as rain, although heavy snow occasionally occurs as late as April.

The prevailing wind direction is northerly in January and February. In March and April the wind direction is about evenly divided between northerly and southerly. In the rest of the year, the prevailing wind direction is southerly. The yearly average wind speed is 10 to 12 miles per hour. Spring is the windiest season. Winds average 12 to 14 miles per hour or more, and on several days the average speed reaches 20 miles per hour or more. These windy days often are in groups of 2 or 3 days at a time. In winter the average wind speed is lowest, but at times when strong, northerly winds persist for several days following the passage of a cold front. Sustained winds of 20 miles per hour are infrequent in summer and fall. Peak windspeeds occur during severe thunderstorms and are of short duration.

The monthly amounts of potential evapotranspiration, as computed by the Thornthwaite method using mean temperatures above 32° for the period 1937–66, are given below.

	Inches		*Inches*
March	0.44	August	5.89
April	2.06	September	3.72
May	3.72	October	2.08
June	5.49	November	0.43
July	6.55		

The probabilities of freezing temperatures after specified dates in spring or before certain dates in fall are given in table 10. For example, in half the years the air temperature will fall below 32° after May 2, the average date of last freeze. In 1 year in 10 it will freeze as late as May 18. In fall it will freeze before September 21 in 1 year out of 10. In 5 years out of 10 it will freeze before October 6, the average date of first freeze in fall.

TABLE 9.—*Temperature and precipitation data at Red Cloud, Nebr.*

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than [2]	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than [2]	Average total [1]	One year in 10 will have— Equal to or less than [3]	One year in 10 will have— Equal to or more than [3]	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover [1]
	° F.	° F.	° F.	° F.	Inches	Inches	Inches	Number	Inches
January	37. 1	12. 5	58	−8	0. 60	0. 04	1. 25	12	3. 7
February	42. 7	17. 9	64	−1	. 83	. 11	1. 57	9	3. 4
March	51. 3	25. 9	75	7	1. 55	. 05	2. 57	6	6. 2
April	65. 9	39. 0	83	25	2. 00	. 45	4. 60	1	2. 7
May	76. 1	49. 9	90	37	3. 46	1. 10	6. 32	0	----------
June	85. 2	60. 0	102	49	5. 07	1. 17	7. 85	0	----------
July	91. 9	64. 9	105	56	3. 44	. 75	7. 16	0	----------
August	90. 6	63. 5	104	53	2. 61	. 90	5. 02	0	----------
September	81. 2	53. 0	98	38	2. 80	. 55	5. 42	0	----------
October	71. 0	41. 0	85	26	1. 17	. 17	3. 18	([4])	1. 5
November	53. 1	26. 1	70	13	. 79	. 02	2. 16	2	2. 8
December	41. 6	17. 1	59	−1	. 62	. 01	1. 48	7	4. 0
Annual	65. 6	39. 2	[5] 105	[6] −15	24. 94	16. 74	32. 92	36	4. 0

[1] Data based on 1937–66 period.
[2] Data based on 1931–63 period.
[3] Data based on 1895–1966 period.
[4] Less than half a day.
[5] Average annual maximum.
[6] Average annual minimum.

TABLE 10.—*Probabilities of specified temperatures in spring and fall*

[All data at Red Cloud, Nebr.]

Probability	Dates for given probability and temperature— 16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	April 7	April 15	April 22	May 7	May 18
2 years in 10 later than	April 2	April 10	April 16	May 2	May 12
5 years in 10 later than	March 22	March 31	April 6	April 21	May 2
Fall:					
1 year in 10 earlier than	October 26	October 21	October 12	October 1	September 21
2 years in 10 earlier than	November 1	October 26	October 18	October 6	September 26
5 years in 10 earlier than	November 12	November 5	October 28	October 16	October 6

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has 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 the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity. The capacity of a soil to hold water available for use by plants, usually expressed in linear depths of water per unit depth of soil. Commonly defined as the difference between the percentage of soil water at field capacity and the percentage at wilting point. This difference multiplied by the bulk density and divided by 100 gives a value in inches of water per inch of soil. In this survey, the classes of available water capacity for a soil 60 inches deep, or to a limiting layer are:

Inches	
0 to 3	Very low.
3 to 6	Low.
6 to 9	Moderate.
More than 9	High.

Buried soil. A developed soil, once exposed but now overlain by more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Narrow steps on moderately steep and steep hillsides, caused by slumping or soil slippage.

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 compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

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 and brittle; little affected by moistening.

Depth, soil. The total thickness of weathered soil material overlying mixed sand and gravel or bedrock. In this survey, the classes of soil depth used are:

Inches	
0 to 10	Very shallow.
10 to 20	Shallow.
20 to 40	Moderately deep.
More than 40	Deep.

Dispersion, soil. Deflocculation of the soil and its suspension in water.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Dune. A mound or ridge of loose sand piled up by the wind.

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 wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

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 some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Permeability. The quality that enables the moist soil to transmit air and water. In this survey, terms used to describe permeability apply to that part of the soil below the Ap or equivalent layer, and above a depth of 60 inches, or to bedrock that occurs at a shallower depth. Where there is a change of two or more permeability classes within a short vertical distance, the classes and depths are stated. Classes of soil permeability are:

Inches per hour	
Less than 0.063	Very slow.
0.063 to 0.20	Slow.
0.20 to 0.63	Moderately slow.
0.63 to 2.00	Moderate.
2.00 to 6.30	Moderately rapid.
6.30 to 20.00	Rapid.
20.00 and higher	Very rapid.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; and alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff, surface. The water that flows off the land surface without sinking in.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope. The degree of deviation of a surface from the horizontal, usually expressed in percent or degrees. In this survey, the following slope classes are used:

Percent	
0 to 1	Nearly level.
1 to 3	Very gently sloping.
3 to 7	Gently sloping.
7 to 10	Moderately sloping.
10 to 31	Moderately steep.
31+	Very steep.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that 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.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological 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, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulch. Stubble or other crop residues left on the soil, or partly worked into the soil, to provide protection from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

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 may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Underlying material. In this survey, the weathered soil material immediately beneath the solum.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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