SOIL SURVEY OF

Harlan County, Nebraska

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

Issued November 1974

Major fieldwork for this soil survey was done in the period 1940 to 1950. The survey was revised and updated from 1964 to 1966. 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 Lower Republican Natural Resource 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 SOIL SURVEY

THIS SOIL 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 Harlan 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 windbreak suitability group 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 on 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 descriptions of the capability units, the range sites, and the windbreak suitability groups.

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

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife and Recreation."

Ranchers and others can find, under "Management of the 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 dwellings, industrial buildings, schools, and parks in the section "Engineering Evaluation of the Soils."

Engineers and builders can find, under "Engineering Evaluation of the 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 Soils."

Newcomers in Harlan 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 information about the county given in the section "General Nature of the County."

Cover: Field has been stripcropped to conserve moisture and reduce soil blowing. The summer-fallowed strip is newly seeded to winter wheat, and the alternate strip is in grain sorghum. The soil is Holdrege silt loam.

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SOILS SURVEYED BY GILBERT BOWMAN, MERRITT PLANTZ, MAURICE MILLER, AND JOHN WILLARD, SOIL CONSERVATION SERVICE

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

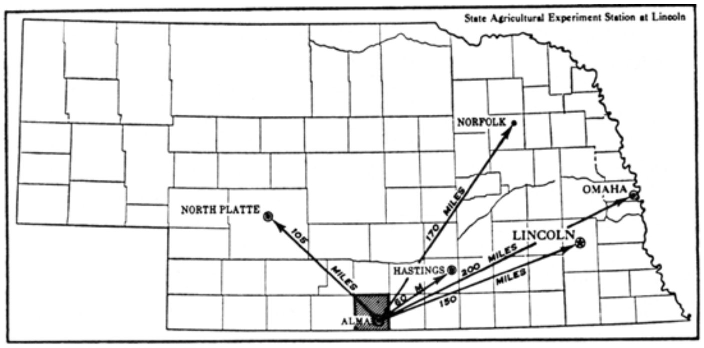

Figure 1.—**Location of Harlan County in Nebraska.**

HARLAN COUNTY is in south-central Nebraska; its southern boundary joins the State of Kansas (fig. 1). The county is 24 miles square and has a land area of 354,560 acres. The Harlan County Reservoir, on the Republican River, occupies an additional 13,800 acres. Alma, the county seat, is about 150 miles southwest of Lincoln. Smaller towns are Orleans, Republican City, Stamford, Oxford, Huntley, and Ragan.

Harlan County is in the Great Plains physiographic province. The Republican River crosses the county from northwest to southeast. Breaks to the Republican River Valley drain most of the county except the northeastern corner, which has a more nearly level landscape.

Harlan County is mainly farmland. Wheat-fallow is the dominant system of farming, but there is also much of the diversified feed grain-livestock type. The U.S. Census of Agriculture indicates that in 1964 about 35 percent of the county was in harvested cropland. Of this amount, about 15 percent was irrigated. About 31 percent of all farms had some irrigation. Native grass rangeland occupies the moderately sloping to steep soils of most upland drainageways. The average farm in 1969 was 615 acres in size. Cattle, hogs, and chickens are the principal kinds of livestock.

An older soil survey of Harlan County was published in 1930 (*3*).[1] The present survey was made to provide additional, up-to-date information. This information is needed because of technical advances in farming methods, engineering, and soil classification.

[1] Italic numbers in parentheses refer to Literature Cited, p. 63.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Harlan 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.

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. Leshara and Coly, for example, are the names of two soil series. All the soils in the United States that have 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 layer 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, 0 to 1 percent slopes, is one of several phases within the Holdrege series.

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 at the back of this publication was prepared from 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 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. One such kind of mapping unit is shown on the soil map of Harlan County: the 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 can be made up of only one of the dominant soils, or of two or more. Coly and Hobbs silt loams is an undifferentiated soil group in this county.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been 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. Broken alluvial land is a land type in this county.

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

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a given kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they 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 current 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 Harlan 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.

The soil texture given in the descriptive heading for the soil association refers to the texture of the surface layer. For example, in the heading of association 1, the words "silty soils" refer to the texture of the surface layer.

Soil association names and delineations on the general soil map do not fully agree with those on the general soil map made in adjacent counties at a different date. The differences in the maps are the result of improvement in the classification of the soils, particularly modifications or refinements in the soil series concepts. In addition, more precise and detailed maps are needed because the number of users of the maps and the need for detail have increased in recent years. The more modern maps meet these needs. Still another difference is the pattern of occurrence of the major soils or the range in slope that is permitted within associations in different surveys.

The soil associations in Harlan County are described in the following pages.

1. Holdredge Association

Deep, nearly level to very gently sloping, silty soils on loess-mantled uplands

This soil association is made up of upland areas mantled with a thick deposit of loess (fig. 2). The soils are nearly level to very gently sloping. The drainage pattern in most parts of the association is well established by entrenched drainageways, but in some parts water moves slowly into shallow depressions and marshes, where it ponds.

This soil association occupies about 9 percent of the

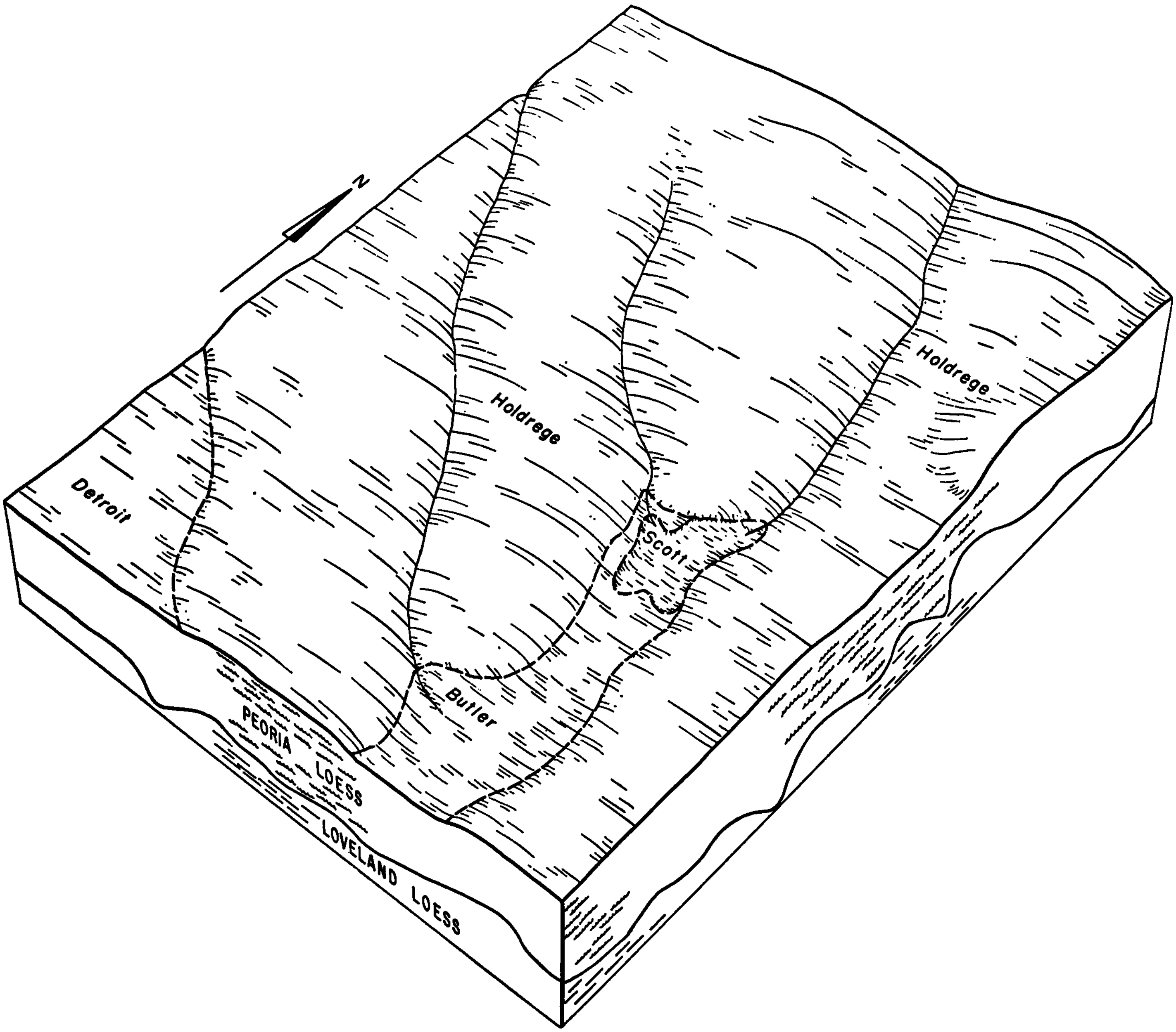

Figure 2.—**Relationship of the soils and parent material in the Holdrege association.**

county. About 86 percent is Holdrege soils, and the remaining 14 percent is minor soils.

Holdrege soils are on the highest parts of the landscape. They are deep, well-drained soils that have a surface layer of gray to dark-gray silt loam. The subsoil is dark-gray to grayish-brown or light brownish-gray light silty clay loam. The underlying material is at a depth of 34 inches and is light-gray silt loam.

Minor soils of this association are the Detroit, Butler, and Scott soils. Detroit soils are nearly level and are slightly below areas of Holdrege soils. Butler soils are nearly level and are in shallow basins slightly below areas of Detroit or Holdrege soils. Scott soils are in shallow depressions in the lowest parts of the upland landscape.

Most of this association is cultivated. Irrigation is important, and crops respond well to additional water. Corn, grain sorghum, and alfalfa are the main irrigated crops. Winter wheat and grain sorghum are the main dryland crops. Most farms are of the cash-grain type, but many farmers fatten livestock in feedlots.

A lack of sufficient moisture is the main limitation where dryland crops are grown. During some seasons, soil blowing is a hazard. Maintaining fertility and managing water are the main needs in irrigated areas.

Farms in this association average about 520 acres in size. Gravel or improved dirt roads are on most section lines. Some paved highways cross the association. Farm produce is marketed at Ragon, and at Holdrege in Phelps County.

2. Holdrege-Coly-Uly Association

Deep, very gently sloping to steep, silty soils on divides and drainageways in the loess-mantled uplands

This soil association is made up of alternating divides and drainageways (fig. 3). Soils of the divides are very gently sloping to moderately sloping, and those of the drainageways are steep. The drainageways are intermittent or spring-fed tributaries of the Republican River, Sappa Creek, Prairie Dog Creek, and Turkey Creek.

This soil association occupies about 78 percent of the county. About 52 percent is Holdrege soils, 20 percent is Coly soils, and 12 percent is Uly soils. The remaining 16 percent is minor soils and land types.

Holdrege soils are on the divides. They are well-drained soils that have a surface layer of gray to dark-gray silt loam. The subsoil is dark-gray to grayish-brown and light brownish-gray light silty clay loam. The underlying material is at a depth of 34 inches and is light-gray silt loam.

Coly soils are on sides of intermittent drainageways. They are well-drained soils that have a thin surface layer of grayish-brown silt loam. Beneath this is a transition layer of light brownish-gray, friable silt loam. The underlying material is at a depth of 12 inches and is light-gray silt loam.

Uly soils occupy the lower parts of some divides and the upper parts of some drainageways between areas of Holdrege and Coly soils. They are well-drained soils that have a thick surface layer of dark-gray silt loam and a subsoil of friable, grayish-brown silt loam. The underlying material is at a depth of 16 inches and is very pale brown silt loam.

Minor soils and land types of this association are the Nuckolls and Hobbs soils and Broken alluvial land. Nuckolls soils are on the sides of drainageways, below

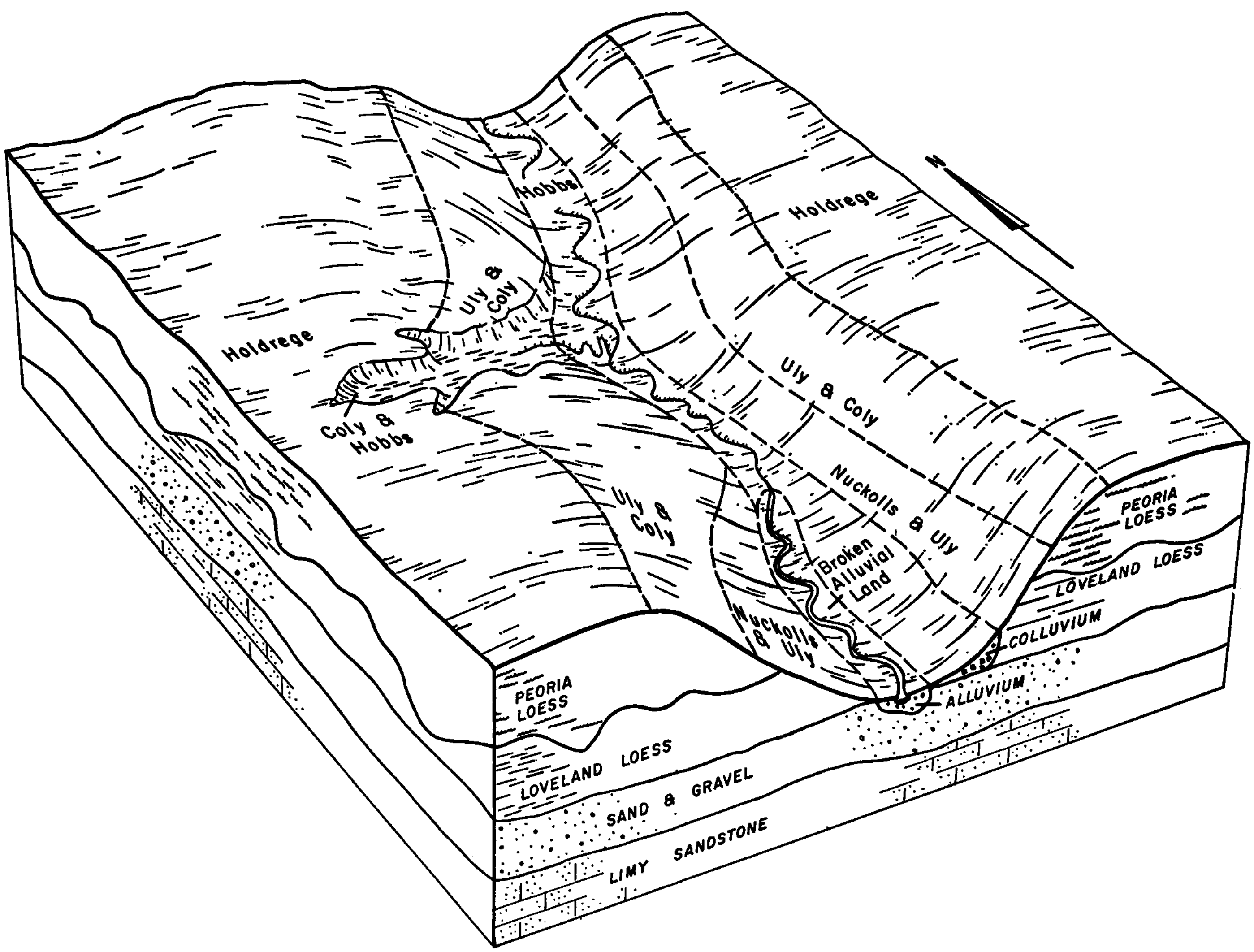

Figure 3.—**Relationship of the soils and parent material in the Holdrege-Coly-Uly association.**

areas of Coly soils. Hobbs soils are in the narrow bottoms of small drainageways. Broken alluvial land is in the bottoms of larger drainageways where flooding is frequent or where there are deep, meandering channels.

Farms in this association are diversified. Most are of the cash grain-livestock type. Soils on the divides are used mainly for dryland cultivation. Wheat and grain sorghum are the main crops. Steep soils of the drainageways are used mainly for range. A few nearly level soils are irrigated. Some livestock is fattened and marketed.

Water erosion, soil blowing, and drought are the main hazards in cultivated areas. Proper management and control of water erosion are needed on rangeland.

Farms in this association average about 720 acres in size. Gravel or improved dirt roads are on most section lines. Some paved highways cross the association. Farm produce is marketed mainly within the county, but some is delivered to markets in adjacent counties, such as Holdrege in Phelps County.

3. Hord-Cozad-Hall Association

Deep, nearly level to gently sloping, silty soils on stream terraces and narrow bottom lands

This soil association is made up of stream terraces and foot slopes of the Republican River and Sappa Creek Valleys and stream terraces, foot slopes, and bottom lands of Prairie Dog Creek, Turkey Creek, Spring Creek, and Deep Creek Valleys (fig. 4). The soils are nearly level to gently sloping and are well drained. Although the association is below the adjacent uplands, only the lowest lying areas are commonly flooded.

This soil association occupies about 9 percent of the county. About 37 percent is Hord soils, 19 percent is Cozad soils, and 18 percent is Hall soils. The remaining 26 percent is minor soils and land types.

Hord soils are on high stream terraces. They have a thick surface layer of grayish-brown to dark-gray silt loam. The subsoil is friable, grayish-brown to light brownish-gray silt loam. The underlying material is at a depth of about 40 inches and is light-gray silt loam.

Cozad soils are on foot slopes adjacent to uplands and on stream terraces. They are at the highest elevation in the association. Cozad soils have a thick surface layer of grayish-brown silt loam and a thin subsoil of brownish-gray silt loam. The underlying material is at a depth of about 16 inches and is light-gray, calcareous silt loam.

Hall soils are in association with Hord soils on stream terraces. They have a thick surface layer of gray silt loam. The upper part of the subsoil is grayish-brown silty clay loam, and the lower part is pale-brown light silty clay loam. The underlying material is at a depth of about 46 inches and is light-gray silt loam.

Minor soils and land types of this association are the Hobbs, McCook, and Coly soils and Broken alluvial land. McCook soils are in association with Hobbs soils on narrow bottom lands and foot slopes. Coly soils are steep and occur on breaks of stream terraces to bottom lands.

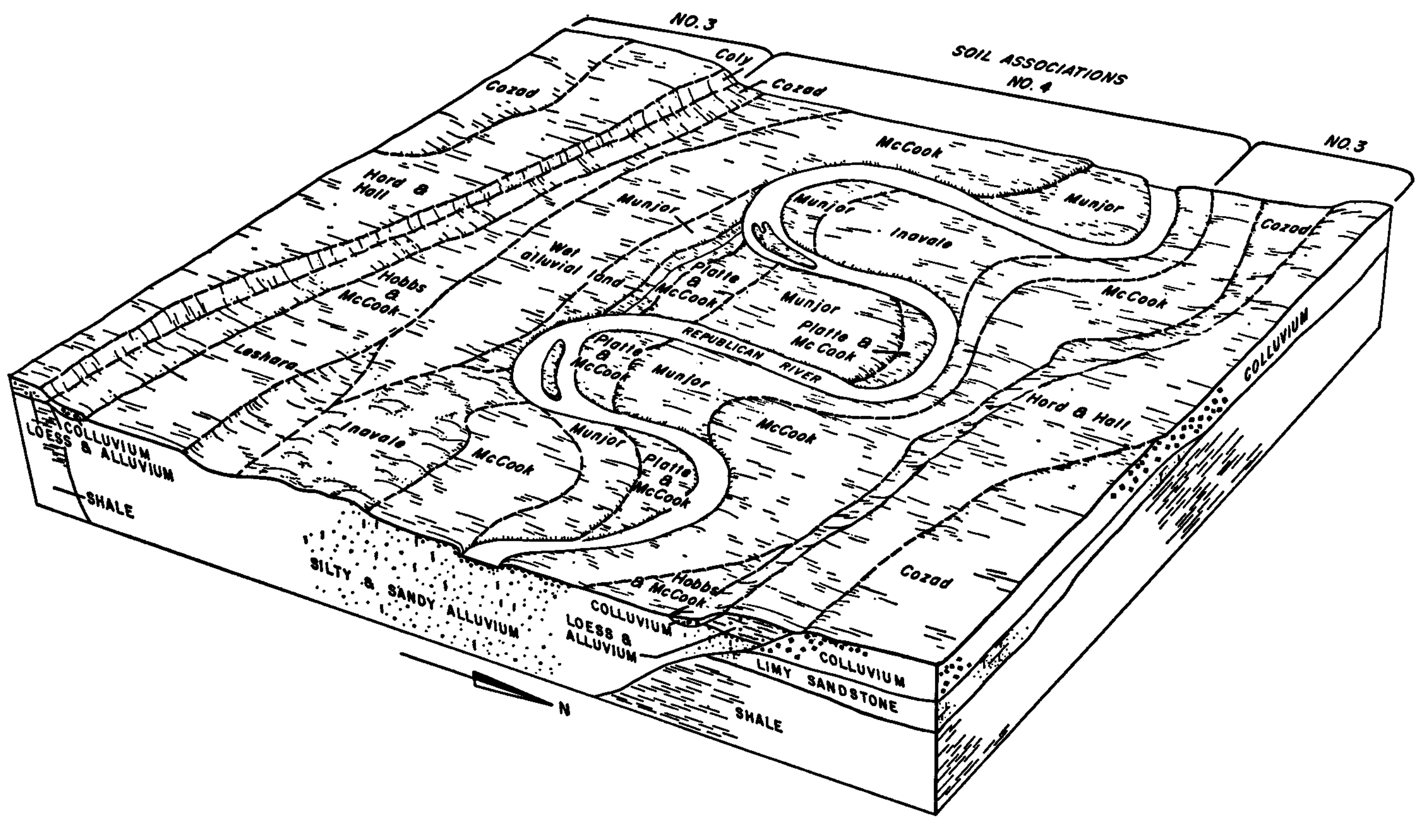

***Figure 4.*—Relationship of the soils and parent material in the Hord-Cozad-Hall and the McCook-Munjor-Inavale associations.**

Broken alluvial land is at the lowest elevations of the association on frequently flooded bottoms and adjacent steep sides of the major creeks.

Most soils in this association are cultivated, and many are irrigated. Some areas are in native grass. Corn, alfalfa, and grain sorghum are the main crops. Wheat and alfalfa are important dryland crops. Most farms are of the cash grain-livestock type.

Soil blowing and lack of sufficient moisture are the main hazards in dryfarmed areas. Maintaining fertility and managing water are the main needs in irrigated areas.

Farms in this association average about 500 acres in size. Most farms contain parts of adjacent associations. Good gravel or improved dirt roads are on most section lines and are adequate for transporting farm produce to market. Highways are paved.

4. McCook-Munjor-Inavale Association

Deep, nearly level to very gently sloping, loamy soils on bottom lands

This soil association is on bottom lands of the valleys of the Republican River and its tributary, Sappa Creek (see fig. 4). The soils are nearly level to very gently sloping. A few areas are low and hummocky. The water table is between depths of 2 and 10 feet in most of the area, but along Sappa Creek it is deeper.

This soil association occupies about 4 percent of the county. About 55 percent is McCook soils, 7 percent is Inavale soils, and 22 percent is Munjor soils. The remaining 16 percent is minor soils and land types.

McCook soils are moderately well drained and are on some of the highest parts of this association. They have a thick surface layer of grayish-brown, calcareous loam and a transition layer of light brownish-gray, calcareous very fine sandy loam. The underlying material is at a depth of 16 inches and is light-gray, calcareous very fine sandy loam.

Munjor soils are moderately well drained and at lower elevations than any of the other major soils of this association. They have a thick surface layer of grayish-brown to light brownish-gray, calcareous fine sandy loam. The thin transition layer is light brownish-gray, calcareous fine sandy loam. The underlying material is at a depth of 18 inches and is light brownish-gray and light-gray, calcareous, stratified loamy sand, fine sandy loam, and sandy loam.

Inavale soils are excessively drained, low, and hummocky. They have a thick surface layer of grayish-brown, calcareous fine sandy loam and a transition layer of light brownish-gray loamy fine sand. The underlying material is at a depth of 30 inches and is pale-brown to very pale brown, calcareous loamy sand.

Minor soils and land types of this association are the Cozad, Hobbs, Platte, and Leshara soils and Wet alluvial land. Cozad soils are on foot slopes that are the highest elevations of the association. Hobbs soils are in association with McCook soils on some of the highest elevations of the bottom lands of this association. The Platte soils are shallow to sand and occur in old, abandoned river channels and other low-lying areas. Leshara soils are deep and occupy lower positions than McCook or Hobbs soils and higher positions than Platte soils. Wet alluvial land is at the lowest elevations, either in old, abandoned channels or in small depressions.

Most soils in this association are cultivated. Many are irrigated with water readily available from shallow irrigation wells. Corn, wheat, alfalfa, and grain sorghum are the main dryland crops. Corn and grain sorghum are the main irrigated crops. Some areas along the Republican River are still in native grass. Trees are along the creeks and river channels. Most farms are of the cash-grain type, but some are more diversified and are used for raising cattle and hogs, particularly in feedlots.

Maintaining fertility and managing water are the main needs in irrigated areas. Soil blowing, occasional flooding, and wetness are hazards in some areas. Lack of moisture is a severe limitation in dryfarmed areas. Proper range management is needed on soils used for grazing.

Only a few farmsteads are in this association. The soils are farmed as parts of the Hord-Cozad-Hall association. Farms average about 680 acres in size. Section lines in this association have roads only where bridges are constructed to span the Republican River and Sappa Creek.

Descriptions of the Soils

This section describes the soil series and mapping units in Harlan County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless 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 familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Unless otherwise stated, the colors given in the descriptions are for a dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Wet alluvial land, for example, does not belong to a soil series but, nevertheless, is 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 are the capability unit, range site, and windbreak suitability group in which the mapping unit has been placed. The page for the description of each capability unit, range site, and windbreak suitability group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*4*).

The names of some soils are unlike those appearing in recently published surveys of adjacent counties. This is the result of changes in concepts of soil series in the application of the soil classification system. For some series, the profile selected as representative has one or more features outside the defined range of characteristics. In these instances, a reference is made to explain how the soil differs. Unless otherwise stated, the profiles have characteristics that are within the defined range of the series.

Some soil boundaries and soil names do not match those of adjoining areas in adjacent counties. This can be the result of changes in slope groupings, combinations of mapping units, or correlation procedures that occur in soil classification and mapping guidelines.

Broken Alluvial Land

Broken alluvial land (0 to 2 percent slopes) (Bk) is on bottom lands in areas adjacent to tributaries of the Republican River. These areas are rough, deeply channeled, and frequently flooded. The meandering of creeks has made the formation of escarpments and the cutting of streambanks common. Areas are narrow and in places are several miles long. They range from 10 to 300 acres in size.

The soil material of this land type is deep and mainly medium textured. Thin layers and strata of moderately coarse textured material are in some places. Dark- and light-colored strata are present because silt is deposited during each flood.

Included in mapping were small areas of Hobbs soils on some higher lying areas.

Frequent flooding after heavy rain is the principal limitation to use of this soil. In addition, the areas are too narrow and too cut up by the meandering creek to be suitable for cultivation.

Nearly all the acreage is used for grazing. Feed crops can be grown in areas where the flood plain is widest. Native trees are common along streambanks. Capability unit VIw-1 dryland; Silty Overflow range site; Moderately Wet windbreak suitability group.

Butler Series

The Butler series consists of deep, somewhat poorly drained soils that have a claypan subsoil. These soils are nearly level and are in shallow, basinlike depressions in the uplands. They formed in loess.

In a representative profile the surface layer is dark-gray and very dark gray silt loam 14 inches thick. Beneath this is a leached subsurface layer of gray silt loam about 3 inches thick. The claypan subsoil is 31 inches thick. It is dark-gray, very firm silty clay in the upper part; gray, very firm silty clay in the middle; and light brownish-gray, firm light silty clay loam in the lower part. The underlying material is at a depth of 48 inches and is light brownish-gray, calcareous silt loam.

Butler soils have slow permeability and high available water capacity. Content of organic matter is moderate,

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

Soils	Area	Extent
	Acres	*Percent*
Broken alluvial land	10, 500	3. 0
Butler silt loam	1, 400	0. 4
Coly and Hobbs silt loams	5, 000	1. 4
Coly and Nuckolls silt loams, 9 to 31 percent slopes, eroded	39, 900	11. 3
Coly and Uly silt loams, 3 to 9 percent slopes, eroded	18, 600	5. 2
Cozad silt loam, 0 to 1 percent slopes	3, 000	. 8
Cozad silt loam, 1 to 3 percent slopes	2, 100	. 6
Cozad silt loam, 3 to 7 percent slopes	1, 000	. 3
Detroit silt loam, 0 to 1 percent slopes	1, 800	. 5
Hobbs and McCook silt loams, 0 to 1 percent slopes	6, 000	1. 7
Hobbs and McCook silt loams, 1 to 3 percent slopes	1, 900	. 5
Holdrege silt loam, 0 to 1 percent slopes	25, 100	7. 1
Holdrege silt loam, 1 to 3 percent slopes	11, 700	3. 3
Holdrege silt loam, 1 to 3 percent slopes, eroded	110, 400	31. 3
Holdrege silt loam, 3 to 7 percent slopes	2, 400	. 7
Holdrege and Uly soils, 3 to 7 percent slopes, eroded	3, 100	. 9
Hord and Hall silt loams, terrace, 0 to 1 percent slopes	14, 200	4. 0
Hord and Hall silt loams, terrace, 1 to 3 percent slopes	3, 500	1. 0
Inavale fine sandy loam, 0 to 3 percent slopes	1, 000	. 3
Leshara silt loam	360	. 1
McCook loam	4, 300	1. 2
McCook sand, overwash	1, 000	. 3
Munjor fine sandy loam, 0 to 3 percent slopes	1, 500	. 3
Munjor loamy fine sand, 0 to 3 percent slopes	1, 500	. 3
Nuckolls and Uly silt loams, 9 to 15 percent slopes	6, 000	1. 7
Nuckolls and Uly silt loams, 9 to 31 percent slopes, eroded	800	. 2
Nuckolls, Uly, and Canlon soils, 9 to 31 percent slopes	2, 600	. 8
Platte and McCook soils	700	. 2
Scott silt loam	700	. 2
Uly silt loam, 3 to 9 percent slopes	3, 800	1. 1
Uly and Coly silt loams, 9 to 31 percent slopes	68, 200	19. 2
Wet alluvial land	500	. 1
Total land area	354, 560	100. 0
Harlan County Reservoir	13, 800	--------

and natural fertility is high. Reaction in these soils is neutral in the surface layer, neutral to moderately alkaline in the subsoil, and moderately alkaline in the underlying material.

Butler soils are suited to cultivated crops, both dryland and irrigated. A few small areas are in native grass. These soils are suited to trees, wildlife habitat, and recreation.

Representative profile of Butler silt loam, in a cultivated field, 2,440 feet east and 400 feet south of the northwest corner of sec. 22, T. 4 N., R. 17 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, fine, crumb structure; slightly hard, friable; neutral; abrupt, smooth boundary.

A12—6 to 14 inches, very dark gray (10YR 3/1) silt loam, black (10YR2/1) moist; weak, coarse, prismatic structure parting to weak, medium, granular; slightly hard, friable; neutral; clear, smooth boundary.

A2—14 to 17 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, prismatic structure parting to moderate, medium, granular; slightly hard, very friable; neutral; abrupt, smooth boundary.

B21t—17 to 34 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate, coarse, prismatic structure parting to strong, medium, blocky; very hard, very firm; neutral; clear, smooth boundary.

B22t—34 to 40 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate, coarse, prismatic structure parting to strong, medium, blocky; very hard, very firm; mildly alkaline; clear, smooth boundary.

B3ca—40 to 48 inches, light brownish-gray (10YR 6/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, firm; violent effervescence; moderately alkaline; clear, smooth boundary.

C—48 to 60 inches, light brownish-gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The A1 horizon ranges from 10 to 16 inches in thickness and from slightly acid to neutral in reaction. The A2 horizon ranges from 1 to 3 inches in thickness, and the B horizon from 12 to 36 inches in thickness. The B2t horizon is silty clay or clay. Calcium carbonate is at a depth of 24 to 45 inches. Lime concretions are in the C horizon in some areas.

Butler soils are in the same landscape as Scott, Detroit, and Holdredge soils. They have a thicker surface layer than Scott soils, which are in enclosed depressions and are ponded longer. They have a finer textured subsoil than Detroit and Holdredge soils and have a gray A2 horizon that does not occur in those soils.

Butler silt loam (0 to 1 percent slopes) (Bu).—This soil is in shallow basins of the loessial uplands. Areas range from 5 to about 400 acres in size.

Included with this soil in mapping were small areas of Holdrege silt loam and Detroit silt loam.

This Butler soil is droughty in dryfarmed areas. Moisture penetrates the claypan slowly and is released to plants slowly. Numerous small, timely showers are needed to provide adequate moisture for crops. In places runoff from adjacent higher lying slopes, following heavy rain, temporarily floods areas of this soil. Some crop damage may occur or planting or tillage may be delayed because of this.

Most of the acreage of this soil is cultivated. Corn, wheat, and grain sorghum are the main crops. Some areas are irrigated by water from deep wells. Capability units IIs–2 dryland and IIs–2 irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Canlon Series

The Canlon series consists of shallow, loamy, well-drained soils. These soils are strongly sloping to steep. They are on uplands on the lower parts of drainageways that are part of the southern breaks to the Republican River Valley. They formed in material weathered from limy sandstone.

In a representative profile the surface layer is dark grayish-brown loam 5 inches thick. Beneath this is a transition layer of light brownish-gray, friable loam 5 inches thick. The underlying material is at a depth of 10 inches and is light-gray loam. Hard, limy sandstone is at a depth of 18 inches. Sandstone fragments are throughout the profile.

Canlon soils have moderate permeability and low available water capacity. The organic-matter content and natural fertility are low. Reaction in these soils is mildly alkaline in the surface layer and moderately alkaline in the transition layer and underlying material. Canlon soils are calcareous throughout the profile. They release moisture readily to plants.

Canlon soils are suited to rangeland. They are too shallow and too sloping for cultivated crops. Some areas have short, scattered native trees. These soils are also suited to trees in windbreaks, wildlife habitat, and recreation.

In Harlan County, Canlon soils are mapped only in an undifferentiated soil group with Nuckolls and Uly soils.

Representative profile of Canlon loam in an area of Nuckolls, Uly, and Canlon soils, 9 to 31 percent slopes, in native rangeland, 0.3 mile north and 300 feet west of the southeast corner of sec. 7, T. 1, N., R. 19 W.:

A—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; hard, very friable; few small sandstone fragments; strong effervescence; mildly alkaline; clear, smooth boundary.

AC—5 to 10 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard; friable; few medium sandstone fragments; strong effervescence; moderately alkaline; clear, smooth boundary.

C—10 to 18 inches, light-gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak, coarse, blocky structure; hard, firm; many small and large sandstone fragments; violent effervescence; moderately alkaline; abrupt, smooth boundary.

R—18 to 24 inches, white (7.5YR 8/0) limy sandstone; violent effervescence.

The A horizon ranges from 3 to 6 inches in thickness and from dark grayish brown to light brownish gray. It is typically loam, but ranges from silt loam to very fine sandy loam. Depth to lime ranges from 0 to 6 inches. Depth to hard sandstone ranges from 10 to 20 inches.

Canlon soils are in the same landscape as Nuckolls and Uly soils. They are shallow soils that formed in sandstone bedrock, whereas Nuckolls and Uly soils are deep soils that formed in thick loess. Canlon soils are shallow, as are Platte soils, which have underlying material of mixed sand and gravel.

Coly Series

The Coly series consists of deep, well-drained, silty soils. These soils are gently sloping to very steep. They are immature soils that formed in loess on uplands and breaks of stream terraces.

In a representative profile the surface layer is grayish-brown silt loam 5 inches thick. Beneath this is a transition layer of light brownish-gray, friable silt loam about 7 inches thick. The underlying material is at a depth of 12 inches and is light-gray silt loam.

Coly soils have moderate permeability and high available water capacity. The organic-matter content and natural fertility are low. Reaction in these soils is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the rest of the profile.

Coly soils are well suited to rangeland or pasture. In less sloping areas, they can be used for cultivated crops. They are also suited to trees and wildlife habitat.

Representative profile of Coly silt loam in an area of Uly and Coly silt loams, 9 to 31 percent slopes, in native range, 0.2 mile east and 75 feet south of the northwest corner of sec. 32, T. 4 N., R. 18 W.:

A—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; slightly hard, friable; mildly alkaline; clear, smooth boundary.

AC—5 to 12 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; strong effervescence; moderately alkaline; gradual, smooth boundary.

C—12 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The A horizon ranges from 2 to 6 inches in thickness and from grayish brown to light brownish gray and pale brown. The AC horizon ranges from 2 to 8 inches in thickness. The C horizon is light gray, pale brown, or very pale brown. Depth to calcium carbonates ranges from 0 to 10 inches.

Coly soils are in the same landscape as Uly, Holdredge, and Nuckolls soils. They have a thinner A horizon than any of those soils, do not have a B horizon, and have lime nearer the surface.

Coly and Hobbs silt loams (0 to 50 percent slopes) (Ch).—Coly silt loam and Hobbs silt loam are the main soils in this unit. In most areas Coly soils make up 40 to 60 percent of the acreage and Hobbs soils, 5 to 30 percent. The rest is 5 to 15 percent Uly silt loam and 10 to 20 percent rough and broken land. In some places, areas of this mapping unit have little bottom land, and Coly and Uly soils and broken land make up most of the landscape.

Soils in this mapping unit are in upland drainageways that have steep and very steep soils on the sides and nearly level soils in the narrow bottoms (fig. 5). Areas range from 5 to 60 acres in size. The Hobbs soil is described under the heading "Hobbs Series."

Water erosion is a hazard in areas of the Coly soil. Flooding is a hazard on narrow bottoms where water is channeled after rain. Erosion is most severe where the soils have been overgrazed.

Most of the acreage of these soils is in native grass used for grazing livestock. Some areas have a few shrubs and isolated trees. Wildlife commonly use these areas for food and habitat. Capability unit VIe–9 dryland; Coly soil in Limy Upland range site and Silty to Clayey windbreak suitability group; Hobbs soil in Silty Overflow range site and Moderately Wet windbreak suitability group.

Figure 5.—**Area of Coly and Hobbs soils that has Coly soils on the sides and Hobbs soils on the narrow bottoms. Nearly all areas are used for grazing.**

Coly and Nuckolls silt loams, 9 to 31 percent slopes, eroded (CkD2).—Soils in this mapping unit are on sides of intermittent drainageways in the loessial uplands. Areas are confined to tributaries that are part of the breaks to the Republican River Valley. The upper part of the landscape is Coly silt loam and makes up 50 to 75 percent of the acreage. Nuckolls silt loam is on the lower part and makes up 0 to 25 percent. A few areas have only one of these soils. They have profiles similar to the ones described as representative of their respective series except they are moderately to severely eroded.

Included with these soils in mapping were small areas of Hobbs silt loam on narrow valley floors that make up 0 to 15 percent of the acreage; areas of Holdrege silt loam that make up 0 to 10 percent; and areas of rough, broken land that make up 0 to 10 percent.

Water erosion is the main hazard. Runoff is rapid, and rills and gullies caused by the rapidly moving water are common. Flooding of the narrow valley floors is common after heavy rain. The Coly soil is low in fertility.

Most of the acreage is used for cultivated crops, but because of the erosion hazard, this is not their best use. A few areas have been seeded to native and tame grasses and are used for pasture. Capability unit VIe–8 dryland; Coly soil in Limy Upland range site and Silty to Clayey windbreak suitability group; Nuckolls soil in Silty range site and Silty to Clayey windbreak suitability group.

Coly and Uly silt loams, 3 to 9 percent slopes, eroded (CmC2).—Soils in this mapping unit are on divides between the drainageways. Coly silt loam makes up 50 to 75 percent of the acreage and Uly silt loam makes up 0 to 30 percent. A few areas have only one of these soils. Areas of this mapping unit range from 5 to 40 acres in size. These soils have a profile similar to the ones described as representative of their respective series except their surface layer is slightly thinner.

Included with these soils in mapping were areas of Holdrege silt loam, 3 to 7 percent slopes, that make up 0 to 15 percent of the acreage and areas of Hobbs silt loam that make up 0 to 10 percent.

Water erosion is the main hazard. Small rills and gullies are common in cultivated areas. The Coly soil has low fertility and low organic-matter content.

Most of the acreage of these soils is used for winter wheat, grain sorghum, and corn. A few areas have been seeded to native or tame grasses and are used for pasture. Some areas are still in native rangeland. Capability units IVe–8 dryland and IVe–11 irrigated; Coly soil in Limy Upland range site and Silty to Clayey windbreak suitability group; Uly soil in Silty range site and Silty to Clayey windbreak suitability group.

Cozad Series

The Cozad series consists of deep, well-drained, silty soils. These soils are nearly level to gently sloping and are on low stream terraces and foot slopes in the valleys of the Republican River and its tributaries. They formed in alluvium, colluvium, or mixtures of these materials.

In a representative profile the surface layer is grayish-brown silt loam about 10 inches thick. The subsoil is grayish-brown, very friable silt loam 6 inches thick. Beneath this is the underlying material, which is calcareous, very friable silt loam or very fine sandy loam. It is light brownish gray in the upper part and light gray in the lower part.

Cozad soils have moderate permeability and high available water capacity. Content of organic matter is moderately low, and natural fertility is medium. The surface layer is slightly acid or neutral. The subsoil and underlying material are neutral to moderately alkaline.

Cozad soils are suited to both dryland and irrigated cultivated crops. They are also suited to trees for windbreaks, grass, wildlife habitat, and recreation.

Representative profile of Cozad silt loam, 0 to 1 percent slopes, in a cultivated field, 0.1 mile west and 200 feet south of the center of sec. 32, T. 1 N., R. 19 W.:

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

A12—5 to 10 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

B2—10 to 16 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, very friable; neutral; clear, smooth boundary.

C1—16 to 24 inches, light brownish-gray (10YR 6/2) silt loam or very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; slight effervescence; mildly alkaline; clear, smooth boundary.

C2—24 to 36 inches, light-gray (10YR 7/2) silt loam or very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline; clear, smooth boundary.

C3—36 to 42 inches, light-gray (10YR 7/2) silt loam or very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline; clear, smooth boundary.

C4—42 to 60 inches, light-gray (10YR 7/2) silt loam or very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline.

The A horizon ranges from 7 to 16 inches in combined thickness and from grayish brown to dark grayish brown. The surface layer is mainly silt loam, but ranges to very fine sandy loam. The B horizon ranges from 6 to 16 inches in thickness and from grayish brown to light brownish gray. The C horizon is silt loam or very fine sandy loam and ranges from grayish brown to light gray. A weakly developed, buried soil is common between depths of 24 and 60 inches. Depth to calcium carbonate ranges from 15 to 26 inches.

Cozad soils are in the same landscape as Hord and Hall soils. They have a thinner A horizon and lime higher in their profile than Hord soils. They have a less clayey B horizon than Hall soils. In places, Cozad soils are associated with McCook soils. In contrast with those soils, they have a B horizon and have lime at a greater depth, and they are not stratified.

Cozad silt loam, 0 to 1 percent slopes (CoA).—This soil is on low stream terraces of the Republican River and its major tributaries. It has the profile described as representative of the series. Areas range from 5 to 300 acres in size.

Included with this soil in mapping were small areas of Hord, McCook, and Hobbs soils.

This Cozad soil is droughty in dryfarmed areas. Organic-matter content needs to be improved. Maintaining fertility is a management need, particularly in irrigated areas. Runoff is slow.

Most of the acreage of this soil is cultivated. Wheat, grain sorghum, corn, and alfalfa are the main crops. Crops are grown under both dryland and irrigated management. A few small areas are in native grass. This is one of the best soils in the county for crops. Capability units IIc–1 dryland and I–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Cozad silt loam, 1 to 3 percent slopes (CoB).—This soil is mainly on foot slopes between uplands and stream terraces on bottom lands. Areas range from 5 to 100 acres in size. The largest areas are long and narrow. This soil has a profile similar to the one described as representative of the series except the surface layer and subsoil are slightly thinner.

Included with this soil in mapping were small areas of Hord soils and a few areas where the surface layer is very fine sandy loam.

This Cozad soil is droughty in dryfarmed areas. Maintaining fertility is a management need. Water erosion and soil blowing are the main hazards. Iron and zinc deficiencies are present in some areas, particularly where the soil has been cut for land leveling. Runoff is slow.

Most of the acreage of this soil is cultivated. Corn, alfalfa, wheat, and grain sorghum are the main crops. Many areas are irrigated. Capability units IIe–1 dryland and IIe–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Cozad silt loam, 3 to 7 percent slopes (CoC).—This soil is on footslopes in the valleys of the Republican River and its tributaries. Areas are generally long and narrow, ranging from 5 to 30 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is about 3 inches thinner.

Included with this soil in mapping were small areas of Uly silt loam, 3 to 9 percent slopes, and Cozad silt loam, 1 to 3 percent slopes.

Water erosion and loss by runoff are the main hazards. Soil blowing is a hazard where the surface is not adequately protected. Maintaining fertility is a management need, particularly in irrigated areas. Runoff is medium.

Most of the acreage of this soil is cultivated. Wheat and grain sorghum are the main crops. Alfalfa and corn are also grown. Most areas are dryfarmed, but some are irrigated. Some areas are still in native grass. Capability units IIIe-1 dryland and IIIe-1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Detroit Series

The Detroit series consists of deep, moderately well drained soils. These soils are nearly level on loessial uplands and are on flat areas slightly higher in elevation than the Butler soils of the depressions.

In a representative profile the surface layer is dark-gray silt loam 16 inches thick. The subsoil is about 26 inches thick. The upper part is dark grayish-brown, firm heavy silty clay loam; the middle part is grayish-brown, firm silty clay loam; and the lower part is light brownish-gray, friable silty clay loam. The underlying material is at a depth of 42 inches and is very pale brown, calcareous silt loam.

Detroit soils have slow permeability and high available water capacity. Content of organic matter is moderate, and natural fertility is high. The surface layer is slightly acid or neutral. The subsoil is neutral or mildly alkaline, and the underlying material is mildly alkaline or moderately alkaline.

Detroit soils are suited to cultivated crops, both dryland and irrigated. They are also suited to grass, trees, and wildlife habitat.

Representative profile of Detroit silt loam, 0 to 1 percent slopes, in a cultivated field, 200 feet east and 140 feet north of the southwest corner of sec. 15, T. 4 N., R. 17 W.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, fine, crumb structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

A12—7 to 16 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, coarse, prismatic structure parting to weak, medium, granular; slightly hard, very friable; neutral; clear, smooth boundary.

B21t—16 to 24 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, blocky; very hard, firm; neutral; clear, smooth boundary.

B22t—24 to 32 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; very hard, firm; mildly alkaline; clear, smooth boundary.

B3t—32 to 42 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; mildly alkaline; clear, smooth boundary.

C—42 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; slightly hard, very friable; strong effervescence; small and medium lime concretions; moderately alkaline.

The A horizon ranges from 12 to 20 inches in thickness. The B2t horizon is silty clay loam or light silty clay. The B horizon ranges from 12 to 30 inches in thickness. Depth to lime ranges from 24 to 50 inches.

Detroit soils are in the same landscape as Holdrege, Butler, and Scott soils. They have a finer textured B2t horizon than Holdrege soils. They do not have the A2 horizon of Butler or Scott soils and are not so fine textured in the B2t horizon as those soils. Scott and Butler soils are in depressions and basins at slightly lower elevations than Detroit soils.

Detroit silt loam, 0 to 1 percent slopes (DeA).—This soil formed in loess and is on uplands. Areas range from 5 to 80 acres in size.

Included with this soil in mapping were small areas of Holdrege silt loam and Butler silt loam.

The annual precipitation does not provide an adequate moisture supply in most years. The soil is subject to soil blowing if the surface is left unprotected. This soil is easy to work. Maintaining fertility is a management need in irrigated areas. Runoff is slow.

Nearly all the acreage of this Detroit soil is cultivated. Corn, wheat, grain sorghum, and alfalfa are the main crops. Only a few areas are in native grass. Some areas are irrigated. Capability units IIc-1 dryland and I-1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hall Series

The Hall series consists of deep, well-drained soils. These soils are nearly level and are on stream terraces in the valleys of the Republican River and some of its major tributaries. They formed in silty alluvium.

In a representative profile the surface layer is gray silt loam 18 inches thick. The subsoil is silty clay loam about 28 inches thick. The upper part of the subsoil is grayish brown and friable, the middle part is grayish brown and brown and firm, and the lower part is pale brown and friable. The underlying material is at a depth of 46 inches and is light-gray, friable silt loam.

Hall soils have moderately slow permeability and high available water capacity. Content of organic matter is moderate, and natural fertility is high. The surface layer is slightly acid or neutral. The subsoil is neutral, and the underlying material is neutral or mildly alkaline.

Hall soils are suited to cultivated crops, both dryland and irrigated. They are also suited to grass, trees, wildlife habitat, and recreation.

In Harlan County, Hall soils are mapped only in an undifferentiated soil group with Hord soils.

Representative profile of Hall silt loam in an area of Hord and Hall silt loams, terrace, 0 to 1 percent slopes, in a cultivated field, 0.35 mile west and 200 feet south of the northeast corner of sec. 35, T. 1 N., R. 18 W.:

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, crumb structure; slightly hard, friable; neutral; abrupt, smooth boundary.

A12—6 to 18 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to weak, medium, granular; slightly hard, friable; neutral; clear, smooth boundary.

B1—18 to 22 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, friable; neutral; clear, smooth boundary.

B21t—22 to 28 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; neutral; clear, smooth boundary.

B22t—28 to 34 inches, brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; neutral; clear, smooth boundary.

B3t—34 to 46 inches, pale-brown (10YR 6/3) light silty clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; neutral; clear, smooth boundary.

C—46 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable; mildly alkaline.

The A horizon ranges from 10 to 20 inches in thickness. The B1 and B21t horizons are grayish brown or dark grayish brown. Depth to lime ranges from 40 to 72 inches.

Hall soils are in the same landscape as Hord and Hobbs soils. They have a finer textured B horizon than Hord soils. They have a B horizon which does not occur in Hobbs soils.

Hobbs Series

The Hobbs series consists of deep, moderately well drained soils. These soils are nearly level and very gently sloping and are on flood plains of the Republican River Valley and on bottom lands of intermittent drainageways. They formed in silty alluvium (fig. 6).

In a representative profile the surface layer is grayish-brown and dark-gray silt loam 20 inches thick. Beneath this is a transition layer of grayish-brown, friable silt loam 8 inches thick. The underlying material is at a depth of 28 inches and is pale-brown, very friable loam. The lower part is calcareous.

Hobbs soils have moderate permeability and high available water capacity. Content of organic matter is moderate, and natural fertility is high. The surface layer and transition layer are slightly acid or neutral. The underlying material is neutral to moderately alkaline. Hobbs soils absorb moisture easily and release it readily to plants.

Hobbs soils are suited to cultivated crops, grass, and trees. Some areas are irrigated. These soils are also suited to wildlife habitat and recreation.

Representative profile of Hobbs silt loam in an area of Hobbs and McCook silt loams, 0 to 1 percent slopes, in a cultivated field, 0.1 mile west and 120 feet south of the northeast corner of sec. 18, T. 2 N., R. 19 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; hard, friable; neutral; abrupt, smooth boundary.

A12—6 to 20 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to weak, fine, granular; hard, friable; neutral; clear, smooth boundary.

AC—20 to 28 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, friable; neutral; clear, smooth boundary.

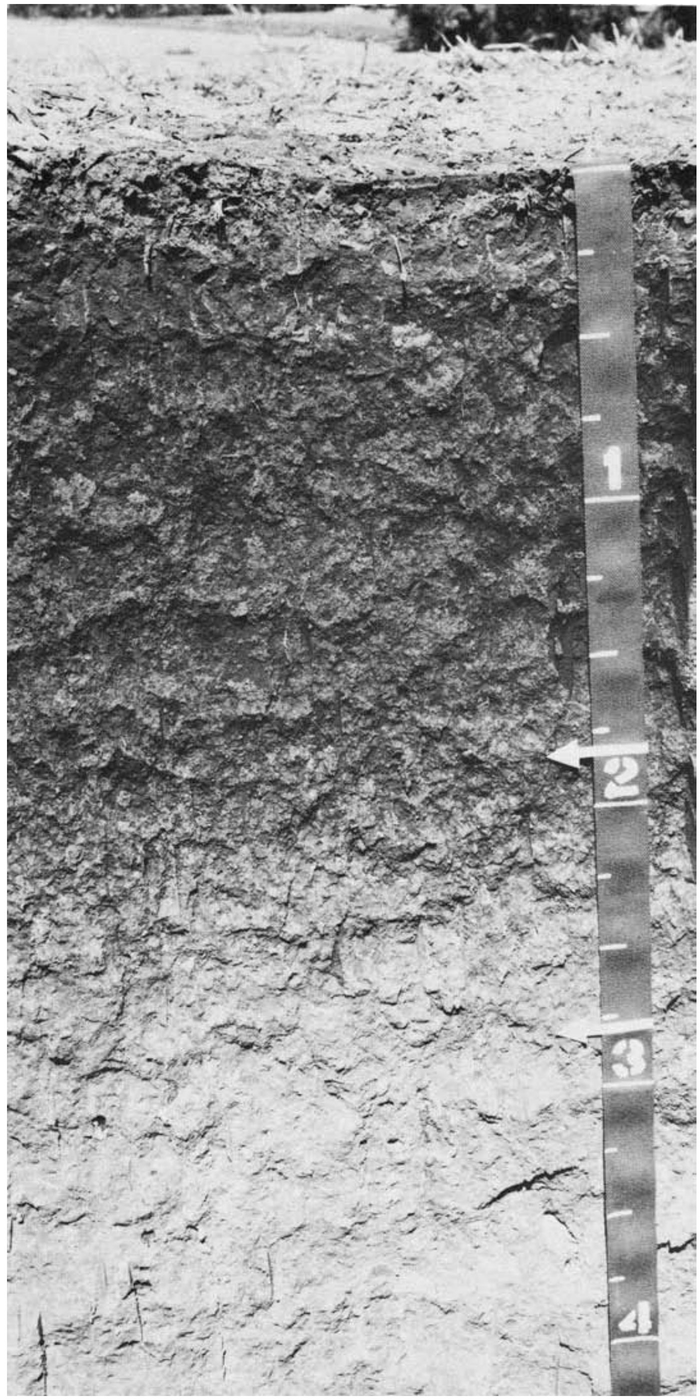

Figure 6.—**Profile of Hobbs silt loam, a deep, silty soil on bottom lands. The surface layer is very thick.**

C1—28 to 41 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; faintly stratified with silt loam and very fine sandy loam; slightly hard, very friable; moderately alkaline; abrupt, smooth boundary.

C2—41 to 60 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak, coarse, platy structure; stratified with darker layers; soft, very friable; strong effervescence; moderately alkaline.

The A horizon ranges from 20 to 42 inches in thickness. In some places there is a thin layer of calcareous loamy material recently deposited on the surface of the soil. Depth to lime ranges from 40 to about 72 inches.

Hobbs soils are in the same landscape as McCook, Leshara, and Munjor soils. They have a thicker A horizon and have lime at a greater depth than any of those soils. Hobbs soils do not have the moderately high water table that is typical of Leshare soils and are not so coarse textured in the C horizon as Munjor soils.

Hobbs and McCook silt loams, 0 to 1 percent slopes (HmA).—Hobbs silt loam and McCook silt loam are the main soils in this unit. Some areas have only one of these soils. Most areas that contain both Hobbs and McCook soils are in the Republican River Valley. Most areas that have only the Hobbs soil are in the narrow bottoms of canyon-like drainageways and creeks that drain into the Republican River.

Soils in this mapping unit are on the flood plain of the Republican River and along channels of the larger drainageways in the uplands. They are occasionally flooded and receive depositions of soil after rain. Areas are generally long and narrow, ranging from 5 to 300 acres in size. The Hobbs soil has the profile described as representative of the Hobbs series. It has a thicker surface layer and is not so calcareous as the McCook soil.

Included with these soils in mapping were small areas of Hord, Leshara, and Munjor soils and small areas of Broken alluvial land. In some places, recent floods have added a thin layer of calcareous, silty material to the surface.

Occasional flooding is the main hazard. Some slight channeling and deposition of sand can occur during the heaviest rain. Wetness delays tillage in most years, mainly during spring. Runoff is slow.

On the wide flood plains, most of the acreage is cultivated. Wheat, corn, alfalfa, and grain sorghum are the main crops. Many areas are successfully irrigated. On the narrow canyon floors, the soils are in native grass used for grazing. These areas are also excellent for wildlife habitat and for some kinds of recreation, such as hunting. Capability units IIw–3 dryland and IIw–3 irrigated; Moderately Wet windbreak suitability group; Hobbs soil in Silty Overflow range site, McCook soil in Silty Lowland range site.

Hobbs and McCook silt loams, 1 to 3 percent slopes (HmB).—Hobbs silt loam and McCook silt loam are the main soils in this unit. The proportions generally vary from one area to another, and some areas have only the Hobbs soil.

Soils in this mapping unit are mostly in the bottoms of intermittent drainageways and on the floors of the more deeply entrenched canyons. They receive some flood water as runoff from adjacent, steeper soils. Areas are long and narrow, ranging from 5 to 100 acres in size. These soils have profiles similar to the ones described as representative of their respective series.

Included with these soils in mapping were small areas of Hord and Hall soils.

These very gently sloping soils are flooded for short durations after heavy rain. In places a thin layer of silty soil material is deposited on the surface as the flood waters recede. There is commonly some slight channeling by the flood waters. In cultivated areas, tillage is delayed following rain, and crops can be damaged. Runoff is slow.

About half the acreage is in cultivated crops. Corn and grain sorghum are the main crops. The rest of the acreage is used mainly for range, because areas are commonly too narrow to be used for cultivated crops. Capability units IIw–31 dryland and IIe–11 irrigated; Moderately Wet windbreak suitability group; Hobbs soil in Silty Overflow range site, McCook soil in Silty Lowland range site.

Holdrege Series

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

In a representative profile the surface layer is gray and dark-gray silt loam 14 inches thick. The subsoil is about 20 inches thick. It is dark-gray, friable light silty clay loam in the upper part; grayish-brown, firm light silty clay loam in the middle; and light brownish-gray, friable heavy silt loam in the lower part. The underlying material is at a depth of 34 inches and is light-gray silt loam.

Holdrege soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. The surface layer is slightly acid or neutral. The subsoil is mildly alkaline, and the underlying material is moderately alkaline. Holdrege soils release moisture readily to plants.

Holdrege soils are suited to cultivated crops, both dryland and irrigated. They are also suited to grass, trees, wildlife habitat, and recreation.

Representative profile of Holdrege silt loam, 1 to 3 percent slopes, in a cultivated field, 0.15 mile south and 150 feet west of the northeast corner of sec. 19, T. 3 N., R. 18 W.:

Ap—0 to 7 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; weak, fine, crumb structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A12—7 to 14 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to weak, fine, granular; hard, friable; neutral; clear, smooth boundary.

B1—14 to 18 inches, dark-gray (10YR 4/1) light silty clay loam, very dark gray (10YR 3/1) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; mildly alkaline; clear, smooth boundary.

B2t—18 to 24 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; hard, firm; mildly alkaline; clear, smooth boundary.

B3—24 to 34 inches, light brownish-gray (10YR 6/2) heavy silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; worm casts; mildly alkaline; clear, smooth boundary.

C—34 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; strong effervescence; lime disseminated in old root channels and as white soft accumulations; worm casts; moderately alkaline.

The A horizon ranges from 7 to 14 inches in thickness. The B1 horizon ranges from dark gray to grayish brown and from heavy silt loam to light silty clay loam. Depth to lime ranges from 20 to 36 inches. Some profiles have an accumulation of lime beneath the B3 horizon.

Holdrege soils are in the same landscape as Detroit, Uly, Coly, and Scott soils. They have a coarser textured subsoil than Detroit or Scott soils, and they lack the A2 horizon typical of Scott soils. Holdrege soils have a finer textured subsoil than Uly soils and have lime at a lower depth. They differ from Coly soils in having a thicker A horizon and in having a B horizon.

Holdrege silt loam, 0 to 1 percent slopes (HoA).—This silty soil is on loessial uplands. Areas range from 10 to 1,000 acres in size. This soil has a profile similar to the one described as representative of the series except the surface layer is slightly thicker.

Included with this soil in mapping were small areas of Butler and Detroit soils and areas of soils that have a profile similar to the one described as representative of the Hord series.

Lack of sufficient moisture is the main limitation in dryfarmed areas. Soil blowing is a hazard where the surface is not adequately protected. Runoff is slow. This is one of the best soils in the county for crops.

Nearly all the acreage of this Holdrege soil is cultivated. A large part is irrigated. Corn, alfalfa, grain sorghum, and wheat are the main crops. Capability units IIc–1 dryland and I–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege silt loam, 1 to 3 percent slopes (HoB).—This deep, silty soil is on uplands. Areas range from 5 to 400 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of Detroit soils; Holdrege silt loam, 0 to 1 percent slopes; and Holdrege silt loam, 1 to 3 percent slopes, eroded.

Water erosion and soil blowing are hazards on this soil. Some land leveling is needed for gravity irrigation. In dryfarmed areas, inadequate moisture supply is a common limitation. Runoff is slow.

Most of the acreage of this Holdrege soil is used for cultivated crops, both dryland and irrigated. A few areas are in native grass. Capability units IIe–1 dryland and IIe–1 irrigated; Silty range site; Silty to Clayey windbreak suitablity group.

Holdrege silt loam, 1 to 3 percent slopes, eroded (HoB2).—This soil is on some drainage divides and on ridgetops in the loessial uplands. Areas range from 20 to about 3,000 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner. In places water erosion and soil blowing have removed much of the darkened surface layer. Tillage has mixed the remaining material from the surface layer with material from the upper part of the subsoil.

Included with this soil in mapping were small areas where erosion has removed most of the original surface layer, and the grayish-brown and light brownish-gray subsoil is exposed. Also included are small areas of Uly soils and areas of uneroded Holdrege soils.

Water erosion is the main hazard. Fertility is low where the soil is more severely eroded. This soil is only fairly easy to work where material from the subsoil has been mixed into the plow layer. Soil blowing is a hazard where the surface is not adequately protected. Runoff is slow.

Nearly all the acreage of this Holdrege soil is cultivated and is used primarily for wheat and grain sorghum. Smaller areas are in corn and alfalfa. Some areas are irrigated. Capability units IIe–1 dryland and IIe–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege silt loam, 3 to 7 percent slopes (HoC).—This soil is on sides of drainageways along tributaries of the Republican River and in areas adjacent to depressions and basins on the loessial plains. Areas range from 5 to 20 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner.

Included with this soil in mapping were small areas of Uly soils and Holdrege silt loam, 1 to 3 percent slopes.

Water erosion is a moderate hazard in cultivated areas. In places small rills and gullies form, but they are filled in during each successive tillage. Runoff is medium.

Most of the acreage of this Holdrege soil is in native grass. Only a few areas are cultivated. Capability units IIIe–1 dryland and IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Holdrege and Uly soils, 3 to 7 percent slopes, eroded (HpC2).—Holdrege silt loam, Holdrege silty clay loam, and Uly silt loam are the main soils in this unit. The proportions generally vary from one area to another, and a few areas have only one of these soils.

Soils in this mapping unit are on ridgetops or divides between drainageways of breaks to the Republican River. Areas range from 5 to about 40 acres in size. These soils have profiles similar to the ones described as representative of their respective series, but the surface layer and subsoil are slightly thinner, and lime is nearer the surface. Reaction in the surface layer is neutral.

Included with these soils in mapping were small areas that are severely eroded. In these areas the soils are lighter colored than is typical for the series because erosion has removed most of the original darkened surface layer and tillage has mixed the rest of the surface layer with material from the subsoil. Also included were small areas of Holdrege silt loam, 1 to 3 percent slopes, eroded.

Water erosion is the main hazard in cultivated areas. Soil blowing is a hazard where the surface layer is not adequately protected. Areas that are lightest in color have low fertility. These soils are easy to work. Runoff is medium. Small gullies are common.

Most of the acreage of these soils is cultivated. Wheat and grain sorghum are the main crops. Smaller areas are in corn and alfalfa. Only a few areas are irrigated. A few have been reseeded to tame grass. Capability units IIIe–1 dryland and IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hord Series

The Hord series consists of deep, well-drained soils. These soils are nearly level and very gently sloping and are on stream terraces (fig. 7). They formed in silty alluvium.

In a representative profile the surface layer is grayish-brown and dark-gray silt loam about 24 inches thick. The subsoil is about 16 inches thick. It is grayish-brown, friable silt loam in the upper part and light brownish-gray, friable silt loam in the lower part. At a depth of 40 inches is light-gray, calcareous silt loam.

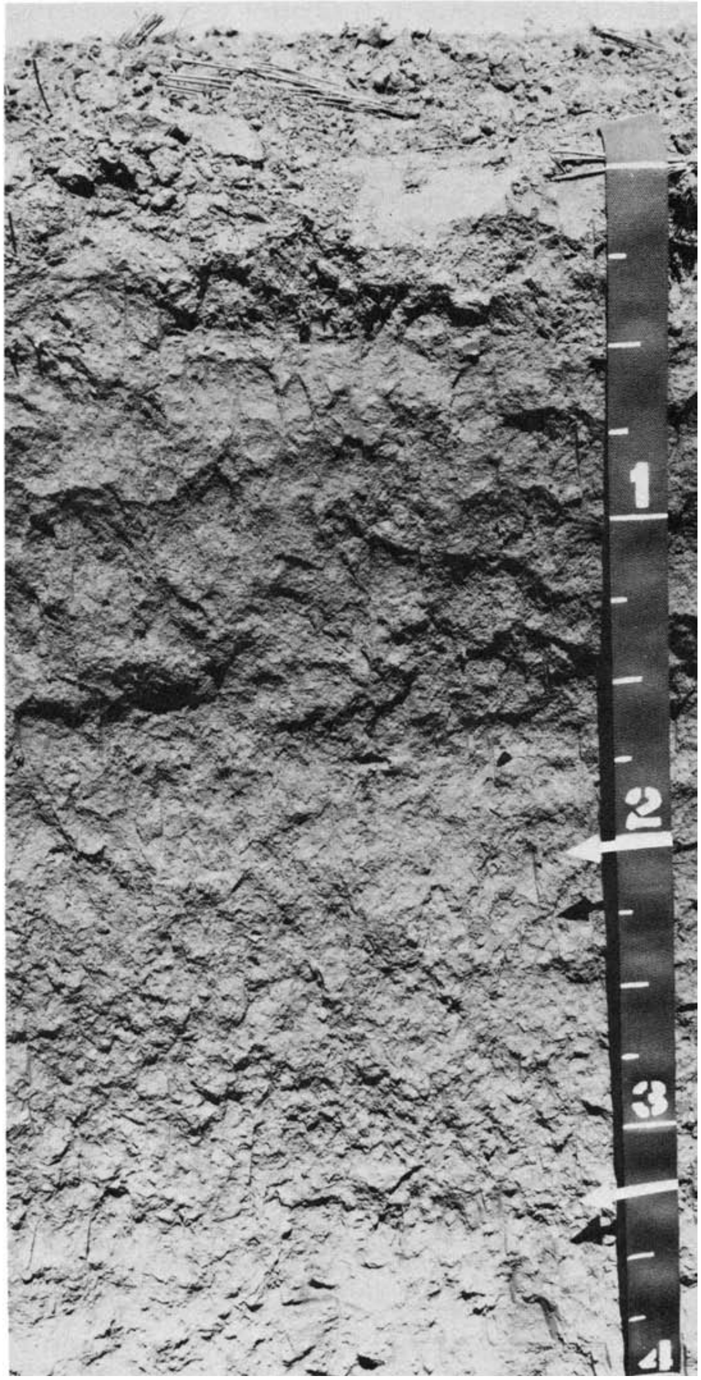

Figure 7.—**Profile of Hord silt loam, a deep, silty soil on stream terraces. Pointers indicate the lower boundary of the surface layer and subsoil.**

Hord soils have moderate permeability and high available water capacity. Content of organic matter is moderate, and natural fertility is high. The surface layer is neutral, and the subsoil is mildly alkaline. Hord soils release moisture readily to plants.

Hord soils are suited to cultivated crops, both dryland and irrigated. They are also suited to grass, trees, recreation, and wildlife habitat.

Representative profile of Hord silt loam in an area of Hord and Hall silt loams, terrace, 0 to 1 percent slopes, in a cultivated field, 0.3 mile north and 150 feet east of the southwest corner of sec. 18, T. 2 N., R. 19 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

A12—6 to 24 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to weak, medium, granular; slightly hard, very friable; neutral; clear, smooth boundary.

B2—24 to 32 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, friable; mildly alkaline; clear, smooth boundary.

B3—32 to 40 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, friable; worm casts; mildly alkaline; clear, smooth boundary.

C—40 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable; strong effervescence; lime accumulated in old root channels; moderately alkaline.

The A horizon ranges from 10 to 24 inches in thickness and from dark gray to grayish brown. The solum ranges from 35 to 55 inches in thickness. Buried horizons are below a depth of 36 inches in some profiles. Depth to lime ranges from 30 to 50 inches.

Hord soils are in the same landscape as Hall soils, but have a less clayey B horizon. They are similar to Holdrege soils, but have a thicker A horizon and a less clayey B horizon.

Hord and Hall silt loams, terrace, 0 to 1 percent slopes (HrA).—Hord silt loam and Hall silt loam are the main soils in this unit. Some areas have only one of these soils.

Soils in this mapping unit are on stream terraces. Areas range from 10 to 1,500 acres in size. The Hord and Hall soils in this unit have the profiles described as representative of their respective series.

Included with these soils in mapping were small areas of Cozad and Hobbs soils.

Droughtiness is the main hazard in dryfarmed areas. Maintaining fertility is a management need in irrigated areas. Soil blowing is a hazard on unprotected fields. Soils in this unit are highly productive and easy to work. Runoff is slow.

This soil is used for both dryland and irrigated management. Wheat and grain sorghum are the main dryland crops. Corn, grain sorghum, and alfalfa are the main irrigated crops. Only a few areas are in native grass. Capability units IIc-1 dryland and I-1 irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hord and Hall silt loams, terrace, 1 to 3 percent slopes (HrB).—Hord silt loam and Hall silt loam are the main soils in this unit. A few areas have only one of these soils. These soils have a profile similar to the ones described as representative of their respective series except the surface layer is slightly thinner.

Soils in this mapping unit are on small stream terraces. Areas range from 5 to about 50 acres in size.

Included with these soils in mapping were small areas of Cozad and Hobbs soils and Broken alluvial land.

Water erosion and soil blowing are hazards. Managing water and maintaining fertility are needs in irrigated areas. Some land leveling is needed for gravity irrigation. Runoff is slow.

Nearly all the acreage is cultivated, and much of it is irrigated. Only a few areas are in native grass. Capability units IIe-1 dryland and IIe-1 irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Inavale Series

The Inavale series consists of deep, excessively drained soils. These soils are nearly level and gently undulating and are on bottom lands in the Republican River Valley. They formed in loamy and sandy alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam 12 inches thick. Beneath this is a transition layer of light brownish-gray, very friable loamy fine sand. The underlying material is at a depth of 30 inches. The upper part is pale-brown loamy sand, and the lower part is very pale brown loamy sand.

Inavale soils have rapid permeability and moderate available water capacity. Content of organic matter and natural fertility are low. Reaction in these soils ranges from mildly alkaline to moderately alkaline throughout the profile. Inavale soils release moisture readily to plants.

Inavale soils are suited to cultivated crops, but their use for this purpose is marginal, particularly under dryland management. They can also be used for trees in windbreaks, grass, wildlife habitat, and recreation.

Representative profile of Inavale fine sandy loam, 0 to 3 percent slopes, in a cultivated field, 0.25 mile north and 300 feet west of the southeast corner of sec. 2, T. 2 N., R. 20 W.:

A—0 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; soft, very friable; strong effervescence; moderately alkaline; clear, smooth boundary.

AC—12 to 30 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; single grained; soft, very friable; moderately alkaline; clear, smooth boundary.

C1—30 to 42 inches, pale-brown (10YR 6/3) loamy sand, grayish brown (10YR 5/2) moist; single grained; soft, loose; slight effervescence; moderately alkaline; clear, smooth boundary.

C2—42 to 60 inches, very pale brown (10YR 7/3) loamy sand, light brownish gray (10YR 6/2) moist; common, faint, medium, yellowish-brown (10YR 5/6) mottles; single grained; soft, loose; thin lenses of coarse sand in lower part; slight effervescence; moderately alkaline.

The A horizon ranges from 4 to 14 inches in thickness and from dark grayish brown to light brownish gray. The AC and C horizons range from loamy fine sand to fine sand. Mottles are common below a depth of 40 inches in some soil areas and do not occur in others.

Inavale soils in Harlan County have more calcium carbonate than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Inavale soils are in the same landscape as Munjor, McCook, and Platte soils. They have coarser underlying material than Munjor or McCook soils and do not have the mixed sand and gravel at the shallow depths typical of the Platte soils.

Inavale fine sandy loam, 0 to 3 percent slopes (InB).—This soil is on bottom lands of the Republican River Valley. In many places it is adjacent to the meandering stream channels. Areas range from 5 to 80 acres in size.

Included with this soil in mapping were small areas of Munjor loamy fine sand; McCook sand, overwash; Platte soils; and Wet alluvial land. Some small included areas of Inavale soils have a surface layer of loamy fine sand or fine sand.

Soil blowing is a major hazard in cultivated areas. Droughtiness is also a hazard. Content of organic matter and fertility are low. Improving and maintaining fertility are management needs, particularly in irrigated areas. Runoff is slow. Most rain is absorbed as rapidly as it falls.

Most of the acreage of this soil is in native grass used for grazing. A few areas are cultivated. Many areas are in native woodland. Capability units IVe-3 dryland and IVe-3 irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Leshara Series

The Leshara series consists of deep, somewhat poorly drained soils. These soils are nearly level and are mainly on bottom lands of the Republican River Valley. They formed in silty alluvium. The water table is at a depth of 2 to 6 feet.

In a representative profile the surface layer is grayish-brown silt loam about 22 inches thick. Beneath this is the underlying material. It is light brownish-gray, friable very fine sandy loam in the upper part; gray, friable silt loam in the middle; and grayish-brown, friable silt loam in the lower part. Mottles are below a depth of 26 inches. The soil is calcareous throughout the profile.

Leshara soils have moderate permeability and high available water capacity. Content of organic matter is moderate, and natural fertility is high. Reaction in these soils is mildly alkaline in the surface layer and moderately alkaline in the underlying material. Leshara soils release moisture readily to plants.

Leshara soils are suited to cultivated crops, grass, and trees in windbreaks. Many areas are irrigated. These soils support wildlife and can be used for recreation.

Represenative profile of Leshara silt loam, in a cultivated field, 0.3 mile west and 100 feet south of the center of sec. 8, T. 2 N., R. 19 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine granular structure; slightly hard, very friable; slight effervescence; mildly alkaline; abrupt, smooth boundary.

A12—6 to 12 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt, smooth boundary.

A13—12 to 22 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt, smooth boundary.

C1—22 to 26 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; stratified; violent effervescence; moderately alkaline; abrupt, smooth boundary.

C2—26 to 38 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; few, medium, distinct, yellowish-brown (10YR

5/6) mottles between depths of 30 and 38 inches; massive; soft, friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

C3—38 to 48 inches, gray (10YR 5/1) silt loam, very dark brown (10YR 2/2) moist; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; hard, friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

C4—48 to 60 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; few, medium, distinct, yellowish-brown mottles; massive; hard, friable; violent effervescence; moderately alkaline.

The A horizon ranges from 10 to 24 inches in thickness and from grayish brown to dark grayish brown. The C horizon is slightly to strongly stratified and has alternating layers of silt loam, loam, or very fine sandy loam. Fine sand or mixed sand and gravel is commonly at a depth of 40 to 84 inches. Buried soil horizons are common in the C horizon.

Leshara soils in Harlan County have more carbonate content in the surface layer than is defined as the range for the series, but this difference does not alter the usefulness or behavior of these soils.

Leshara soils are in the same landscape as McCook, Inavale, Munjor, and Platte soils. They are finer textured and have a higher water table than Munjor and Inavale soils. They also have a higher water table than McCook soils and are deeper over mixed sand and gravel than the shallow Platte soils.

Leshara silt loam (0 to 1 percent slopes) (Le).—This soil is on bottom lands where the water table fluctuates between depths of 2 and 6 feet. Areas range from 5 to 80 acres in size.

Included with this soil in mapping were small areas of McCook loam; McCook sand, overwash; and Munjor fine sandy loam. Also included were small areas of saline-alkali soils.

Tillage and planting are commonly delayed by wetness, and the soil warms up later in spring than associated, better drained soils. This soil is flooded at infrequent intervals. Maintaining fertility and managing water are needs in irrigated areas.

Most of the acreage of this Leshara soil is cultivated. Corn, alfalfa, and grain sorghum are the main crops, and some winter wheat also is grown. A few areas are in native grass. Capability units IIw-4 dryland and IIw-4 irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

McCook Series

The McCook series consists of deep, moderately well drained soils. These soils are nearly level and very gently sloping and are on bottom lands of the Republican River Valley and some of its tributaries and drainageways. They formed in loamy and sandy alluvium (fig. 8).

In a representative profile the surface layer is grayish-brown loam 10 inches thick. Beneath this is a transition layer of light brownish-gray, very friable very fine sandy loam 6 inches thick. The underlying material is at a depth of 16 inches. It is light-gray very fine sandy loam in the upper part, light brownish-gray loam in the middle, and light-gray very fine sandy loam in the lower part.

McCook soils have moderate permeability and high available water capacity. Content of organic matter is moderate, and natural fertility is high. The surface layer is mildly alkaline. The upper and middle parts of the underlying material are moderately alkaline, and the lower part is moderately alkaline or strongly alkaline.

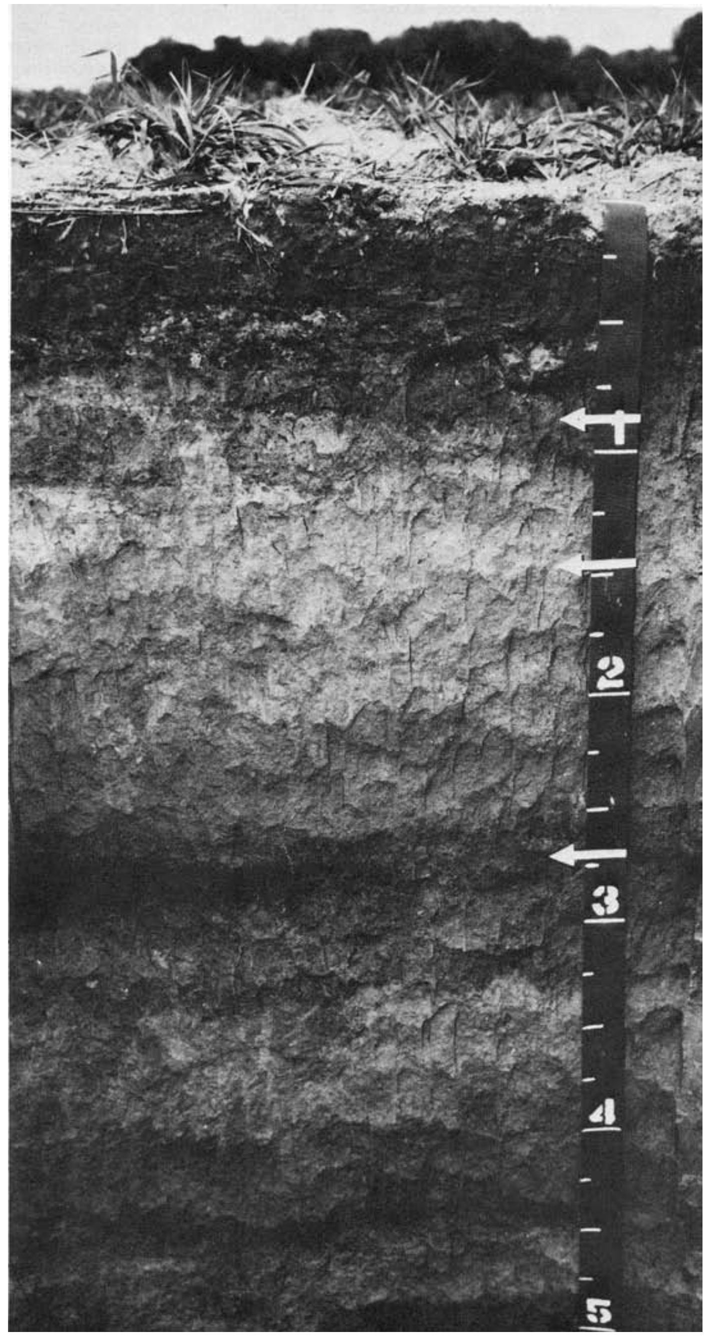

Figure 8.—Profile of McCook loam, a deep, moderately well drained soil on bottom lands. The dark bands in the lower part are older, buried surface layers.

These soils are suited to cultivated crops, both dryland and irrigated. They are also suited to grass, trees in windbreaks, wildlife habitat, and recreation.

Representative profile of McCook loam, in a cultivated field, 0.7 mile south and 500 feet west of the northeast corner of sec. 28, T. 2 N., R. 19 W.:

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

A12—5 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; violent effervescence; mildly alkaline; clear, smooth boundary.
AC—10 to 16 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.
C1—16 to 30 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.
C2b—30 to 34 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 5/2) moist; weak, fine, granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.
C3b—34 to 60 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; violent effervescence; strongly alkaline.

The A horizon ranges from 7 to 19 inches in thickness and from grayish brown to dark grayish brown. The C horizon is commonly stratified with lenses and layers of silt loam, loam, and very fine sandy loam. Thin layers of silty clay loam and fine sandy loam are also common. Buried soil horizons are common in the C horizon. Fine sand or mixed sand and gravel is between depths of 40 to 72 inches in some areas.

McCook soils are in the same landscape as Munjor, Inavale, Hobbs, and Leshara soils. The upper part of their C horizon is not so coarse textured as that of Munjor and Inavale soils. McCook soils have a thinner A horizon and have lime higher in the profile than Hobbs soils. They have a lower water table than Leshara soils.

McCook loam (0 to 1 percent slopes) (Mc).—This soil is mainly on bottom lands of the Republican River Valley. It has the profile described as representative of the series. The water table is between depths of 3 to 10 feet. Areas range from 5 to 100 acres in size.

Included with this soil in mapping were small areas that have a surface layer of fine sandy loam. Also included were a few areas of Munjor and Inavale soils. In some included areas this McCook soil is strongly alkaline in the surface layer, and in others it is strongly alkaline at a depth of 24 to 42 inches. Accumulations of soluble salt are present in a few small included areas.

This soil has a wetness hazard during early spring when the water table is highest and rainfall is heaviest. Tillage is commonly delayed by the wetness, and the soil warms up slower than better drained soils in the county. Runoff is slow. Soil blowing is a hazard where the surface is not protected. Maintaining fertility and managing water are needs in irrigated areas.

Nearly all the acreage of this soil is cultivated. Much of it is irrigated. Corn, alfalfa, and grain sorghum are the main crops. Some winter wheat is grown under dryland management. A few areas are in native grass used for grazing. Capability units IIw-4 dryland and IIw-4 irrigated; Silty Lowland range site; Moderately Wet windbreak suitability group.

McCook sand, overwash (0 to 1 percent slopes) (Mb).—This soil is on bottom lands of the Republican River Valley where sand was deposited on the surface by flood waters. Areas range from 5 to 80 acres in size. It has a profile similar to the one described as representative of the series, but the surface layer is loose, porous sand 6 to 18 inches thick underlain by the soil described as McCook loam.

Included with this soil in mapping were small areas of McCook loam and Munjor fine sandy loam.

Soil blowing is a major hazard in cultivated areas. Runoff is slow, and most precipitation is absorbed by the coarse-textured surface layer. Fertility is low.

Nearly all the acreage of this soil is cultivated. A few areas are in native grass used for grazing. Capability units IVe-5 dryland and IIIe-51 irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Munjor Series

The Munjor series consists of deep, moderately well drained soils. These soils are nearly level and very gently sloping and are on bottom lands of the Republican River Valley. They formed in moderately coarse and coarse alluvium. The water table normally fluctuates between depths of 5 and 8 feet.

In a representative profile the surface layer is grayish-brown and light brownish-gray fine sandy loam about 18 inches thick. Beneath this is the underlying material. It is light brownish-gray loamy sand in the upper part, grayish-brown fine sandy loam in the middle, and light-gray fine sandy loam in the lower part, which begins at a depth of 30 inches. The soil is calcareous throughout the profile.

Munjor soils have moderately rapid permeability and moderate available water capacity. Content of organic matter is moderately low, and natural fertility is medium. The surface layer is mildly alkaline, and the underlying material ranges from mildly alkaline to moderately alkaline. Munjor soils release moisture readily to plants.

Munjor soils are suited to cultivated crops, both dryland and irrigated. They are also suited to trees in windbreaks, grass, wildlife habitat, and recreation.

Representative profile of Munjor fine sandy loam, 0 to 3 percent slopes, in a cultivated field, 0.1 mile south and 0.4 mile west of the northeast corner of sec. 35, T. 3 N., R. 20 W.:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, granular structure; soft, very friable; slight effervescence; mildly alkaline; abrupt, smooth boundary.
A12—5 to 18 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; strong effervescence; mildly alkaline; clear, smooth boundary.
C1—18 to 24 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose; slight effervescence; mildly alkaline; abrupt, smooth boundary.
C2b—24 to 30 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline; clear, smooth boundary.
C3—30 to 54 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; violent effervescence; a few white accumulations of lime; moderately alkaline; thinly stratified layers of material ranging from silt loam to loamy sand; clear, smooth boundary.
C4—54 to 60 inches, light-gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; strong effervescence; a few, small, white accumulations of lime; moderately alkaline.

The A horizon ranges from 6 to 18 inches in thickness and from grayish brown to light brownish gray. Depth to lime carbonate ranges from 0 to 10 inches. Coarse soil materials commonly occur below a depth of 40 inches. Faint mottles are below a depth of 20 inches in some profiles.

Munjor soils are in the same landscape as Leshara, McCook, Inavale, and Platte soils. Their C horizon is coarser textured than that in McCook soils, but not so coarse textured as that in Inavale soils. Munjor soils have a lower water table than Leshara or Platte soils and are deeper than Platte soils.

Munjor fine sandy loam, 0 to 3 percent slopes (MuB).—This moderately well drained soil is on bottom lands of the Republican River Valley. Areas range from 10 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Munjor loamy fine sand and small areas of Inavale, McCook, and Platte soils.

This soil is susceptible to soil blowing. Rainfall is commonly inadequate for dryfarmed crops. Some land leveling is generally needed for gravity irrigation. Maintaining fertility is a management need, particularly in irrigated areas. Phosphorus is commonly deficient. Runoff is slow.

Most of the acreage of this soil is cultivated. A few areas are in native grass. Wheat, corn, grain sorghum, and alfalfa are the major crops. This soil is suited to trees for windbreaks and for use as wildlife habitat. Capability units IIe–3 dryland and IIe–3 irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Munjor loamy fine sand, 0 to 3 percent slopes (MtB).—This soil is on bottom lands of the Republican River Valley. Areas range from 5 to 60 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is coarser textured. Some areas have low, hummocky surface topography.

Included with this soil in mapping were small areas of McCook and Inavale soils. Some small areas of this Munjor soil have a surface layer of fine sandy loam.

Soil blowing is the main hazard in cultivated areas. Maintaining fertility is a management need, especially in irrigated areas. Because this soil is composed of moderately coarse textured and coarse textured material, many of the plant nutrients are leached to a depth below the reach of plant roots. Phosphorus is commonly deficient. Runoff is slow.

Most of the acreage of this soil is used for grazing. Native grass and some cottonwood and willow trees are the principal vegetation. Only a few areas are cultivated. Corn and grain sorghum are the main crops. Capability units IIIe–5 dryland and IIIe–5 irrigated; Sandy Lowland range site; Sandy windbreak suitability group.

Nuckolls Series

The Nuckolls series consists of deep, well-drained soils. These soils are strongly sloping and steep and are in uplands on the sides of drainageways and narrow divides. They formed in loess of the Loveland formation.

In a representative profile the surface layer is grayish-brown silt loam 7 inches thick. The subsoil is about 25 inches thick. The upper part is grayish-brown, friable heavy silt loam, and the lower part is pale-brown, friable silt loam. The underlying material is at a depth of 32 inches and is pale-brown, calcareous, friable silt loam.

Nuckolls soils have moderate permeability and high available water capacity. Content of organic matter is moderately low, and natural fertility is medium. The surface layer and subsoil are neutral or mildly alkaline. The underlying material is moderately alkaline. Nuckolls soils release moisture readily to plants.

Nuckolls soils are suited to grass, trees, wildlife habitat, and recreation. They are too steep and have too severe an erosion hazard to be used for cultivated crops.

Representative profile of Nuckolls silt loam in an area of Nuckolls and Uly silt loams, 9 to 15 percent slopes, in native range, 0.25 mile east and 0.35 mile south of the northwest corner of sec. 22, T. 4 N., R. 18 W.:

A—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B21—7 to 10 inches, grayish-brown (10YR 5/2) heavy silt loam, dark grayish brown (10YR 4/2) moist; moderate, medium, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B22—10 to 16 inches, grayish-brown (10YR 5/2) heavy silt loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; neutral; gradual, smooth boundary.

B3—16 to 32 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; mildly alkaline; gradual, smooth boundary.

C—32 to 60 inches, pale-brown (10YR 6/3) light silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strong effervescence; lime concentrated on structure planes and in old root pores; moderately alkaline.

The A horizon ranges from 7 to 14 inches in thickness, and the B horizon from 12 to 30 inches in thickness. The B2 ranges from silt loam to light silty clay loam. Depth to lime is 20 to 36 inches. The underlying material ranges from pale brown and light yellowish brown to light reddish brown and from loam to light silty clay loam.

Nuckolls soils in Harland County in mapping unit NuE2 have a surface layer that is thinner and lighter colored than is defined as the range for the series, but this difference does not alter the usefulness or behavior of these soils.

Nuckolls soils are in the same landscape as Uly, Coly, and Hobbs soils. They are more deeply leached of lime than Uly and Coly soils. In contrast with Coly and Hobbs soils, they have a B horizon. Nuckolls, Uly, and Coly soils formed in loess, whereas Hobbs soils formed in alluvium on the bottoms of narrow drainageways.

Nuckolls and Uly silt loams, 9 to 15 percent slopes (NuD).—Nuckolls silt loam and Uly silt loam are the main soils in this unit. The proportions generally vary from one area to another, and a few areas have only one of these soils. The Nuckolls part of this mapping unit has the profile described as representative of the series. The Uly part has a profile similar to the one described as representative of the series except the surface layer is thinner.

Soils in this mapping unit have smooth slopes above the steep slopes that border entrenched drainageways on uplands. Areas range from 40 to 300 acres in size.

Included with these soils in mapping were areas of Coly silt loam that make up about 15 to 25 percent of the acreage and areas of Hobbs silt loam that make up 10 to 15 percent.

Water erosion is the main hazard. Runoff is rapid, and management to conserve rainfall is important. Proper management of the rangeland is needed.

Most of the acreage of these soils is in native grass used for grazing. These soils are too steep and have too severe an erosion hazard to be used for cultivated crops. Capability unit VIe–1 dryland; Silty range site; Silty to Clayey windbreak suitability group.

Nuckolls and Uly silt loams, 9 to 31 percent slopes, eroded (NuE2).—Nuckolls silt loam and Uly silt loam are the main soils in this unit. The acreage of the Nuckolls soil is larger than that of the Uly soil. A few areas are made up of only the Nuckolls soil.

Soils in this mapping unit have smooth slopes and are above breaks to intermittent drainageways. They are moderately and severely eroded. Areas range from 5 to 25 acres in size. These soils have profiles similar to the ones described as representative of their respective series, but the surface layer is thinner and lighter colored, and lime is nearer the surface.

Included with these soils in mapping were small areas of Coly and Hobbs soils.

Water erosion is the main hazard. Gullies and small rills are common. Fertility is low. Runoff is rapid, and management to conserve rainfall is important.

Much of the acreage of these soils is used for dryland cultivated crops. Some areas have been seeded to grass, which is an excellent way to conserve and protect these soils. These soils are too steep and have too severe an erosion hazard to be used for cultivated crops. Capability unit VIe–8 dryland; Silty range site; Silty to Clayey windbreak suitability group.

Nuckolls, Uly, and Canlon soils, 9 to 31 percent slopes (NyE).—Nuckolls silt loam, Uly silt loam, and Canlon loam are the main soils in this unit. The proportions generally vary from one area to another, and a few areas have only one of these soils. The Canlon soil is in all the mapped areas.

Soils in this mapping unit are on sides of intermittent drainageways, where geologic erosion has exposed the underlying sandstone formation (fig. 9). Uly soils are on the upper parts of the landscape, Nuckolls soils are in the middle, and Canlon soils are in the lower parts. Areas range from 10 to 200 acres in size. The Canlon soil has the profile described as representative of its series. The Nuckolls and Uly soils have similar profiles to the profiles described as representative of their respective series.

Included with these soils in mapping were areas of Coly silt loam that make up about 10 to 20 percent of the acreage and areas of Hobbs silt loam that make up 10 to 20 percent. Canlon soils make up only about 10 percent of the acreage but are included in the name of the unit because of their contrasting characteristics.

Water erosion is the main hazard. The areas of Canlon soils have limy sandstone at a depth of 10 to 20 inches that limits the growth of plant roots. Runoff is rapid. Capability unit VIe–1 dryland; Nuckolls and Uly soils in Silty range site, Canlon soil not assigned a range site; Nuckolls and Uly soils in Silty to Clayey windbreak suitability group, Canlon soil in Shallow windbreak suitability group.

Platte Series

The Platte series consists of somewhat poorly drained soils that have mixed sand and gravel at a depth of 10 to 20 inches. These soils are nearly level and very gently sloping and are on bottom lands of the Republican River

Figure 9.—Typical landscape of Nuckolls, Uly, and Canlon soils, 9 to 31 percent slopes.

Valley. They formed in loamy and sandy alluvium. The water table is at a depth of 2 to 6 feet.

In a representative profile the surface layer is calcareous, grayish-brown silt loam about 7 inches thick. Beneath this is the underlying material of light-gray, very friable fine sandy loam about 7 inches thick. At a depth of 14 inches is the substratum. It is light-gray, loose sand in the upper part and very pale brown, mixed coarse sand and gravel in the lower part.

Platte soils have moderately rapid permeability in the underlying material and very rapid permeability in that part of the sand and gravel substratum that is not saturated. The available water capacity is low. Content of organic matter and natural fertility are low. Reaction in these soils is mildly alkaline to moderately alkaline throughout the profile. Platte soils release moisture readily to plants.

Platte soils are suited to cultivated crops, both dryland and irrigated. They are also suited to trees in windbreaks, grass, wildlife habitat, and recreation.

Representative profile of Platte silt loam in an area of Platte and McCook soils, in a cultivated field, 2,440 feet east and 100 feet north of the southwest corner of sec. 27, T. 3 N., R. 20 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt, wavy boundary.

C1—7 to 14 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; few, fine, faint, yellowish-brown (10YR 5/6) mottles; massive; soft, very friable; slight effervescence; moderately alkaline; stratified; abrupt, smooth boundary.

IIC2—14 to 36 inches, light-gray (10YR 7/2) fine, medium, and coarse sand, light brownish gray (10YR 6/2) moist; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grained; loose; moderately alkaline; clear, smooth boundary.

IIC3—36 to 60 inches, very pale brown (10YR 7/5) mixed coarse sand and gravel, light brownish gray (10YR 6/2) moist; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grained; loose; water table at depth of 48 inches; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and from loam and silt loam to fine sandy loam. The C1 horizon averages very fine sandy loam or fine sandy loam and is stratified with soil material that ranges from silty clay loam to loamy sand. Depth to the IIC horizon is 10 to 20 inches. Depth to lime ranges from 0 to 10 inches.

Platte soils are in the same landscape as McCook, Inavale, Leshara, and Munjor soils. They are shallower over sand and gravel than those soils and have a higher water table than Inavale, McCook, or Munjor soils. Platte soils are not so coarse textured in the C1 horizon as Inavale soils.

Platte and McCook soils (0 to 2 percent slopes) (Pm).—Platte and McCook soils are the main soils in this unit. Some areas have only one of these soils.

Soils in this mapping unit are on bottom lands of the Republican River Valley. In places, they are in old abandoned channels of the river. For the most part, these soils are on the lowest parts of the landscape. Areas range from 10 to 100 acres in size. The Platte soil has the profile described as representative of its series. The McCook soil has a profile similar to the one described as representative of the series.

Included with these soils in mapping were areas where coarse sand is at a depth of 20 to 40 inches and a few small areas where gravel is on the surface. Also included were small areas of Munjor and Inavale soils. About 10 percent of the acreage of the Platte soil has a thin layer of loamy fine sand or fine sand deposited by recent flooding.

Soil wetness is the main hazard. The lowest areas are sometimes flooded following heavy rain, mainly in spring. When the water table is highest in spring, the soils dry out slowly and tend to warm up slowly, and tillage is commonly delayed. When the water table is lowest, in late summer, the soils are sometimes droughty where dry-farmed, particularly in areas of the shallow Platte soil. Fertility, especially available phosphate, is low. Runoff is slow.

About half the acreage of these soils is cultivated and is used primarily for corn and grain sorghum. Smaller areas are in wheat and alfalfa. The rest of the acreage is in grass and is used for grazing. About 20 percent of the areas used for grazing has cottonwoods and other trees and can be used for recreation, mainly during the hunting season. Capability units IVw-4 dryland and IVw-4 irrigated; Moderately Wet windbreak suitability group; Platte soil in Subirrigated range site, McCook soil in Silty Lowland range site.

Scott Series

The Scott series consists of deep, poorly drained soils that have a claypan subsoil that limits water movement and root growth. These soils are nearly level and are in depressions on uplands. They formed in loess and are frequently flooded.

In a representative profile the surface layer is dark-gray heavy silt loam about 5 inches thick. The subsoil is 51 inches thick. The upper part is dark-gray, very firm silty clay; the middle is gray, very firm heavy silty clay loam; and the lower part is grayish-brown, firm silty clay loam. The underlying material is at a depth of 56 inches and is pale-brown heavy silt loam.

Scott soils have very slow permeability and moderate available water capacity. Content of organic matter is moderately low, and natural fertility is medium. The surface layer is slightly acid. The subsoil and underlying material are neutral to mildly alkaline. Scott soils release moisture slowly to plants.

Scott soils are poorly suited to cultivated crops. They are suitable for wildlife habitat and recreation. They are not suited to native grass or trees in windbreaks.

Representative profile of Scott silt loam, in an idle area, 0.35 mile north and 100 feet east of the southwest corner of sec. 2, T. 4 N., R. 17 W.:

Ap[2]—0 to 5 inches, dark-gray (10YR 4/1) heavy silt loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; hard, friable; slightly acid; abrupt, smooth boundary.

B21t—5 to 32 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate, coarse, prismatic structure parting to strong, medium, angular blocky; extremely hard, very firm; small, shotlike, brown concretions; neutral; clear, smooth boundary.

B22t—32 to 48 inches, gray (10YR 5/1) heavy silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to

[2] This plowed layer includes an A2 horizon that is a part of this soil and is evident in uncultivated areas.

strong, medium, angular blocky; extremely hard, very firm; mildly alkaline; clear, smooth boundary.

B3t—48 to 56 inches, grayish-brown (10YR 5/2) silty clay loam, dark gray (10YR 4/1) moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm; mildly alkaline; clear, smooth boundary.

C—56 to 60 inches, pale-brown (10YR 6/3) heavy silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to massive; hard, friable; mildly alkaline.

The A horizon ranges from 3 to 9 inches in thickness. The A2 horizon, which is present in uncultivated areas, ranges from 1 to 3 inches in thickness and is gray to light gray. In cultivated areas, the Ap horizon is heavy silt loam or light silty clay loam. The B2t horizon ranges from heavy silty clay loam to clay. The solum ranges from 27 to 56 inches in thickness. Depth to carbonates ranges from 46 to about 72 inches.

Scott soils are in the same landscape as Detroit, Butler, and Holdrege soils. They have a finer textured B2t horizon than Detroit soils and have an A2 horizon that does not occur in those soils. Scott soils have a thinner A horizon than Butler soils. They have a finer textured, lighter colored B horizon than Holdrege soils and have an A2 horizon that does not occur in those soils. Scott soils are at lower elevations than any of the associated soils.

Scott silt loam (0 to 1 percent slopes) (Sc).—This soil is in depressions of the loessial uplands. Areas range from 5 to 200 acres in size. Areas too small to delineate are shown on the maps by a special spot symbol that indicates a small depression.

Included with this soil in mapping were small areas of Butler silt loam.

Soil wetness is a severe hazard in cultivated areas. This soil is frequently flooded by water from higher lying, adjacent soils. Runoff does not occur unless the soil is artificially drained. During seasons of higher than average rainfall, crops commonly are drowned. During the wettest parts of each year, water ponds in the lowest areas to form an intermittent lake. The soil is difficult to till because the surface layer is thin, and implements commonly mix some of the very firm subsoil material into the plow layer. The surface layer is silt loam to silty clay loam. Most roots have difficulty in penetrating the claypan subsoil. For this reason, the soil is sometimes droughty during late summer, when normal rainfall is low.

Most of the acreage is cultivated. Wheat and grain sorghum are the main crops. Crop production is uncertain. Some areas are artificially drained by V-ditches or land leveling. Some undrained areas are used for wildlife habitat. Others are used for whatever pasture they provide, or are left idle. Capability unit IVw-2 dryland; not assigned a range site; Undesirable windbreak suitability group.

Uly Series

The Uly series consists of deep, well-drained, loamy soils. These soils are gently sloping to steep and are on uplands. They formed in loess.

In a representative profile (fig. 10) the surface layer is dark-gray silt loam about 10 inches thick. The subsoil is grayish-brown, friable silt loam about 6 inches thick. The underlying material is at a depth of 16 inches and is very pale brown, calcareous silt loam.

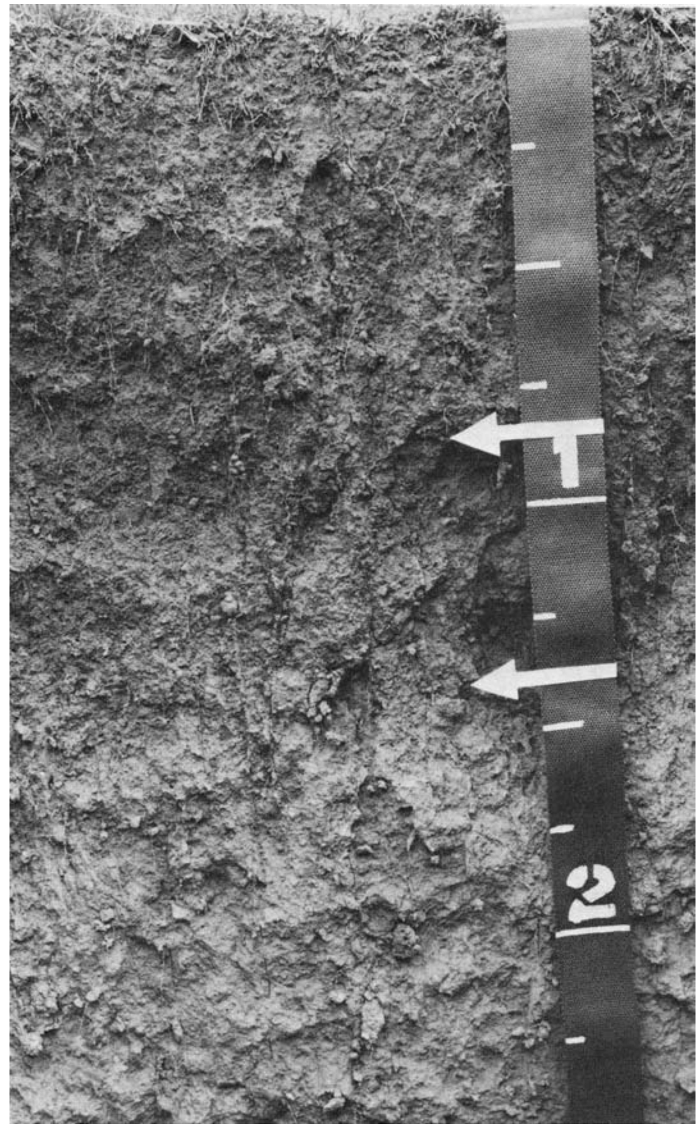

Figure 10.—**Profile of Uly silt loam. Pointers indicate the lower boundaries of the surface layer and subsoil.**

Uly soils have moderate permeability and high available water capacity. Content of organic matter is moderately low, and natural fertility is medium. The surface layer is slightly acid or neutral. The subsoil is neutral or mildly alkaline, and the underlying material is mildly alkaline to moderately alkaline. Uly soils release moisture readily to plants.

The less sloping Uly soils are suited to cultivated crops, both dryland and irrigated. The steeper Uly soils are suited to grass, trees, wildlife habitat, and recreation.

Representative profile of Uly silt loam, 3 to 9 percent slopes, in native pasture, 0.35 mile south and 230 feet west of the northeast corner of sec. 6, T. 2 N., R. 18 W.:

A—0 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to weak, medium, granular; slightly hard, friable; neutral; clear, smooth boundary.

B—10 to 16 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; mildly alkaline; clear, smooth boundary.

C—16 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and from grayish brown to dark gray. The B horizon ranges from 6 to 10 inches in thickness. The C horizon ranges from light gray to very pale brown. Depth to lime is 10 to 24 inches.

Uly soils are in the same landscape as Holdrege, Coly, Hobbs, and Nuckolls soils. In contrast with Holdrege soils, they have a thinner B horizon and lime at a higher level. They have lime at a lower level than Coly soils, which do not have a B horizon. They have a thinner A horizon than Hobbs soils, which also do not have a B horizon. They formed in Peoria Loess, whereas Nuckolls soils formed in material of the Loveland Formation and are more deeply leached of lime.

Uly silt loam, 3 to 9 percent slopes (UsC).—This soil is on sides of intermittent drainageways and on narrow divides between deeply entrenched drainageways in loessial uplands. Areas are generally small, ranging from 5 to 80 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were areas of Coly silt loam that make up about 15 percent of the acreage. Also included were small areas of Hobbs silt loam.

Water erosion is a severe hazard in cultivated areas. Soil blowing is a hazard where the surface is not adequately protected. Runoff is medium. This soil is easy to work.

Most of the acreage of this soil is in native grass that is grazed. A few areas have been cultivated, and wheat and grain sorghum are the main crops. Capability units IVe–1 dryland and IVe–1 irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Uly and Coly silt loams, 9 to 31 percent slopes (UtE).—Uly silt loam and Coly silt loam are the main soils in this unit. A few areas have only one of these soils. The Uly and Coly soils have a profile similar to the ones described as representative of their respective series.

Soils in this mapping unit are on narrow divides between deeply entrenched drainageways in the loessal uplands. Areas range from 20 to 1,000 acres in size.

Included with these soils in mapping were areas of Nuckolls silt loam that make up about 15 percent of the acreage; areas of Hobbs silt loam that make up about 15 percent; rough broken areas of loess that make up about 10 percent; and areas of Holdrege silt loam that make up about 5 percent.

Water erosion is a severe hazard. Because surface runoff is rapid, the soil surface takes in only a small part of the precipitation that falls. In rangeland the native grasses furnish good protection from erosion and tend to slow down runoff.

Nearly all the acreage is in native grass used as rangeland. A few areas are cultivated, but gullies are common and erosion is difficult to control. These soils are suitable for wildlife habitat. Capability unit VIe–1 dryland; Uly soil in Silty range site; Coly soil in Limy Upland range site; Silty to Clayey windbreak suitability group.

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wa) is in old abandoned river channels and basinlike depressions on bottom lands in the Republican River Valley. The water table is within a depth of 2 feet. Areas range from 5 to 60 acres in size.

The soil material of this land type ranges from silty clay loam to sand. Depth to the underlying sand and gravel is 10 to 60 inches. The soil material is mainly loamy, but in about 40 percent of the acreage it is sandy. The surface layer ranges from 10 to 20 inches in thickness. The material above the water table is commonly strongly mottled and is calcareous in the uppermost few inches.

Included in mapping were small areas of Munjor, Inavale, Hobbs, and McCook soils and small marshy areas.

Soil wetness is the principal limitation to use of this soil. This wetness is caused by the high water table and by occasional flooding after heavy rain.

This land type is used for wildlife habitat, recreation, and limited grazing. Grass is sparse, but other plants grow that have grazing value. Cottonwood and willow trees are common. Capability unit Vw–1 dryland; Wet Land range site; Very Wet windbreak suitability group.

Management of the Soils for Crops [3]

This section describes the management of dryfarmed and irrigated cropland, explains the capability grouping of soils, and discusses management by capability units. In addition, a table shows predicted yields of the main crops grown in the county.

Managing Dryfarmed Cropland

In Harlan County 85 percent of all cropland is farmed without irrigation water. The most important dryland crops are wheat, grain sorghum, alfalfa, and corn. Also dryfarmed are smaller acreages of oats, barley, and rye and minor hay crops.

Controlling erosion, preserving tilth, maintaining fertility, and keeping a good organic cover on the surface are important in dryfarmed areas. The practices applicable to most dryfarmed soils in the county are described in the following paragraphs.

It is important that the right kind of crops and the sequence in which they are grown are suited to the soil. A planned cropping system is needed to protect the soil from erosion, to maintain soil structure, and to control weeds, insects, and diseases.

The best cropping system for a coarse-textured soil, such as Munjor loamy fine sand, is a grass-legume crop for a fairly high percentage of the time and a row crop for 1 year or for 2 consecutive years. Holdrege silt loam, 0 to 1 percent slopes, can be used for row crops more frequently without damage to the soil. A desirable cropping system includes crops that produce a good supply of long-lasting residue, for example, wheat, sorghum, and corn.

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[3] By ERVIN O. PETERSON, conservation agronomist, Soil Conservation Service.

Keeping crop residue on the surface or growing a protective cover of plants keeps the soil from sealing or crusting during and following heavy rain. Tall stubble left in the field during winter traps snow. Leaving crop residue on the surface forms an organic mulch that slows down evaporation, increases moisture intake, and reduces the loss of soil from both water erosion and soil blowing. Removal of crop residue by burning is undesirable. Good residue management is particularly important on the Munjor and Inavale soils and other soils that have a moderately coarse textured surface layer.

Moisture can be conserved and soil loss reduced by using terraces and contour farming in sloping cultivated areas. The terrace ridges act as small dams to prevent runoff and also serve as guidelines for all contour tillage. Terraces and contour farming are needed for erosion control on silty, gently sloping soils. Most terraces are level, but a few are graded. Spacing between terraces is determined by the slope and kind of soil. For example, terraces on Holdrege silt loam, 1 to 3 percent slopes, should be spaced farther apart than on Uly silt loam, 3 to 9 percent slopes.

To divert surplus water from an erodible area, diversion terraces are needed. Diversions seeded to grass and constructed on a low gradient drain water toward a satisfactory disposal outlet.

A seedbed for wheat is generally prepared by summer fallowing during the season previous to planting. In 1964 Harlan County had 64,483 acres of summer-fallowed land. For protection against soil blowing during the fallow period and during the initial growth of the wheat crop, some organic residue is needed on the surface. The amount needed depends on the kind of residue, the kind of soil, and the exposure of the field to prevailing winds. Stubble mulching is a tillage practice that leaves most of the crop residue on the surface and is particularly well suited to the wheat-fallow system of farming.

Excessive tillage breaks down structure in some soils, such as Holdrege, Uly, and Hord soils, and therefore minimum tillage is desirable. Reducing the amount of tillage reduces the cost of crop production. The till-plant method is well suited to row crops. Grasses can be established by drilling into a cover of sorghum stubble without further seedbed preparation.

The cropping system can be managed so that highly productive soils that have little or no erosion hazard, such as Holdrege silt loam, 0 to 1 percent slopes, are used for row crops and steeper, more eroded soils, such as Coly and Nuckolls silt loams, 9 to 31 percent slopes, eroded, are used for hay and pasture. This practice reduces soil loss through erosion.

Dryland soils in Harlan County do not need as much fertilizer as irrigated soils. The amount of fertilizer used is based on the results of soil tests and on related information. Crops are most likely to respond to nitrogen and phosphorus fertilizer. Phosphorus and zinc are sometimes beneficial on the eroded Holdrege and Uly soils. Fertilizer applications are adjusted to moisture conditions. Phosphorus commonly results in good crop response on soils that are calcareous at the surface, such as Inavale fine sandy loam, Leshara silt loam, McCook silt loam, and Munjor fine sandy loam. Most soils in Harlan County have a neutral or mildly alkaline surface layer and, thus, do not need lime.

The common dryfarmed crops are well suited to the soils and climate of the county. The potential for new crops is good, provided they are as well suited as the established crops and markets are available in the larger centers of population.

Managing Irrigated Cropland

Irrigation in Harlan County is mainly on the tablelands of the northeastern part of the county on broad divides between canyonlike areas north of the Republican River Valley and on soils in the Republican River Valley. Water for irrigation is obtained from deep wells, shallow wells, and open canals. The Harlan County Reservoir in the extreme eastern part of the county stores water for open-ditch irrigation. In the western part of the Republican River Valley, canal water comes from the Frenchman-Cambridge Irrigation District.

Corn, grain sorghum, and alfalfa are the main irrigated crops. Minor acreages of wheat, oats, and soybeans are irrigated. In 1964 about 15 percent of all cropland in the county was irrigated.

In order to use water from gravity irrigation systems efficiently, some land leveling or reshaping is generally needed. Water can be distributed on the field by furrows, borders, flooding, sprinklers, or corrugations. Different methods of distribution are suited to different crops and different soils. The sprinkler system is well suited to moderately coarse textured soils that have an irregular surface, such as Inavale fine sandy loam, 0 to 3 percent slopes.

Erosion control is needed on all very gently sloping and gently sloping irrigated soils. Applications of irrigation water in addition to natural rainfall increase the erosion hazard. The method of irrigation, the rate of water application, and the time of irrigation are important considerations. A correctly designed system that minimizes soil loss and obtains the best efficiency in the use of irrigation water is needed. On nearly level soils, the furrow system is most commonly used for row crops and the border system for hay crops. Soils that have slopes of 1 to 3 percent can be leveled in order to reduce the grade of flow of the irrigation water. Contour bench leveling and contour irrigation supplemented by terraces are alternative systems. If irrigation is desired on gently sloping soils, the sprinkler system is best suited.

Terraces combined with contour farming help in controlling erosion on gently sloping soils. Close-growing crops, such as alfalfa and small grain, tend to hold the soil in place better than row crops. Plowing under green-manure crops, adding barnyard manure, and using a stubble-mulch system of cultivation all help control water erosion and soil blowing. These practices are beneficial on such soils as Coly and Uly silt loams, 3 to 9 percent slopes, eroded, and Cozad silt loam, 3 to 7 percent slopes.

Care is needed in leveling the shallow Platte soils to avoid exposing the underlying sand and gravel.

More fertilizer is needed to maintain fertility on irrigated soils than on dryland soils. Nitrogen and phosphorus are the most commonly needed elements, but iron and zinc can also give good results where the soil is eroded or where land leveling has made deep cuts in the soil. The kind and amount of fertilizer can be determined by soil tests.

Farmers who need technical help in planning irrigation developments can contact the local office of the Soil Conservation Service or the county agricultural agent. Information about costs and equipment can be obtained from equipment dealers.

Those crops presently irrigated are well suited to the climate and soils of the county and are readily marketable. Bench leveling increases the potential for irrigation on gently sloping, silty soils. Sprinklers can be used on some uneven soil areas, and their use is increasing. The total acreage of irrigated soils in the county has been steadily increasing during the past 30 years, and this trend is likely to continue for a few additional years. The limited quantity of water, particularly in the northeastern part of the county, is likely to present a problem as more and more water is pumped to the surface.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

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, for forest trees, or for engineering.

In the capability system, the kinds of soils 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 require moderate conservation practices.
- 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.
- 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.
- Class VII soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to pasture or range, woodland, or wildlife. (None in Harlan County.)
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes. (None in Harlan County.)

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main 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, although they have other limitations that restrict their use largely to pasture or range, woodland, wildlife habitat, 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 IVw-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.

The capability classification of the soils in Harlan County is given in the "Guide to Mapping Units" at the end of this survey. For an explanation of the capability classification, see Agricultural Handbook 210, Land Capability Classification (*6*).

In the following pages the capability units in Harlan County are described and suggestions for the use and management of the soils are given.

Management by capability units

The dryland and irrigated capability units in Harlan County are described on the pages that follow, and practices useful in management are suggested.

Suitable crops, suggested management, and hazards and limitations are considered for both dryland and irrigation management. Because irrigation and dryland management differ, irrigated and dryfarmed soils are assigned to different capability units.

CAPABILITY UNITS IIc-1 DRYLAND AND I-1 IRRIGATED

These units consist of nearly level soils of the Cozad, Detroit, Hall, Holdrege, and Hord series. These are deep, well drained and moderately well drained soils on uplands and stream terraces. They have a medium-textured surface layer and a medium-textured to moderately fine textured subsoil. The underlying material is medium textured.

The soils in these units have moderate to slow permeability. The available water capacity is high. The soils absorb moisture easily and release it readily to plants. Content of organic matter is moderate to moderately low, and natural fertility is medium to high. Runoff is slow.

These soils are among the best in the county for cultivated crops. The principal management concern is maintaining the content of organic matter and the high fertility. Soil blowing is a hazard if the surface is not protected. Under dryland management, the limited rainfall is the main limitation for crops.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are wheat, grain sorghum, and corn. Barley, rye, oats, and millet also can be grown.

A summer-fallow system is commonly used to store moisture for crops. If fertility is maintained, these soils can be cultivated intensively without risk of damage. Proper use of crop residue helps control soil blowing, crusting of the surface layer, and loss of moisture through evaporation. It is important that the cropping system provide a cover of organic residue on the surface throughout the year. Diseases and insects can be controlled by using chemicals and a crop sequence that alternates row crops with small grain or hay. Nonlegume crops respond in some years to commercial fertilizers, particularly nitrogen.

IRRIGATION MANAGEMENT: Corn, small grain, sorghum, and alfalfa are the main irrigated crops. Small acreages of soybeans, oats, potatoes, and vegetables also are grown.

Managing irrigation water on these soils is a major concern. Water has to be applied in sufficient amounts and at a rate that permits maximum absorption and minimum runoff. Only a small amount of land leveling is needed for gravity irrigation. Fertility can be maintained by applying commercial fertilizer and barnyard manure and by returning crop residue to the soil. All major kinds of irrigation systems are suited to the soils of this unit. Crop residue left on the surface during winter helps control soil blowing.

CAPABILITY UNITS IIe-1 DRYLAND AND IIe-1 IRRIGATED

These units consist of very gently sloping soils of the Cozad, Holdrege, Hord, and Hall series. These are deep, well-drained soils on loessal uplands and stream terraces. They have a medium-textured surface layer and a medium-textured or moderately fine textured subsoil. The underlying material is medium textured.

The soils in these units have moderate or moderately slow permeability. The available water capacity is high. The soils absorb moisture easily and release it readily to plants. Content of organic matter is moderate or moderately low. Natural fertility is medium in Cozad soils and high in all the rest. The soils are moderately eroded in some areas. Runoff is slow.

Water erosion and soil blowing are the main hazards in cultivated areas. In dryfarmed areas, the lack of adequate moisture during many years can limit crop production. Maintaining soil tilth, fertility, and the content of organic matter is important.

DRYLAND MANAGEMENT: Terraces, contour farming, and grassed waterways control surface runoff. The cropping system should include only a limited number of years in consecutive row crops. Stubble mulching and minimum tillage practices aid in moisture conservation and erosion control. Nitrogen fertilizer commonly benefits nonlegume crops, particularly during years of more than average rainfall. A system of summer fallow helps conserve and store moisture for use by the crop that follows (fig. 11).

IRRIGATION MANAGEMENT: These are good soils for irrigated crops. Corn, grain sorghum, and alfalfa are the main irrigated crops.

Some land reshaping is needed for efficient gravity irrigation. Bench leveling is well suited to these soils. Terraces and contour rows help in controlling erosion and in managing irrigation water properly. Crop residue kept on the surface improves water intake, prevents soil blowing, and improves fertility. Runoff of irrigation water should be conserved and controlled at the ends of fields. Sprinkler irrigation is suited to these soils. Fertility can be maintained and improved by using commercial fertilizers and barnyard manure.

CAPABILITY UNITS IIe-3 DRYLAND AND IIe-3 IRRIGATED

Munjor fine sandy loam, 0 to 3 percent slopes, is the only soil in these units. It is a deep, moderately well drained soil on bottom lands. The surface layer and underlying material are moderately coarse textured. The soil is calcareous throughout.

This soil has moderately rapid permeability. The available water capacity is moderate. The soil releases moisture readily to plants. It is easy to work. Content of organic matter is moderately low, and natural fertility is medium. Runoff is slow.

This soil is subject to soil blowing and water erosion. During many years, there is not enough moisture for growing crops under dryland management. Phosphorus is not readily available. Improving and maintaining fertility are management needs.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are wheat and grain sorghum. Alfalfa, oats, rye, and barley also are grown.

Soil blowing can be largely prevented by keeping the surface covered with a growing crop or crop residue. Stripcropping and field windbreaks also help reduce soil blowing. Stubble-mulch tillage is a good method of keeping residue on the surface. If needed, terraces and contour farming can be used to prevent water erosion. Row crops can be alternated with small grains and legumes in the cropping sequence. This soil can be tilled throughout a wide range of moisture content. It warms up earlier in spring than some finer textured soils. Cover crops help increase the content of organic matter. Commercial fertilizers and barnyard manure improve and maintain fertility.

IRRIGATION MANAGEMENT: Corn, sorghum, and alfalfa are the main irrigated crops. Minor acreages of soybeans and hayland are also irrigated.

Figure 11.—**Summer fallow conserves moisture for use by the next crop on field of Holdrege silt loam, 1 to 3 percent slopes, eroded. Capability unit IIe–1 dryland.**

Planting high residue crops increases the content of organic matter and helps prevent soil blowing. Other practices suited to this soil are stripcropping, using cover crops, and stubble mulching. Careful management of irrigation water is needed. Overirrigation tends to leach nutrients beyond the reach of plant roots. Proper timing and careful application of water avoid this hazard. A cover of growing crops or residue is important, particularly during fall. Overgrazing of crop residue should be avoided. Some land leveling is commonly needed for gravity irrigation. Length of irrigation run should be controlled on this moderately coarse textured soil. For sustained crop production, the optimum use of commercial fertilizers and barnyard manure is needed.

CAPABILITY UNITS IIs–2 DRYLAND AND IIs–2 IRRIGATED

Butler silt loam is the only soil in these units. It is a deep, somewhat poorly drained, nearly level soil that has a claypan subsoil. It is in shallow, basinlike areas of the loessal uplands. The surface layer and underlying material are medium textured, and the subsoil is fine textured.

This soil has slow permeability. The available water capacity is high. In places the soil is droughty if dryfarmed because the claypan subsoil prevents effective movement of the limited amount of natural rainfall. The soil absorbs moisture easily until the surface layer becomes saturated, after which it absorbs moisture slowly. The surface layer releases moisture readily to plants, but roots absorb moisture slowly from the subsoil. Content of organic matter is moderate, and natural fertility is high. Runoff is slow.

The droughty nature of this soil in fall is one of the main hazards in dryfarmed areas. During spring, water tends to accumulate, and in some places crops are damaged. Tillage is sometimes delayed by excessive wetness in spring. Soil blowing can occur if the surface is not protected.

DRYLAND MANAGEMENT: This soil is particularly well suited to winter wheat, which matures before hot, dry weather begins. Grain sorghum is well suited because it can withstand the droughty nature of the soil and the slow release of moisture by the subsoil. Grasses and legumes in the cropping sequence help keep the subsoil open, and improve water penetration and help conserve subsoil moisture. Stubble mulching improves tilth and reduces evaporation. A summer-fallow system helps conserve moisture for the crop that follows. If fertility is maintained by using commercial fertilizers, row crops can be grown in successive years.

IRRIGATION MANAGEMENT: Grain sorghum, forage sorghum, and corn are the main irrigated crops. Some alfalfa is also grown.

A cropping system that includes a legume or legume-grass mixture helps open the subsoil and improves water penetration. Barnyard manure and green-manure crops help maintain good tilth and fertility and improve the capacity to take in water. In some places land leveling is needed to improve distribution of irrigation water. Care is needed to avoid exposing the claypan subsoil, because this material is difficult to till and crops do not respond well when it is at or near the surface. Backfilling is necessary in places. Fertility can be maintained by using commercial fertilizers. The response of crops to good irrigation management is excellent.

CAPABILITY UNITS IIw-3 DRYLAND AND IIw-3 IRRIGATED

Hobbs and McCook silt loams, 0 to 1 percent slopes, is the only soil in these units. It is an undifferentiated soil group made up mainly of Hobbs silt loam and McCook silt loam. Some areas have only one of these soils. These are deep, nearly level, moderately well drained soils on bottom lands. The surface layer and underlying material are medium textured.

The soils in these units have moderate permeability. The available water capacity is high. The soils release moisture readily to plants. They are easy to work. Content of organic matter is moderate, and natural fertility is high. Runoff is slow.

Soil wetness from occasional flooding is the main hazard in cultivated areas. Wetness can cause delayed tillage and some damage to growing crops by depositing silt and sand and by scouring. During dry seasons, however, some flooding is beneficial. because it adds to the total moisture supply.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are wheat and grain sorghum. Some corn is also grown. Alfalfa does not stand flooding well.

In most areas diversions can be used to control flood waters. In other areas, drainage ditches help remove excess water. Management that keeps ditches and diversions clean of obstructions is needed if these structures are to serve their purpose. Leveling helps fill in the lowest areas and avoid drowning the crops. Maintaining high fertility and good tilth is essential. Commercial fertilizers and organic matter supply the fertility and contribute to good tilth.

IRRIGATION MANAGEMENT: Corn and sorghum are the main irrigated crops. Small grain and alfalfa are also suited if the flooding hazard is controlled.

An irrigation system that provides for diverting or intercepting flood waters is needed on this soil. Land leveling helps provide good surface drainage. Furrow and border irrigation systems are better suited than other methods. A sprinkler system can be used in long, narrow areas. Management that reduces or controls excess water at the ends of the row is also needed. Adequate commercial fertilizers are needed to maintain fertility.

CAPABILITY UNITS IIw-31 DRYLAND AND IIe-11 IRRIGATED

Hobbs and McCook silt loams, 1 to 3 percent slopes, is the only soil in these units. It is an undifferentiated soil group made up mainly of Hobbs silt loam and McCook silt loam. These are deep, very gently sloping, moderately well drained soils on bottoms of narrow drainageways and canyons. They are medium textured throughout the profile.

The soils in these units have moderate permeability. The available water capacity is high. The soils absorb water easily and release it readily to plants. They are easy to work. Content of organic matter is moderate, and natural fertility is high. Runoff is slow.

Unless protected by a diversion, these soils are flooded for short duration. In some areas, there is channeling by the flood waters. In cultivated areas, tillage is delayed following rain and crops can be damaged. Water erosion is a slight hazard. Soil blowing can occur if the surface is not protected. During dry years, flooding is beneficial if crops are large enough so that they are not damaged.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are corn and grain sorghum. Some of the flooding can be controlled by installing terraces and diversions on the adjacent higher lying soils. In some places, small V-shaped ditches facilitate removal of flood water, but a suitable outlet is needed. Commercial fertilizers maintain fertility. Tilth can be improved and soil blowing prevented by a stubble-mulch system of cultivation.

IRRIGATION MANAGEMENT: Corn and small grain are the main irrigated crops, but alfalfa can also be grown if the flooding hazard is controlled.

These soil areas can be protected by installing terraces and diversions on the adjacent higher lying soils. Drainage ditches can be used in some areas to remove flood water. Land leveling generally helps improve surface drainage and, at the same time, provides for even water distribution. Furrow, border, and sprinkler systems are suited to these long, narrow areas. Runoff should be controlled at the ends of the field.

CAPABILITY UNITS IIw-4 DRYLAND AND IIw-4 IRRIGATED

These units consist of nearly level Leshara silt loam and McCook loam. These are somewhat poorly drained and moderately well drained soils on bottom lands. The surface layer and underlying material are medium textured. The soils are calcareous at the surface. The water table is at a depth of 2 to 10 feet.

The soils in these units have moderate permeability. The available water capacity is high. Content of organic matter is moderate, and natural fertility is high. The soils release moisture readily to plants. They are easy to work. Runoff is slow.

Soil wetness is the main hazard in cultivated areas. These soils warm up slowly in spring, and tillage is commonly delayed by wetness. Areas of these soils are infrequently flooded as a result of stream overflow. During dry seasons and years of less than normal rainfall, the water table provides beneficial moisture for crops by subirrigation. Soil blowing is a hazard if the surface is not protected. Maintaining fertility is needed. Phosphorus is commonly not available on these calcareous soils.

DRYLAND MANAGEMENT. The main crops suited to dryfarming are wheat, grain sorghum, alfalfa, and corn.

The water table can be lowered in some instances by drainage ditches or tile drains. Leveling helps remove surface water. Lowering the water table is desirable only if it is so high that it seriously interferes with efficient management. Under dryland management, a water table at a depth of no less than 3 feet provides subirrigation that benefits most crops. Suitable outlets are needed if drains are installed. Using alfalfa or grass in the crop sequence helps maintain fertility, tilth, and organic-matter content. Phosphate should be added if it is not readily available. Commercial fertilizer maintains a high level of fertility. Stubble-mulch tillage helps prevent soil blowing.

IRRIGATION MANAGEMENT. Corn, sorghum, and alfalfa are the main irrigated crops.

Some land leveling is generally needed for even water distribution and surface drainage. If the water table is too high, tile drains or drainage ditches lower it slightly. Commercial fertilizer maintains a high level of fertility. Growing a cover crop and keeping crop residue on the surface control soil blowing. Legumes generally respond to applications of phosphate on these calcareous soils. Barnyard manure and green-manure crops help maintain good tilth and high fertility. The sprinkler system is suited to these soils.

CAPABILITY UNITS IIIe-1 DRYLAND AND IIIe-1 IRRIGATED

These units consist of gently sloping soils of the Cozad, Holdrege, and Uly series. These are deep, well-drained soils on uplands and foot slopes. They have a surface layer of silt loam. The subsoil is silt loam or silty clay loam, and the underlying material is silt loam. Some of the soils are eroded.

The soils in these units have moderate permeability. The available water capacity is high. The soils absorb moisture easily and release it readily to plants. They are easy to work. Content of organic matter is moderately low or moderate, and natural fertility is medium to high. Runoff is medium.

The principal management concerns are controlling water erosion and conserving water. Soil blowing is a minor hazard. Under dryland management, natural rainfall is commonly inadequate to meet crop needs. Under irrigation management, maintaining fertility is a concern.

DRYLAND MANAGEMENT. The main crops suited to dryfarming are wheat, grain sorghum, alfalfa, and tame grass. Oats, barley, and rye also can be grown.

The cropping system should include some close-growing crops, as well as row crops. A legume or grass crop helps to keep the soil fertile and maintain tilth. Crop residue can be returned to the soil. Use of the alternate crop-summer fallow system enables moisture to be stored for use by the crop that follows the fallow program. Level terraces and farming on the contour reduce the amount of runoff and water erosion (fig. 12). Grassed waterways

***Figure 12.*—Level terraces and contour farming saved practically all the water that fell on this field of Holdrege silt loam, 3 to 7 percent slopes. Capability unit IIIe-1 dryland.**

can be used in many places. Burning crop residue is an undesirable practice. Nonlegume crops commonly respond to nitrogen fertilizer. Barnyard manure can also be used to help maintain fertility.

Irrigation Management: Corn, alfalfa, and grain sorghum are the main irrigated crops. Tame grass and soybeans also can be grown.

Under irrigation management, erosion can be controlled by using terraces, contour farming, and waterways and by keeping crop residue on the surface. Bench leveling is suited to the lower slopes. If legumes and grass are not included in the cropping system, tilth can be improved by returning all crop residue to the soil and by using green-manure crops and barnyard manure. The sprinkler system is well suited to the soils of this capability unit. The rate of water application should be carefully adjusted to keep the soil from eroding. Commercial fertilizers maintain fertility if they are properly used.

CAPABILITY UNITS IIIe-5 DRYLAND AND IIIe-5 IRRIGATED

Munjor loamy fine sand, 0 to 3 percent slopes, is the only soil in these units. This is a deep, nearly level and very gently sloping, moderately well drained soil on bottom lands. The surface layer is coarse textured, and the underlying material is moderately coarse textured. The soil is calcareous throughout the profile. The water table is at a depth of 5 to 8 feet.

This soil has moderately rapid permeability. The available water capacity is moderate. This soil absorbs moisture easily and releases it readily to plants. It has loose consistence when dry and is not so easy to work as soils that have better tilth. It can be tilled over a wide range of moisture conditions. Content of organic matter is moderately low, and natural fertility is medium.

Soil blowing is a severe hazard on this soil. Fertility and organic-matter content should be improved and maintained. Water erosion is sometimes a hazard during heavy rainfall on the very gentle slopes. This soil is droughty during seasons of lowest rainfall. Phosphorus is not readily available. A lack of sufficient rainfall is serious during some years.

Dryland Management: The main crops suited to dryfarming are grain sorghum, wheat, corn, alfalfa, and tame grass.

A cropping system that includes a legume or grass is desirable because it keeps the surface covered most of the time, which prevents soil blowing. Wind stripcropping, stubble mulching, and field windbreaks also help prevent soil blowing. All crop residue should be kept on the surface. Additions of barnyard manure improve fertility and tilth. Rye and vetch used as cover crops improve fertility and tilth. Fallowing the land for 1 year in 2 stores moisture for the crop grown during the second year. Terracing this soil is difficult because the surface is so sandy. Contour farming is suitable where slopes are 1 to 3 percent.

Irrigation Management: Corn, grain sorghum, and alfalfa are the main irrigated crops. Soybeans and tame grass also can be grown.

A cropping system that keeps a cover on the soil most of the time is desirable because it decreases soil blowing. Furrow, border, and sprinkler systems can be used. Sprinklers are especially well suited because no land leveling is needed on the low, hummocky topography of some areas. Land leveling is needed for furrow and border irrigation. If deep cuts are made, barnyard manure and additional commercial fertilizer help restore fertility. Fertilizers are needed to improve and maintain fertility in irrigated areas. Frequent and light applications of irrigation water are needed. Excessive application of water causes fertilizer loss through leaching. Short irrigation runs are needed if the furrow system is used.

CAPABILITY UNITS IVe-1 DRYLAND AND IVe-1 IRRIGATED

Uly silt loam, 3 to 9 percent slopes, is the only soil in these units. This is a deep, gently sloping and sloping, well-drained soil on loessial uplands. The surface layer, subsoil, and underlying material are medium textured.

This soil has moderate permeability. The available water capacity is high. The soil absorbs moisture easily and releases it readily to plants. It is easy to work and has good tilth. Content of organic matter is moderately low, and natural fertility is medium. Runoff is medium.

Water erosion and soil blowing are the main hazards in cultivated areas. Moisture conservation is an important management need. In dryfarmed areas, rainfall is commonly insufficient for growing the common crops economically. Maintaining fertility is essential.

Dryland Management: The main crops suited to dryfarming are wheat and grain sorghum. Alfalfa and corn also are suited.

A cropping system that limits row crops to 1 successive year is desirable. Including legumes, grasses, or close-growing small grain during most of the cropping sequence helps prevent water erosion and soil blowing. Terraces, contour farming, stubble-mulch tillage, and grassed waterways are well suited to this soil and are needed to control water erosion and conserve water. Crop residue should be kept on the surface. Burning stubble is an undersirable practice. Crops respond to commercial fertilizer in places, particularly in the lightest colored soil areas.

Irrigation Management: Hay and pasture crops, such as grass and alfalfa, are the main irrigated crops. Row crops, such as corn and sorghum, are suited, but adequate measures are needed to prevent water erosion. Wheat is a close-growing crop that is well suited to the soil.

Erosion can be controlled by using terraces, contour farming, and grassed waterways. Bench leveling can be used on the lower slopes. Leaving crop residue on the surface improves water intake and helps control soil blowing. A sprinkler system can be used to distribute the water if reshaping or leveling the soil is not desired. Application rates should be carefully controlled so that the water applied does not exceed the intake rate of the soil. Fertility can be improved and maintained by adding barnyard manure and commercial fertilizer.

CAPABILITY UNITS IVe-3 DRYLAND AND IVe-3 IRRIGATED

Inavale fine sandy loam, 0 to 3 percent slopes, is the only soil in these units. It is a deep, nearly level and gently undulating, excessively drained soil on bottom lands. The surface layer is moderately coarse textured, and the underlying material is coarse textured. The soil is calcareous throughout.

This soil has rapid permeability. The available water capacity is moderate. This soil absorbs water easily and releases it readily to plants. It has very friable consistence when dry and is not so easy to work as the medium-textured soils of the county. It can be tilled over a wide range of moisture conditions. Content of organic matter and natural fertility are low.

Soil blowing is a major hazard in cultivated areas. The soil is droughty in dryfarmed areas. It is infrequently flooded by stream overflow following very heavy rain. Fertility and organic-matter content should be improved.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are wheat and tame grass. Grain sorghum, alfalfa, and corn also are grown, but in smaller acreages.

Stubble mulching, wind stripcropping, and field windbreaks are suitable for this soil and help prevent soil blowing. Using close-growing crops also helps prevent soil blowing. This soil is generally unsuited to terraces because it is too hummocky and uneven. Summer fallowing after a wheat crop stores moisture for the crop that follows the fallow period. Barnyard manure and crop residue help stabilize this soil. Commercial fertilizers help improve fertility.

IRRIGATION MANAGEMENT: Alfalfa, tame grass, corn, and grain sorghum are the main irrigated crops.

A cropping system that keeps the soil covered most of the time is best suited. The use of cover crops, stubble mulch, and stripcropping helps prevent soil blowing. Emergency tillage can be practiced if blowing begins early in spring or late in fall. Land leveling is necessary if gravity irrigation is planned. The furrow method is suitable, but short rows are essential; the sprinkler system is better suited because no leveling is needed. Good control of irrigation water is needed in order to maintain adequate moisture without leaching nutrients from the root zone. Barnyard manure and commercial fertilizer increase and maintain fertility of this soil.

CAPABILITY UNITS IVe-5 DRYLAND AND IIIe-51 IRRIGATED

McCook sand, overwash, is the only soil in these units. This is a deep, nearly level, moderately well drained soil on bottom lands. It has a coarse-textured surface layer deposited by flood water. The underlying material is medium textured.

This soil has moderate permeability, but intake of moisture into the surface layer is rapid. The available water capacity is high. This soil is difficult to work because the surface layer has loose consistence. Tilth is poor. The soil absorbs moisture easily and releases it readily to plants. Content of organic matter and natural fertility are low.

Soil blowing is a serious hazard where the surface is not protected. Increasing the organic-matter content and fertility is essential. Young plants are sometimes damaged by lack of moisture. During some years, this soil is flooded following very heavy rain.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are grain sorghum and corn. A minor acreage of alfalfa is grown.

Keeping the surface covered with a growing crop or organic matter is important in order to control soil blowing. Cover crops, field windbreaks, and stubble-mulch tillage also can be used to control soil blowing. A cropping system that limits the number of years in row crop and includes some close-growing crops is desirable. Crops respond to fertilizers, especially nitrogen. Barnyard manure helps stabilize the soil surface and increases fertility.

IRRIGATION MANAGEMENT: Corn, sorghum, and alfalfa are the main irrigated crops.

Late in spring and early in fall it is important to keep the surface covered with a growing crop or organic matter to prevent soil blowing. Cover crops, stubble-mulch tillage, and close-growing crops also help control soil blowing. Field windbreaks and stripcropping also are helpful. Timely irrigation is needed to meet the needs of the crop during its early growth as well as when it is maturing. Barnyard manure and commercial fertilizers help improve fertility. Land leveling is required in places where the surface is channeled if furrow irrigation is used. Sprinklers are well suited to this soil.

CAPABILITY UNITS IVe-8 DRYLAND AND IVe-11 IRRIGATED

Coly and Uly silt loams, 3 to 9 percent slopes, eroded, are the only soils in these units. These are deep, gently sloping and sloping, well-drained soils on uplands. The surface layer and underlying material are silt loam. The Uly soil has a subsoil of silt loam.

Permeability is moderate. The available water capacity is high. The soils release moisture readily to plants. They are moderately to severely eroded and, as a result, have only fair tilth. They are not so easy to work as the more friable soils that contain more organic matter. Content of organic matter is low and moderately low, and natural fertility is low to medium. Runoff is medium.

Water erosion is a serious hazard in cultivated areas. Improving the organic-matter content and fertility is essential. Soil blowing is a hazard in unprotected areas. Gullies and rills are common. Moisture should be conserved on these gently sloping and moderately sloping soils. In dryfarmed areas, rainfall is insufficient in some years for economical crop production.

DRYLAND MANAGEMENT: The main crops suited to dryfarming are wheat, grain sorghum, and alfalfa. Minor acreages of corn and tame grasses are grown.

Further losses of soil from erosion should be prevented. Terraces, contour farming, and grassed waterways can be effectively used. Stubble-mulch tillage adds organic matter and helps prevent soil blowing. A cropping system that restricts row crops and provides close-growing crops during most years is desirable. Turning under green-manure crops and returning all crop residue to the soil help increase the content of organic matter. Commercial fertilizer and barnyard manure help increase fertility.

IRRIGATION MANAGEMENT: Corn, sorghum, alfalfa, and tame grass are the main irrigated crops. Soybeans also can be grown, but only a limited acreage is in these crops. The soils are best suited to close-growing crops. Proper erosion-control measures are needed, particularly for row crops. Contour bench leveling can be installed on the lowest slopes. Terraces and contour farming are other methods of controlling erosion. Returning all crop residue to the soil, using barnyard manure, and plowing under green-manure crops help improve the content of organic matter, fertility, and tilth. Nitrogen and phosphate fertilizers are needed on these soils to improve and maintain fertility.

CAPABILITY UNIT IVw-2 DRYLAND

Scott silt loam is the only soil in this unit. This is a deep, nearly level, poorly drained soil in depressions of the loessal uplands. The surface layer is medium textured, the claypan subsoil is fine textured, and the underlying material is medium textured.

This soil has very slow permeability. The available water capacity is moderate, but the claypan subsoil severely restricts movement of moisture through the soil. The soil releases moisture slowly to plants. This soil is difficult to work. At times it is too wet. At other times it is dry and the subsoil, which is near the surface, is very hard. Content of organic matter is moderately low, and natural fertility is medium. Runoff is very slow or does not occur.

Unless this soil is artificially drained, flood water remains on the surface for long periods of time after rain. Wetness is a severe hazard. Crops should be grown only 1 year in every 4 to 5 years on these areas. Roots have difficulty penetrating the subsoil deeply. If these areas are dry, soil blowing is a hazard unless the soil is adequately protected. Organic-matter content and tilth should be improved. The soil is not suited to irrigation because of the hazard of drowning crops. Many areas are not used for crops.

DRYLAND MANAGEMENT: If these areas are drained, the soil can be used for corn, sorghum, and small grain. Alfalfa is sensitive to flooding and is not grown on this soil. The soil is not suited to native grass or trees. It is excellent habitat for certain kinds of wildlife and is excellent for some forms of recreation, such as hunting. Satisfactory outlets for excess water are needed in cultivated areas. Some introduced grasses, such as reed canarygrass, produce large amounts of forage.

Terraces and diversions on the adjacent, higher lying soils help reduce the amount of flooding on this soil. V-shaped ditches can be used to drain excess water off the soil if a good outlet is available. Turning under crop residue and barnyard manure improves tilth, organic-matter content, and fertility.

CAPABILITY UNITS IVw-4 DRYLAND AND IVw-4 IRRIGATED

Platte and McCook soils is the only soil in these units. This is an undifferentiated soil group made up mainly of Platte and McCook soils. These are shallow to deep, somewhat poorly drained and moderately well drained soils on bottom lands. The water table is at a depth of 2 to 8 feet.

The soils in these units have moderate to very rapid permeability. The available water capacity ranges from low to high. The soils absorb moisture easily and release it readily to plants. They are easy to work, except when wetness is a hazard in early spring. Content of organic matter ranges from low to moderate, and fertility is low. Runoff is slow.

Excessive wetness is the main hazard, primarily early in spring when the water table is highest and rainfall is heaviest. During wet seasons, the soils dry out and warm up slowly, and tillage is delayed. Low-lying areas sometimes flood during heavy rain. During fall, some areas, particularly of Platte soils, are droughty because of the lower water table and the sand-gravel substratum. Available phosphorus is generally low.

DRYLAND MANAGEMENT: The main crop suited to dryfarming is alfalfa. Grain sorghum, wheat, and corn also are suited. Spring-sown small grain is adversely affected by soil wetness during seedbed preparation.

Surface drainage can be obtained by using V-shaped ditches or by land leveling. Lowering the water table is difficult, but tile drains or ditches are beneficial where the water table is exceptionally high. Commercial fertilizer and barnyard manure improve fertility. Using a cropping sequence eliminates the need for spring tillage. Returning all crop residue to the soil helps improve and maintain the organic-matter content and also helps control soil blowing. Reed canarygrass can be planted in some of the wettest areas.

IRRIGATION MANAGEMENT: Corn, alfalfa, and sorghum are the main irrigated crops. Alfalfa is the best suited crop because it eliminates the need for tillage in spring, when the soil is wettest. For all irrigation methods except sprinkler, some land leveling is needed in order to prevent flooding of low areas and allow for maximum efficiency in water distribution. Commercial fertilizers, particularly nitrogen and phosphorus, are needed to maintain fertility. Deep cuts should be avoided wherever possible. Small but frequent applications of water are needed to prevent burning the crop where the soils are shallow. Lowering the water table is difficult, but tile drains or V-shaped ditches are beneficial where the water table is exceptionally high.

CAPABILITY UNIT Vw-1 DRYLAND

Wet alluvial land is the only soil or land type in this unit. It is in old, abandoned river channels and basins on bottom lands. The soil material ranges widely in texture, but is mainly loamy and sandy. The water table fluctuates within a depth of 2 feet. Depth to the underlying sand ranges from 10 to 60 inches.

This land type has moderate to rapid permeability. Permeability is only important if the areas are drained or the water table is lowered. The soil material releases moisture readily to plants. The high water table is the main feature that affects use and management of this unit. Runoff is slow or does not occur.

Wetness is the main hazard. The water table is high, and flooding occurs after heavy rain. Bogs form in some areas.

DRYLAND MANAGEMENT: This land type is too wet for cultivated crops. Water-tolerant vegetation is best suited. Such grasses as reed canarygrass have excellent possibility for use. Proper stocking and deferred grazing help maintain production and also prevent development of bogs. In some areas, there is a dense stand of trees and little grass. These areas are well suited to wildlife habitat and are used by hunters for recreation.

CAPABILITY UNIT VIe-1 DRYLAND

This unit consists of strongly sloping and steep, well-drained, uneroded soils of the Nuckolls, Uly, Canlon, and Coly series on uplands (fig. 13). The Canlon soils are shallow, and the rest are deep. The surface layer and

Figure 13.—Typical grazing land made up of a combination of soils in capability units VIe–1 dryland and IVe–1 dryland. Coly and Uly are the principal soils.

underlying material are medium textured. Nuckolls and Uly soils also have a medium-textured subsoil.

The soils in these units have moderate permeability. The available water capacity ranges from low to high. The soils absorb moisture easily but, because of the slope, lose much rainfall by runoff. They release moisture readily to plants. Canlon soils have sandstone bedrock at a depth of 10 to 20 inches, but the rest are easy to work. Content of organic matter is low to moderate, and natural fertility is low or medium. Runoff is rapid.

Water erosion is the main hazard. Conserving moisture is a management concern on these sloping soils. If the grass cover is removed, the soils erode easily.

Dryland Management: These soils are too steep and have too severe an erosion hazard for successful cultivation. They are best suited to grazing. Cultivated areas can be seeded to native grasses and converted to rangeland. Proper range management is needed to maintain a good cover. These soils offer some good sites for flood-detention reservoirs, livestock water developments, and grade-control structures, some of which have secondary uses for recreation.

CAPABILITY UNIT VIe–8 DRYLAND

This unit consists of gently sloping to steep, eroded soils of the Coly, Nuckolls, and Uly series. These are deep, well-drained soils on uplands.

The soils in these units have moderate permeability. The available water capacity is high. The soils absorb moisture easily but, because of the slope, lose much rainfall by runoff. They release moisture readily to plants. They are easy to work. Content of organic matter and fertility are low. Runoff is rapid.

Water erosion is the main hazard. Low fertility and low organic-matter content are serious limitations. Because runoff is rapid, conserving moisture is an important management concern. Gullies and rills are common.

Dryland Management: These soils are not suited to cultivated crops because they are too steep and have too severe an erosion hazard. They are best suited to grass. Cultivated areas can be seeded to native grasses and used for grazing. The reseeded areas need proper management if a good grass cover is to be maintained. Proper stocking, deferred grazing, and control of weeds are beneficial. These soils also provide sites for stockwater dams, erosion-control structures, and flood-detention reservoirs, which provide secondary uses for wildlife habitat and recreation.

CAPABILITY UNIT VIe-9 DRYLAND

Coly and Hobbs silt loams are the only soils in this unit. They are deep, nearly level to very steep soils in intermittent upland drainageways. The Coly soil is on the sides and the Hobbs soil is in the bottoms of the drainageways. Both soils are medium textured throughout. The Coly soil is well drained, and the Hobbs soil is moderately well drained.

Soils in these units have moderate permeability. The available water capacity is high. Content of organic matter is low to moderate, and natural fertility is low to high.

Water erosion is the main hazard. The Hobbs soil is flooded for short periods after heavy rain. Gullies are in some areas.

DRYLAND MANAGEMENT: These soils are too steep for successful cultivation. They are best suited to rangeland. Proper management is needed to keep the grasses vigorous. Such practices as deferred grazing, rotation grazing, proper range use, fencing, and salting help maintain vigor and production. These areas offer some good sites for dams to provide water for livestock, wildife, and recreation. Flood-detention and erosion-control structures can be built in some of the drainageways.

CAPABILITY UNIT VIw-1 DRYLAND

Broken alluvial land is the only soil or land type in this unit. The soil material is deep, nearly level and very gently sloping, and mainly medium textured. It is on bottom lands of canyons and intermittent drainageways. This land type is frequently flooded.

This land type has moderate permeability. The available water capacity is high. The soil material releases moisture readily to plants. It is easy to work because it is medium textured, but debris and trash are commonly deposited by flood water. Runoff is slow.

Wetness, caused by frequent flooding, is the main hazard. Some erosion takes place as the moving water forms gullies and deepens the stream channels.

DRYLAND MANAGEMENT: This land type is used almost entirely for grazing, which is its best use. It is too frequently flooded for cultivated crops. In many areas grass is sparse because of the many native trees on the streambanks. Proper stocking and deferred grazing help main-

TABLE 2.—*Predicted average acre yields of*

[Yields in columns A are expected where an average level of management is used. Yields in columns B are expected under

Soil name	Corn				Alfalfa			
	Irrigated		Dryland		Irrigated		Dryland	
	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Butler silt loam	90	140	20	30	2.8	4.6	1.0	1.5
Coly and Uly silt loams, 3 to 9 percent slopes, eroded							1.2	1.8
Cozad silt loam, 0 to 1 percent slopes	100	145	40	50	5.0	7.0	3.0	4.0
Cozad silt loam, 1 to 3 percent slopes	80	110	30	40	4.0	6.0	2.0	3.5
Cozad silt loam, 3 to 7 percent slopes	65	90	20	30	2.5	4.3	1.5	2.5
Detroit silt loam, 0 to 1 percent slopes	100	145	25	30	5.0	7.0	1.5	2.0
Hobbs and McCook silt loams, 0 to 1 percent slopes	100	140	40	50	2.5	4.5	2.5	3.5
Hobbs and McCook silt loams, 1 to 3 percent slopes	95	135	35	45	2.4	4.3	1.8	3.2
Holdrege silt loam, 0 to 1 percent slopes	100	150	28	35	5.0	7.0	2.0	2.5
Holdrege silt loam, 1 to 3 percent slopes	95	135	20	30	4.0	6.0	1.6	2.2
Holdrege silt loam, 1 to 3 percent slopes, eroded	90	130	18	28	3.7	5.5	1.5	2.0
Holdrege silt loam, 3 to 7 percent slopes	80	100			2.5	4.0		
Holdrege and Uly soils, 3 to 7 percent slopes, eroded	75	95	15	25	2.5	3.5	1.2	1.8
Hord and Hall silt loams, terrace, 0 to 1 percent slopes	100	150	28	35	5.0	7.0	2.0	2.5
Hord and Hall silt loams, terrace, 1 to 3 percent slopes	90	135	20	30	4.0	6.0	1.6	2.2
Inavale fine sandy loam, 0 to 3 percent slopes			18	23			2.0	3.0
Leshara silt loam	75	100	25	35	3.0	5.0	3.0	4.0
McCook loam	95	130	30	55	4.0	6.0	3.0	4.0
McCook sand, overwash	70	100	20	40	2.5	4.0	1.2	1.8
Munjor fine sandy loam, 0 to 3 percent slopes	85	110	30	25	3.0	5.0	2.0	3.5
Munjor loamy fine sand, 0 to 3 percent slopes	50	60	25	30	2.5	4.0	2.0	3.0
Platte and McCook soils	50	60			2.5	3.5	1.5	3.0
Scott silt loam			8	15			0.4	0.9

[1] Wheat is raised under a fallow system. Yields are those obtained every 2 years.

tain a good grass cover. Many areas provide suitable sites for stockwater dams and flood-detention reservoirs. Erosion-control structures can be installed if care is used in selecting the site.

Predicted Yields

Table 2 lists most of the soils in the county and shows predicted average acre yields for the principal crops grown. Yields are shown under two levels of management and, for some crops, under both dryland and irrigated management. Predictions are based mainly on information obtained from farmers, farm workers, and others familiar with the soils and farming of the county. Unpredictable changes in weather, the use of new varieties of crops, and other factors of improved management can cause changes in yields. The estimates shown are averages based on seeded acres and on yields received by farmers in the past 5 years.

The yields in columns A are those obtained by most farmers in the county under a system of management that does not include regular cropping systems or improved methods of tillage or irrigation. It includes the use of fertilizers and crop residue, but is short of optimum needs of the crop for highest yields. Weed, disease, and insect controls are not consistently used.

Yields in columns B are those obtained under management that includes the use of adequate amounts of fertilizer, improved methods of tillage and irrigation, cropping systems that provide for maximum use of crop cover and residue, and other practices that enhance soil and water conservation. Such practices include drainage, erosion control, proper tillage, good-quality seed in optimum stands, application and amount of fertilizer indicated by soil tests and field experience, and control of weeds, insects, and disease.

Not listed in table 2, because they generally are not used for crops, are Broken alluvial land; Coly and Hobbs silt loams; Coly and Nuckolls silt loams, 9 to 31 percent slopes, eroded; Nuckolls and Uly silt loams, 9 to 15 percent slopes; Nuckolls and Uly silt loams, 9 to 31 percent slopes, eroded; Nuckolls, Uly, and Canlon soils, 9 to 31 percent slopes; Uly silt loam, 3 to 9 percent slopes; Uly and Coly silt loams, 9 to 31 percent slopes; and Wet alluvial land.

principal dryland and irrigated crops

a high level of management. Absence of yield indicates that the soil is not suited to the crop or that the crop is grown in small amounts]

Grain sorghum				Forage sorghum				Wheat [1] (Dryfarmed)		Tame pastures (Irrigated)	
Irrigated		Dryland		Irrigated		Dryland					
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*A.U.M* [2]	*A.U.M* [2]
85	135	25	35	6.0	9.0	3.0	4.0	15	25	------	------
------	------	20	25	------	------	1.2	1.5	15	18	------	------
85	140	50	75	6.0	9.0	3.5	5.0	25	40	10.0	14.0
80	105	35	50	5.0	8.0	2.2	3.5	20	30	8.0	12.0
60	95	25	35	4.6	7.0	1.2	1.5	18	22	5.0	9.0
85	140	35	50	6.0	9.0	3.0	4.0	20	30	10.0	14.0
85	140	50	70	6.0	9.0	3.5	5.0	25	35	------	------
80	135	35	50	5.0	7.5	2.0	3.0	21	33	------	------
95	150	40	60	7.0	10.0	3.0	5.0	23	32	10.0	14.0
90	135	30	45	6.0	9.0	2.0	3.3	20	30	8.0	12.0
85	130	28	43	5.5	8.5	1.8	3.1	18	28	7.5	11.0
80	110	------	------	4.0	7.0	------	------	------	------	5.0	9.0
75	95	25	35	3.5	6.0	1.0	2.0	15	25	4.5	8.5
95	150	40	60	7.0	10.0	3.0	5.0	23	32	10.0	14.0
90	135	30	45	6.0	9.0	2.0	3.3	20	30	8.0	12.0
------	------	20	25	------	------	2.0	2.5	15	20	------	------
65	95	25	35	------	------	3.0	5.0	------	------	------	------
80	125	50	75	5.5	8.5	3.5	5.0	25	40	------	------
65	90	20	40	5.0	8.0	2.5	3.0	18	23	------	------
75	115	35	45	5.0	8.0	2.2	3.5	25	35	8.0	10.0
55	70	35	45	3.5	6.0	2.5	3.5	15	20	7.0	8.0
50	60	------	------	4.0	6.5	------	------	------	------	------	------
------	------	10	15	------	------	------	------	10	15	------	------

[2] Animal-unit-months. The figures represent the number of animal units, or 1,000 pounds of live weight, that can be grazed on an acre of pasture for a period of 30 days.

Management of the Soils for Range[4]

Rangeland amounts to approximately 35 percent of the total farmland in Harlan County. It is scattered throughout the county but is somewhat concentrated along the breaks to the Republican River Valley. It generally is not suitable for cultivation. The major soil association is the Holdrege-Coly-Uly association. All the soils and land types in the county but Scott silt loam are suited to grass for pasture or range.

The raising of livestock, mainly cow and calf herds from which the calves are sold in fall as feeders, is the largest farming industry in the county.

Management practices that maintain or improve range condition are needed on all rangeland, regardless of other practices used. These are proper grazing use, deferred grazing, and planned grazing systems. The proper distribution of livestock in a pasture can be improved by the correct location of fences, livestock water developments, and salting facilities.

Practices that improve range condition include range seeding, or the establishment of either wild harvest or improved strains of native grasses by seeding or reseeding on land suitable for use as range. For example, where Coly and Nuckolls silt loam, 9 to 31 percent slopes, eroded, is still being used as cropland it should be range seeded. The most important warm-season grasses used in the seed mixtures are big bluestem, little bluestem, switchgrass, indiangrass, and side-oats grama. Other than management of grazing, little care is needed to maintain forage production.

Range Sites and Condition Classes

Different kinds of rangeland produce different kinds and amounts of native grass. For proper range management, an operator should know the different kinds of land or range sites in his holding and the native plants each site can grow. Management can then be used that favors the growth of the best forage plants on each kind of land.

Range sites are distinctive kinds of rangeland that differ from each other in ability to produce a significant difference in the kind, proportion, or production of climax 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. It is generally the most productive combination of range plants on a site.

Range condition is classified according to the percentage of vegetation on the site that is original, or climax, vegetation. This classification is used to compare the kind and amount of present vegetation with that which the site can produce. Changes in range condition are caused mainly by the intensity of grazing and by drought.

Climax vegetation can be altered by intensive grazing. Livestock graze selectively, constantly seeking the more palatable and nutritious plants. Plants respond to grazing by decreasing, increasing, or invading a site. 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 or are less palatable to livestock; thus, 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 is expressed in four condition classes to show the present condition of the vegetation on a range site in relation to the vegetation that grew on it originally. 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.

Descriptions of Range Sites

The range sites in Harlan County are Wet Land, Subirrigated, Silty Overflow, Silty Lowland, Sandy Lowland, Silty, Clayey, and Limy Upland (fig. 14). These sites are described in this section. The descriptions include the topography of each site, a brief description of the mapping units in each site, the dominant vegetation if the site is in excellent condition, the dominant vegetation if the site is in poor condition, and the total annual yield in pounds per acre, air-dry weight, in years when rainfall is average and the site is in excellent condition.

The names of the soil series and land types represented in a range site are named in the description of the range site, but this does not mean that all the soils of a given series are in that group. 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 or sites that occur in each soil mapping unit can be found in the "Guide to Mapping Units." Scott silt loam is not assigned to a range site because the vegetation that grows on this soil is not stable.

WET LAND RANGE SITE

Wet alluvial land is the only soil or land type in this site. This land type is nearly level and is in old, abandoned river channels and basinlike areas of bottom lands of the Republican River. The soil material is shallow to deep, loamy to sandy, poorly drained, and commonly mottled. It is calcareous at the surface. The kind of vegetation that grows on this site is mainly the result of a high water table that ranges from the surface to a depth of 2 feet.

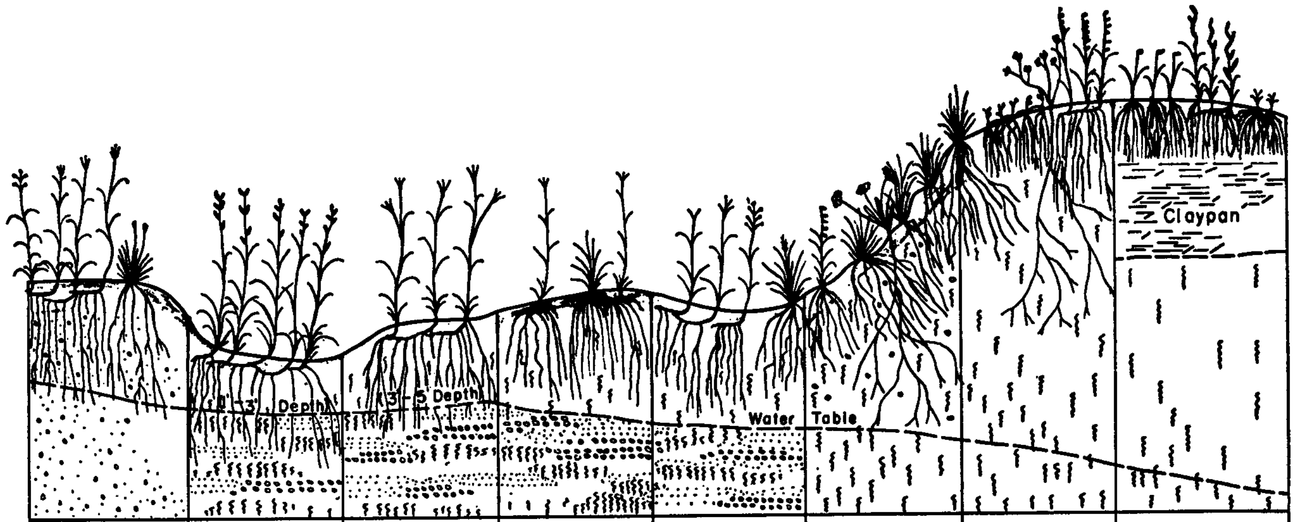
The climax plant cover is a mixture of such decreaser grasses as prairie cordgrass and reedgrasses. These grasses make up at least 75 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Sedges are the principal increasers. When the site is in poor condition, the typical plant community consists of Kentucky bluegrass, willows, and sparse amounts of prairie cordgrass and sedges.

If rainfall is average and the site is in excellent condition, the total annual production ranges from a low of 5,000 pounds per acre, air-dry weight, in unfavorable years to a high of 6,000 pounds in favorable years.

SUBIRRIGATED SITE

This site consists of soils in the Leshara and Platte series. These soils are nearly level and somewhat poorly drained and are on bottom lands in the Republican River Valley. They are shallow and deep, and they have a silty

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



Range Site	Sandy Lowland	Wet land	Subirrigated	Silty Lowland	Silty Overflow	Limy Upland	Silty	Clayey
Soil Series or Land Type	Munjor	Wet alluvial land	Leshara	McCook	Hobbs	Coly	Holdrege	Butler

Figure 14.—**Relationship of range sites in Harlan County. Each soil is placed in a range site, which can be a guide in planning management.**

surface layer. The underlying material ranges from silty to sandy. The kind of vegetation that grows on this site is mainly the result of a water table that fluctuates between depths of 2 and 6 feet.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, prairie cordgrass, and Canada wildrye. These grasses make up at least 75 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Western wheatgrass and sedges are the principal increasers. When the site is in poor condition, the typical plant community consists of Kentucky bluegrass, foxtail barley, blue verbena, cottonwoods, willows, and sparse amounts of western wheatgrass and sedges.

If rainfall is average and the site is in excellent condition, the total annual production ranges from a low of 4,500 pounds per acre, air-dry weight, in unfavorable years to a high of 5,500 pounds in favorable years.

SILTY OVERFLOW RANGE SITE

This site consists of soils in the Hobbs series and Broken alluvial land. These soils are moderately well drained and are on bottom lands along narrow upland drainageways and the valley of the Republican River. They are deep and mainly medium textured. The kind of vegetation that grows on this site is mainly the result of the additional water received from periodic overflow, the high available water capacity of the soils, and the moderate infiltration rate.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, and Canada wildrye. These grasses make up at least 70 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Western wheatgrass, side-oats grama, and sedges are the principal increasers. When the site is in poor condition, the typical plant community 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 ranges from a low of 4,000 pounds per acre, air-dry weight, in unfavorable years to a high of 5,000 pounds in favorable years.

SANDY LOWLAND RANGE SITE

This site consists of soils in the Inavale and Munjor series and McCook sand, overwash. These soils are moderately well drained, well drained, or excessively drained and are on bottom lands. They are deep. The surface layer ranges from moderately coarse textured to coarse textured, and the underlying material ranges from medium textured to coarse textured. The water table is at a depth of 5 to 10 feet. The kind of vegetation that grows on this site is mainly the result of the water table and the moderately coarse textured and coarse textured surface layer.

The climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, indiangrass, needle-and-thread, and Canada wildrye. These grasses make up at least 70 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Prairie sandreed, blue grama, sand dropseed, western wheatgrass, and sedges are the principal increasers. When the site is in poor condition, the typical plant community consists of sand dropseed, blue grama, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual production ranges from a low of 3,000 pounds per acre, air-dry weight, in unfavorable years to a high of 4,000 pounds in favorable years.

SILTY LOWLAND RANGE SITE

This site consists of soils in the Hord and Hall series and McCook soils that have a surface layer of loam or silt loam. These soils are well drained and moderately well drained and are on bottom lands and stream terraces where the water table is at a depth of 5 to 10 feet. They are deep and are mainly medium textured. The kind of vegetation that grows on this site is mainly the result of the additional beneficial moisture from the water table and from periodic overflow.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, little bluestem, switchgrass, and Canada wildrye. These grasses make up at least 70 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Blue grama, sand dropseed, side-oats grama, and western wheatgrass are the principal increasers. When the site in in poor condition, the typical plant community 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 ranges from a low of 3,500 pounds per acre, air-dry weight, in unfavorable years to a high of 4,500 pounds in favorable years.

SILTY RANGE SITE

This site consists of soils in the Cozad, Detroit, Holdrege, Nuckolls, and Uly series. These soils range from nearly level to steep and are on uplands and stream terraces. The surface layer and subsoil range from medium textured to moderately fine textured. Permeability ranges from moderate to slow. The kind of vegetation that grows on this site is mainly the result of the moderately good and good drainage of the soils, the high available water capacity, and the silty texture.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, indiangrass, and switchgrass. These grasses make up at least 55 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Side-oats grama, blue grama, buffalograss, and western wheatgrass are the principal increasers. When the site is in poor range condition, the typical plant community consists of blue grama, buffalograss, sand dropseed, western ragweed, blue verbena, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual production ranges from a low of 2,500 pounds per acre, air-dry weight, in unfavorable years to a high of 3,500 pounds in favorable years.

CLAYEY RANGE SITE

Butler silt loam is the only soil in this site. It is nearly level and somewhat poorly drained and is on uplands. The surface layer is medium textured, and the subsoil is fine textured. The kind of vegetation that grows on this site is mainly the result of slow permeability in the subsoil.

The climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, and Canada wildrye. These grasses make up at least 55 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Blue grama, buffalograss, tall dropseed, and western wheatgrass are the principal increasers. When the site is in poor range condition, the typical plant community consists of buffalograss, blue grama, blue verbena, western wheatgrass, and cool-season annual grasses.

If rainfall is average and the site is in excellent condition, the total annual production ranges from a low of 2,000 pounds per acre, air-dry weight, in unfavorable years to a high of 3,500 pounds in favorable years.

LIMY UPLAND RANGE SITE

This site consists of soils in the Coly series. These soils range from gently sloping to steep and are on uplands. The surface layer and underlying material are medium textured. The soils are deep and well drained. The kind of vegetation that grows on this site is mainly the result of the limy soil, the moderate permeability, and the good drainage.

The climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, switchgrass, and indiangrass. These grasses make up at least 60 percent of the total plant volume. Other perennial grasses and forbs make up the rest. Side-oats grama, blue grama, and buffalograss are the principal increasers. When the site is in poor condition, the typical plant community consists of blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual production ranges from a low of 1,500 pounds per acre, air-dry weight, in unfavorable years to a high of 2,500 pounds in favorable years.

Woodland and Windbreaks [5]

Natural stands of trees in Harlan County grow in bottom lands along the Republican River and its tributaries and in some natural depressions. Ash, box elder, cedar, chokecherry, cottonwood, American elm, hackberry, honey locust, bur oak, plum, walnut, and willow are native to the county. Other species of trees suitable for windbreaks have been introduced from other areas.

Except for their watershed, wildlife habitat, and esthetic values, the natural stands have limited economic value at present. Early settlers planted trees for shade and fenceposts and to protect their homes. Throughout the years, landowners have continued to plant trees to protect their buildings, livestock, and soil.

Farmstead and livestock windbreaks are the main kinds planted in Harlan County. The former are used around farm buildings and feedlots. If properly designed and located, they control the drifting of snow and keep snow out of farmyards. They also shelter the home, farmyard, and feedlot (fig. 15). A good farmstead windbreak easily adds hundreds of dollars to the value of a farm. Livestock windbreaks are effective in protecting livestock during winter storms.

On most soils, preparation for windbreaks is the same as for ordinary field crops. Even though many trees used are native to the county, they ordinarily are not growing naturally on the soil for which a windbreak is designed.

[5] By JAMES W. CARR, JR., forester, Soil Conservation Service.

Figure 15.—**A 6-year-old windbreak controlling snow around a farmstead in the Holdrege-Coly-Uly soil association.**

Therefore, they can be treated the same as a crop of corn or sorghum. In soils that are not sandy, the soil can be prepared enough in advance so that it will have time to settle and accumulate good subsoil moisture. Alfalfa or grass sod can be plowed in summer at least 1 year prior to planting, and cropland can be fall-plowed. Sandy soils can be planted without much advance preparation, or a cover crop can be planted a year before planting the trees. The cover crop protects the soil both before and after the planting and also protects the young seedlings.

Careful planning is needed for every windbreak so that it can be most effective. Farmstead windbreaks should not be planted too close or too far from the area to be protected. When choosing stock for planting, select species that grow best on the kind of soil at the planting location should be selected. Healthy seedlings from seeds collected locally and from reputable nurseries or other agencies are desirable. Planting early in spring, to protect the seedlings from drying out while being planted, and packing the soil so it is firm around the roots of the seedlings are also important.

Young trees need considerable care if they are to survive and do well on soils of Harlan County. Because rainfall is limited and irregular, weeds should be controlled so that they do not compete with the trees for moisture. This can be accomplished by cultivation or by using chemical weed killers. Trees should be protected from livestock and fire, and seedlings from rabbits and mice. Additional information on design planting and care of windbreaks is available from the Soil Conservation Service and the Extension Service forester in Harlan County.

The kind of soil greatly influences the growth of trees in this area. Trees grow best on a fine sandy loam soil. Only fair to poor growth is made on clayey soils because they absorb and release moisture too slowly. Very sandy soils do not store enough water and plant nutrients to be well suited to trees. A deep soil is better suited to trees than a shallow soil is because more moisture can be stored for use during droughty periods. Hardwoods require deeper soils than conifers, although conifers also make their best growth on the deeper soils.

Table 3 shows the relative vigor and expected height of most trees and shrubs suitable for windbreaks in this county. Detailed measurements made on trees in windbreaks about 20 years of age are given in this table. Measurements were taken on the major soils of the windbreak suitability groups in this county. The soils included in each group are given in the description of the windbreak suitability groups. The soils in each group have similar characteristics that affect tree growth.

The ratings in table 3 are based upon observations of 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 the trees are growing moderately well, there are only a few dead branches, a small amount of die-back in the

TABLE 3.—*Relative vigor and estimated height of trees at 20 years of age on soils of the major windbreak suitability groups*

[Very Wet and Undesirable windbreak suitability groups are not included because the need for windbreaks on these soils in Harlan County is uncommon]

Species	Silty to Clayey		Sandy		Moderately Wet		Shallow	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Ft.		*Ft.*		*Ft.*		*Ft.*
Eastern redcedar	Excellent	18	Excellent	18	Excellent	17	Excellent	15
Ponderosa pine	Excellent	21	Excellent	25	Unsuited	(2)	Good	20
Green ash	Good	22	Good	24	Good	20	Unsuited	(2)
Hackberry	Good	18	Good	20	(1)	(1)	Unsuited	(2)
Honey locust	Good	25	Good	22	(1)	(1)	Unsuited	(2)
Cottonwood	Poor	(2)	Fair to Good	52	Good	58	Unsuited	(2)
Russian-olive	Fair	16	Fair	20	Poor	(2)	Unsuited	(2)

[1] Sufficient data not available.
[2] Majority of trees dead or dying.

upper part of the crown, and a slight indication of damage by fungi and insects. A rating of *fair* indicates that half the trees have a significant number of dead branches in the upper part of the crown, and about one-fourth of the trees are dead, growth has slowed significantly, and there are indications of moderate damage by fungi and 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.

Differences among the soils in each group and the care through cultivation on each windbreak sampled resulted in a variance of growth for each species. The figures shown in table 3 for height represent an average for each species on the soils of that group. Such species as Siberian elm and cottonwood grow faster than others. Such species as Siberian elm are short lived, especially if planted on soils that have a poor moisture relationship; therefore, they are not generally as well suited to this area as other species.

Conifers, such as pine and eastern redcedar, grow slower at first than hardwoods, but their growth is likely to equal that of hardwoods as they mature. Conifers surpass hardwoods in height, in length of life, and in overall effectiveness as a windbreak.

Other pines suited to this area have a growth pattern similar to ponderosa pine. Eastern redcedar is the best all-around species for planting and, when mature, has a height of 30 to 40 feet on the better soils of the county. Pines and hardwoods are normally somewhat taller when they are mature.

Descriptions of the Windbreak Suitability Groups

Soils of Harlan County are grouped according to characteristics that affect tree growth. The soil series represented in the windbreak suitability groups are named in the descriptions of the group, but this does not mean that all the soils of a given series are in that group. To find the names of all the soils in any particular group, refer to the "Guide to Mapping Units" at the back of this survey. Soils in a suitability group produce similar tree growth and survival under normal conditions of weather and care. Following are brief descriptions of the windbreak suitability groups in Harlan County and a list of trees and shrubs that are suitable for windbreak plantings in each group.

SILTY TO CLAYEY WINDBREAK SUITABILITY GROUP

This group consists of soils in the Butler, Coly, Cozad, Detroit, Holdrege, Hall, Hord, Nuckolls, and Uly series. These are deep soils on uplands and stream terraces. The Butler soil is somewhat poorly drained, and the rest are moderately well drained or well drained. The surface layer is medium textured to moderately fine textured, the subsoil is fine textured to medium textured, and the underlying material is medium textured. These soils range from nearly level to steep. They are eroded in places.

The soils of this group generally provide a good site that has capability for good survival and growth of adapted species of trees. Drought, moisture, and competition from weeds and grasses are the main hazards. Water erosion is a hazard on gently sloping to steep soils. Trees and shrubs suitable for planting are—

Conifers: eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine.
Low broadleaf: Russian-olive.
Tall broadleaf: honey locust, green ash, hackberry.
Shrubs: cotoneaster, honeysuckle, lilac, chokeberry.

SANDY WINDBREAK SUITABILITY GROUP

This group consists of soils in the Inavale and Munjor series and McCook sand, overwash. These soils are on bottom lands. They are deep and are moderately well drained or excessively drained. The surface layer ranges from moderately coarse textured to coarse textured, and the underlying material is medium textured to coarse textured. The water table is at a depth of 5 to 10 feet.

The soils of this group are suited to tree planting if soil blowing is prevented. This can be done by maintaining strips of sod or other vegetation between the rows. Drought, moisture, and competition from grass and weeds are the main hazards. Trees and shrubs suitable for planting are—

Conifers: eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine.
Low broadleaf: honey locust, green ash.
Shrubs: skunkbush sumac, cotoneaster, lilac, chokecherry, western sandcherry.

MODERATELY WET WINDBREAK SUITABILITY GROUP

This group consists of soils in the Hobbs, Leshara, and Platte series; McCook soils that have a surface layer of loam and silt loam; and the land type Broken alluvial land. These soils are on bottom lands and upland drainageways or in the Republican River Valley. The surface layer and underlying material are loamy. The substratum material of the Platte soil is mixed sand and gravel. These soils are moderately well drained and somewhat poorly drained. The water table is at a depth of 2 to 5 feet. The soils are flooded at occasional intervals.

The soils of this group provide a good site for tree planting if species are selected that tolerate occasional wetness. Establishment of the trees can be a problem during wet years. Cultivation between the rows also can be difficult. The abundant and persistent herbaceous vegetation that grows on these sites presents a competition problem in the tree rows. Trees and shrubs suitable for planting are—

Conifers: eastern redcedar, Scotch pine.
Tall broadleaf: honey locust, green ash, eastern cottonwood, golden willow, white willow.
Shrubs: redosier dogwood, buffaloberry, chokecherry.

VERY WET WINDBREAK SUITABILITY GROUP

Wet alluvial land is the only mapping unit in this group. This is a land type in abandoned river channels and basinlike areas of bottom lands of the Republican River. It is poorly drained. The soil material is shallow to deep and ranges from loamy to sandy. The water table is within a depth of 2 feet.

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

Tall broadleaf: eastern cottonwood, golden willow, white willow.
Shrubs: redosier dogwood.

SHALLOW WINDBREAK SUITABILITY GROUP

This group consists of soils in the Canlon series. These soils are medium textured and are 10 to 20 inches deep over sandstone bedrock. They are strongly sloping to steep and are well drained.

A limited rooting zone and low available water capacity are the main hazards. Trees planted here suffer from drought in most years. Eastern redcedar is the only species suitable for planting.

UNDESIRABLE WINDBREAK SUITABILITY GROUP

Scott silt loam is the only soil in this group. This is a nearly level, poorly drained soil in upland depressions. It is frequently flooded. The surface layer is medium textured, and the subsoil is a fine-textured claypan. Permeability is very slow.

Excessive wetness makes this soil generally unsuited to windbreak plantings of any kind. Some areas can be used for recreation. If hand planted, water-tolerant tree and shrub species can provide wildlife habitat. Other special practices can be used.

Wildlife and Recreation [6]

Wildlife management requires a knowledge of soils and of the kind of vegetation they are capable of producing. The kind, amount, and distribution of vegetation largely determine the amount and kind of wildlife that can be produced and maintained. Fertility and soil characteristics, such as topography, affect the wildlife-carrying capacity of an area. Fertile soils generally produce more wildlife, and waters drained from such soils generally produce more fish than those from less fertile soils.

Soil topography affects wildlife through its influence on how land can be used. Rough, irregularly shaped areas are often impractical to cultivate and can present hazards to livestock. Undisturbed vegetation on such sites is valuable for wildlife. Where such cover is lacking, it can generally be developed.

Soil permeability and rate of water infiltration through soils are important considerations in the construction of ponds for fish and in developing and maintaining wetland habitat for waterfowl. Marshy areas lend themselves to the development of aquatic and semi-aquatic habitat for waterfowl and some species of furbearers.

Soils that have the largest wildlife population do not rate highest in their suitability for producing wildlife. The reason for this is that the best soils for cultivation are intensively managed for maximum crop production rather than for wildlife habitat.

The soils of Harlan County provide suitable habitat for a variety of game and nongame animals. Some of the better bobwhite-quail habitat in Harlan county is in the Hord-Cozad-Hall and McCook-Munjor-Inavale soil associations. These are mainly the valleys of the Republican River and its tributaries (see General Soil Map). Areas are used mainly for wheat, corn, and alfalfa, but some pastureland, rangeland, and wooded areas provide quail habitat in these soil associations. Sandy areas of the McCook-Munjor-Inavale association support some native woodland that is excellent habitat for deer.

Except at the Harlan County Reservoir, water is scarce for some species of furbearers. However, habitat is abundant for such others as raccoon, coyote, and opossum. Mink, beaver, and muskrat are associated with the shallow areas of the reservoir and with the Republican River. Squirrels and cottontail rabbits have adequate provisions in the wooded areas of the deeper draws. Habitat is also good for a variety of nongame birds and animals in these low-lying soil areas.

The most important fishery in the county is the Harlan County Reservoir. The principal fish here are white bass, large-mouthed black bass, walleye, and crappie. The Republican River is important mainly for catfish.

The reservoir, marshy areas, and river channels are used by waterfowl mainly during their spring and fall migrations.

The main east-west highway through Harlan County is U.S. 136, which follows the valley of the Republican River. 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 for outdoor

[6] By ROBERT J. LEMAIRE, conservation biologist, and JAMES W. CARR, JR., forester, Soil Conservation Service.

recreation. There also are some historic sites that add interest to recreation enterprises.

The Holdrege association provides the best habitat for pheasants in Harlan County. Grain sorghum and wheat provide an excellent supply of food, and wheatland provides nesting areas that are generally undisturbed until after the peak of the pheasant hatch has passed.

Soil topography in the Holdrege association provides some odd areas that produce native shrubbing and herbaceous vegetation that is relatively undisturbed. These areas are important for a variety of game and nongame wildlife species. Scott soils in this association provide ponded areas in wet years and are important to waterfowl. Soils of the Holdrege-Coly-Uly soil association also have varied topography that provides many odd areas of permanent vegetation.

Many areas in the county have sites suitable for dams and ponds. These ponds are suitable for the production of warm-water fish, such as bass, bluegill, and channel catfish. A major problem in many ponds is excessive turbidity caused by suspended particles of clay and silt. This is of particular concern in drainageways where there is little conservation treatment above the pond.

Wildlife is a product of soil and water. Each individual area has a certain capacity for producing wildlife, and this is dependent upon the habitat provided. When grasslands are plowed and used for cultivated crops, there is a loss of cover for some kinds of animals. In turn, an improved food supply is made available for other kinds of animals. Different trees and shrubs can be planted in field and farmstead windbreaks, thus meeting a different requirement for some species. Construction of farm ponds can provide opportunities for improving habitat for wildlife. Herbaceous and woody plantings around ponds supply cover for wildlife. Proper stocking and proper management can produce a sustained annual crop of fish.

Some soil is better suited to wildlife production than to production of crops. Protection of the natural cover or establishment of a needed cover improves conditions for production and maintenance of many wildlife species.

Table 4 shows a general requirement of important game species in Harlan County for certain vegetative types. The vegetative types that rank high or medium are considered essential habitat for that particular type of game species.

Table 5 gives the potential of the soil associations for producing various kinds of vegetation. The ratings *good*, *fair*, *poor*, and *very poor* take into account the soils present and their characteristics with respect to potential for producing kinds of vegetation for wildlife habitat.

Landowners interested in wildlife can develop areas for their own use or for use by other sportsmen. Farmers and landowners can realize an economic return from this land just as from cultivated crops, grass, or woodland. This is because good hunting, fishing, and recreation areas are in increasing demand and justify lease payments by interested sportsmen.

Special areas are marsh developments that have duck blinds, water developments for fishing, upland-game hunting areas, and cabin and scenic area developments. There are small, oddly shaped or isolated areas of land in almost every area of the county where conditions are

TABLE 4.—*Relative importance of three types of vegetation for food and cover for important game species*

Wildlife species	Importance of vegetative types for food and cover					
	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, mainly in spring and fall.

TABLE 5.—*Potential of the soil associations for producing elements of wildlife habitat*

Soil association	Potential for producing—			
	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat
Holdrege	Fair to good	Good	Good	Very poor to fair.[1]
Holdrege-Coly-Uly	Fair	Fair to good	Fair	
Hord-Cozad-Hall	Good	Good	Good	
McCook-Munjor-Inavale	Good	Good	Fair to good	Poor to fair.

[1] Scott soils in this association provide ponded areas in wet years.

ideal for wildlife development. At a minimum, these areas could be developed so as to satisfy the individual landowner's enjoyment. Larger tracts lend themselves to special hunting or other recreational areas and can be used for economic investment.

Developing habitat for wildlife requires proper location and distribution of vegetation. Technical assistance in planning wildlife developments and determining which species of vegetation to use can be obtained from the Soil Conservation Service in Alma, Nebraska. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, Bureau of Sport Fisheries and Wildlife, and from the Federal Extension Service. The Soil Conservation Service also provides technical assistance in the planning and application of conservation practices for development of outdoor recreational facilities.

Engineering Evaluation of the Soils[7]

The engineering properties of soil are important because soil provides a very large volume of construction material. The soil provides the foundation for buildings, dams, and highways. It also supplies sand and gravel for road paving, surfacing, and structural concrete and provides water conveyance and storage locations.

Among the most important engineering properties of soil 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, also are important to engineering use of the soil.

The data given in this report can aid in determining—

1. Possible sites for industrial, business, and residential construction and recreation sites.
2. Preliminary routes for highways, underground utilities, and airport locations.
3. Possible sites for drainage systems, farm ponds, irrigation systems, and sewage and feedlot runoff disposal systems.
4. Sites for borrow materials for highway embankment and for highway subbase, base, and surface courses.
5. Drainage areas and volumes of surface water runoff for bridge and culvert design.
6. Maintenance of structures and vegetation.
7. Detailed investigation needed after surface soils are located.
8. Possible corrosion of underground structures.

Used with the soil map to identify the soils, the engineering interpretations in this section are useful for many purposes. It should be emphasized, however, that the interpretations made in this soil survey are not a substitute for the sampling and testing needed at a site chosen for a specific engineering work that involves heavy loads or at a site where excavations are to be deeper than those reported here. Even in such situations, the soil map is useful for planning more detailed field investigations and for suggesting the kind of problems that can be expected.

The soil mapping units shown on the maps in this survey can include small areas of different soil material that are too small to be mapped separately. They generally are not significant in farming, but they can be important in engineering planning.

Information of value in planning is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation and Classification of Soils."

Some terms used by the scientist may be unfamiliar to the engineer, and some words, such as clay, sand, and silt, may have special meaning in soil science. These and other special terms used in the soil survey are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 6, 7, and 8.

Engineering Classification Systems

Soils are classified so that people can communicate in common terms. Two systems of soil classification are widely used for engineering purposes. These are the system used by the American Association of State Highway Officials (AASHO) (*1*) and the Unified system, which was developed by the Corps of Engineers, U.S. Department of Defense (*8*). The relationship between these two classification systems and the USDA textural classification is indicated in table 7.

In the AASHO system, seven groups of soils are classified on the basis of field performance. The groups are classified from A-1 (soils that have a high bearing capacity) to A-7 (soils that have low bearing capacity when wet). A-1, A-2, and A-3 soils are mostly sand and gravel mixtures. 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 can be further classified by identifying the silt-clay part. Thus, an A-2-4 soil is an A-2 sand with an A-4 silt-clay mixture included.

The group index number (shown in parentheses in table 6) ranges from 0 to 20 and is a rating of field performance of the soil. An A-2-4(0) soil is one of the best for highway construction. A group index number of 20 would indicate one of the least desirable soils for highway location or construction.

The Nebraska Department of Roads uses a group index range of −4 to 32 instead of 0 to 20. This enlarged group index bracket allows the plastic and nonplastic, fine-grained soil occurring in sands to be evaluated and the effect of a high clay content (group index greater than 20) to be determined.

The Unified System is used by many organizations, including the Soil Conservation System, the U.S. Bureau of Reclamation, and the Corps of Engineers. 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.

[7] By ROBERT J. FREDRICKSON, civil engineer, and GILBERT BOWMAN, soil scientist, Soil Conservation Service; and WILLIAM J. RAMSEY, Division of Materials and Tests, Nebraska Department of Roads.

TABLE 6.—*Engineering*

[Tests performed by the Nebraska Department of Roads, in accordance with standard

Soil name and location	Parent material	Report No.	Depth from surface
			In.
Hobbs silt loam: 120 ft. S. and 0.1 mile W. of NE. corner of sec. 18, T. 2 N., R. 19 W. (Modal)	Alluvium and coluvium.	S67–520	6–20
		S67–521	20–28
		S67–522	28–60
Holdrege silt loam: 135 ft. W. and 530 ft. S. of NE. corner of sec. 24, T. 3 N., R. 19 W. (Modal)	Peoria loess.	S67–508	0–5
		S67–509	8–16
		S67–510	24–60
Hord silt loam: 150 ft. E. and 0.3 mile N. of SW. corner of sec. 18, T. 2 N., R. 19 W. (Modal)	Reworked loess.	S67–511	6–24
		S67–512	24–32
		S67–513	40–60
McCook loam: 500 ft. W. and 0.7 mile S. of NE. corner of sec. 28, T. 2 N., R. 19 W. (Modal)	Alluvium.	S67–517	0–5
		S67–518	10–16
		S67–519	34–65
Uly silt loam: 230 ft. W. and 0.35 mile S. of NE. corner of sec. 6, T. 2 N., R. 18 W. (Modal)	Peoria loess.	S67–514	0–10
		S67–515	10–16
		S67–516	16–42

[1] Mechanical analyses according to the American Association of State Highway Officials Designation T 88–70 (*1*). Results by this procedure frequently may differ somewhat from results that would have been 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 than 2 millimeters in diameter is excluded from calculations of grain-size fraction. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made of two or more kinds of soil. The soils in referring to other series that appear in the first column of this table.

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Sand or mixed sand and gravel	Depth from surface (representative profile)	Classification: USDA texture	Classification: Unified[1]
	Ft.	*Ft.*	*In.*		
Broken alluvial land: Bk. Too variable to be rated.					
Butler: Bu	([3])	([4])	0–17	Silt loam	ML or CL
			17–40	Silty clay	CH or CL
			40–60	Silt loam	CL
Canlon. Mapped only with Nuckolls and Uly soils.	([3])	([4])	0–18	Loam	SC or SM
			18–24	Caliche (sandstone).	
*Coly: Ch, CkD2, CmC2. For Hobbs part of Ch, see Hobbs series. For Nuckolls part of CkD2, see Nuckolls series. For Uly part of CmC2, see Uly series.	([3])	([4])	0–5	Silt loam	ML or CL
			5–60	Silt loam	ML or CL

See footnotes at end of table.

test data

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [1]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—						AASHO [2]	Unified [3]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	Pct.			
----------	100	99	92	79	43	23	18	33	12	A-6(9)	CL
----------	----------	100	97	87	48	25	20	37	16	A-6(10)	CL
----------	----------	100	93	76	28	15	11	26	4	A-4(8)	CL-ML
----------	----------	100	98	88	45	25	20	32	12	A-6(9)	CL
----------	----------	100	99	94	59	43	35	50	30	A-7-6(18)	CL or CH
----------	----------	100	99	91	47	23	16	35	13	A-6(9)	ML-CL
----------	----------	100	99	86	35	20	13	31	9	A-4(8)	ML-CL
----------	----------	100	99	89	42	25	19	34	12	A-6(9)	ML-CL
----------	----------	100	99	80	39	17	11	31	7	A-4(8)	ML-CL
100	98	94	77	60	22	12	8	22	2	A-4(8)	ML
100	98	95	64	25	8	3	3	[4] NP	[4] NP	A-4(6)	ML
----------	100	99	83	41	13	7	5	NP	NP	A-4(8)	ML
----------	----------	100	98	90	41	23	18	37	15	A-6(10)	CL
----------	----------	100	99	89	46	26	20	38	16	A-6(10)	CL
----------	----------	----------	100	91	45	22	15	34	12	A-6(9)	ML-CL

[2] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 10): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-66 (*1*).
[3] Based on the Unified Soil Classification System, Military Standard No. 619B, Dept. of Defense, June, 1968 (*8*).
[4] NP=Nonplastic.

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for The symbol > means more than; the symbol < means less than]

Classification—Con.	Percentage of material less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity [2]	Shrink-swell potential
AASHO [1]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Pct.	In./hr.	In./in. of soil	
A-4 or A-6	----------	100	100	75-100	15-27	0.60-2.00	0.22-0.24	Low to moderate.
A-7	----------	100	100	90-100	35-55	0.60-0.20	0.11-0.13	High.
A-6 or A-7	----------	100	100	75-100	15-27	0.60-2.00	0.20-0.22	Low to moderate.
A-4	85-95	80-90	65-80	36-50	5-15	0.60-2.00	0.20-0.22	Low or very low.
A-4 or A-6	----------	100	98-100	85-100	15-27	0.60-2.00	0.22-0.24	Low to moderate.
A-4 or A-6	----------	100	98-100	80-100	15-27	0.60-2.00	0.20-0.22	Low to moderate.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Sand or mixed sand and gravel	Depth from surface (representative profile)	Classification USDA texture	Classification Unified [1]
	Ft.	*Ft.*	*In.*		
Cozad: CoA, CoB, CoC	(3)	(4)	0–16	Silt loam	ML or CL
			16–60	Silt loam	ML or CL
Detroit: DeA	(3)	(4)	0–16	Silt loam	ML or CL
			16–42	Silty clay loam	CL or CH
			42–60	Silt loam	CL
Hall. Mapped only with Hord soils.	(3)	(4)	0–18	Silt loam	ML or CL
			18–34	Silty clay loam	CL
			34–60	Silt loam	ML or CL
*Hobbs: HmA, HmB. For McCook part of these units, see Mc in the McCook series.	(3)	(4)	0–20	Silt loam	CL
			20–28	Silt loam	CL
			28–60	Loam	ML or CL
*Holdrege: HoA, HoB, HoB2, HoC, HpC2. For Uly part of HpC2, see Uly series.	(3)	(4)	0–14	Silt loam	ML or CL
			14–34	Light silty clay loam	CL
			34–60	Silt loam	ML or CL
*Hord: HrA, HrB. For Hall part of these units, see Hall series.	(3)	(4)	0–24	Silt loam	ML or CL
			24–40	Silt loam	ML or CL
			40–60	Silt loam	ML or CL
Inavale: InB	4–6	3–5	0–12	Fine sandy loam	SM or SC
			12–30	Loamy fine sand	SM or SP–SM
			30–60	Loamy sand	SM
Leshara: Le	2–6	3–7	0–22	Silt loam	ML or CL
			22–38	Very fine sandy loam	ML
			38–60	Silt loam	ML or CL
McCook:					
Mb	3–10	7–15	0–12	Sand	SP–SM or SM
			12–30	Loam	ML or CL
			30–60	Silt loam to fine sandy loam.	SM, SC, or ML
Mc	3–10	7–15	0–10	Loam	ML
			10–30	Fine sandy loam and very fine sandy loam.	SM or ML
			30–60	Very fine sandy loam	ML
Munjor:					
MtB	5–8	3–7	0–12	Loamy fine sand	SM
			12–60	Fine sandy loam	SM
MuB	5–8	3–7	0–18	Fine sandy loam	SM, SC, or ML
			18–60	Fine sandy loam	SM, SC, or ML
*Nuckolls: NuD, NuE2, NyE. For Uly part of these units, see Uly series. For Canlon part of NyE, see Canlon series.	(3)	(4)	0–7	Silt loam	CL
			7–16	Heavy silt loam	CL
			16–60	Silt loam	CL or ML
*Platte: Pm. For McCook part of this unit, see Mc in the McCook series.	2–6	1–2	0–7	Silt loam	CL
			7–14	Fine sandy loam	SM or SC
			14–60	Sand and gravel	SP or SP–SM
Scott: Sc	(3)	(4)	0–5	Heavy silt loam	CL
			5–32	Silty clay	CH or CL
			32–56	Silty clay loam	CL or CH
			56–60	Silt loam	CL

See footnotes at end of table.

significant to engineering—Continued

Classification—Con.	Percentage of material less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity [2]	Shrink-swell potential
AASHO [1]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
					Pct.	*In./hr.*	*In./in. of soil*	
A–4 or A–6	----------	100	95–100	85–100	10–22	0. 60–2. 00	0. 22–0. 24	Low to moderate.
A–4 or A–6	----------	100	95–100	80–100	10–22	0. 60–2. 00	0. 20–0. 22	Low to moderate.
A–6	----------	100	98–100	95–100	15–27	0. 60–2. 00	0. 22–0. 24	Moderate.
A–6 or A–7	----------	100	100	97–100	35–45	0. 06–0. 20	0. 18–0. 20	High.
A–6	----------	100	98–100	95–100	15–27	0. 60–2. 00	0. 20–0. 22	Moderate.
A–6	----------	100	98–100	98–100	15–27	0. 60–2. 00	0. 22–0. 24	Moderate.
A–6 or A–7	----------	100	100	98–100	25–35	0. 20–0. 60	0. 18–0. 20	Moderate to high.
A–6	----------	100	98–100	97–100	15–27	0. 60–2. 00	0. 20–0. 22	Moderate.
A–4 or A–6	----------	100	98–100	90–100	15–27	0. 60–2. 00	0. 22–0. 24	Low to moderate.
A–6	----------	100	100	95–100	15–27	0. 60–2. 00	0. 20–0. 22	Moderate.
A–4 or A–6	----------	100	100	90–100	10–18	0. 60–2. 00	0. 20–0. 22	Low.
A–4 or A–6	----------	100	100	95–100	15–27	0. 60–2. 00	0. 22–0. 24	Moderate.
A–6 or A–7	----------	100	100	95–100	25–35	0. 60–2. 00	0. 18–0. 20	Moderate to high.
A–4 or A–6	----------	100	100	97–100	15–27	0. 60–2. 00	0. 20–0. 22	Moderate.
A–4 or A–6	100	100	98–100	85–100	10–20	0. 60–2. 00	0. 22–0. 24	Low to moderate.
A–4 or A–6	100	100	98–100	85–100	10–27	0. 60–2. 00	0. 20–0. 22	Moderate.
A–4 or A–6	100	100	98–100	85–100	10–20	0. 60–2. 00	0. 20–0. 22	Low to moderate.
A–4 or A–2	----------	100	80–100	12–50	5–15	2. 00–6. 00	0. 16–0. 18	Low.
A–2 or A–3	----------	100	80–95	5–30	3–10	6. 00–20. 0	0. 09–0. 11	Very low.
A–2	100	95–100	70–90	12–30	3–10	6. 00–20. 0	0. 08–0. 10	Very low.
A–4 or A–6	----------	100	90–100	85–95	15–27	0. 60–2. 00	0. 22–0. 24	Low to moderate.
A–4	----------	100	90–100	55–95	10–20	0. 60–2. 00	0. 15–0. 17	Moderate.
A–4 or A–6	----------	100	90–100	85–95	15–27	0. 60–2. 00	0. 20–0. 22	Low to moderate.
A–2	100	95–100	75–90	5–25	0–8	6. 00–20. 0	0. 04–0. 06	None.
A–4	----------	100	90–100	50–77	12–22	0. 60–2. 00	0. 17–0. 19	Low.
A–4	----------	100	80–100	40–75	10–20	2. 00–6. 00	0. 20–0. 22	Low to very low.
A–4	----------	100	90–100	50–77	7–15	0. 60–2. 00	0. 20–0. 22	Low.
A–4	----------	100	80–100	40–75	2–15	0. 60–6. 00	0. 15–0. 17	Very low.
A–4	----------	100	90–100	50–85	3–15	0. 60–2. 00	0. 17–0. 19	Very low.
A–2	----------	100	70–90	11–35	3–10	6. 00–20. 0	0. 10–0. 12	Very low.
A–2 or A–4	100	95–100	80–95	15–50	5–15	2. 00–6. 00	0. 14–0. 16	Very low.
A–4	100	95–100	90–100	36–57	5–15	2. 00–6. 00	0. 16–0. 18	Very low.
A–2 or A–4	100	95–100	80–95	12–57	3–12	2. 00–6. 00	0. 14–0. 16	Very low.
A–6	----------	100	98–100	95–100	15–27	0. 60–2. 00	0. 22–0. 24	Moderate.
A–6	----------	100	98–100	95–100	20–30	0. 60–2. 00	0. 20–0. 22	Moderate.
A–6 or A–4	----------	100	98–100	95–100	15–27	0. 60–2. 00	0. 20–0. 22	Moderate.
A–6	98–100	90–100	88–98	50–90	10–22	0. 60–2. 00	0. 22–0. 24	Low to moderate.
A–2 or A–4	98–100	90–100	80–95	12–50	5–15	2. 00–6. 00	0. 15–0. 17	Very low.
A–1	75–95	25–75	15–50	0–10	0–2	>20. 0	0. 03–0. 05	None.
A–6	----------	100	98–100	85–100	15–27	0. 60–2. 00	0. 22–0. 24	Moderate.
A–7	----------	100	98–100	98–100	40–60	<0. 06	0. 11–0. 13	High.
A–6 or A–7	----------	100	98–100	95–100	27–40	0. 20–0. 60	0. 18–0. 20	High.
A–6	----------	100	98–100	85–100	15–27	0. 60–2. 00	0. 20–0. 22	Moderate.

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Sand or mixed sand and gravel	Depth from surface (representative profile)	Classification: USDA texture	Classification: Unified[1]
	Ft.	*Ft.*	*In.*		
*Uly: UsC, UtE. For Coly part of UtE, see Coly series.	(3)	(4)	0–16 16–60	Silt loam Silt loam	CL or ML CL or ML
Wet alluvial land: Wa. Too variable to be rated.	0–2				

[1] When two or more classifications are shown, the classification listed first is considered to be the most common.
[2] The figures for available water capacity are averages based on water retention difference as determined by laboratory tests. Studies are continuing.

TABLE 8.—*Interpretations of 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 for referring to other series that appear

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Sand or mixed sand and gravel	Road subgrade: Paved	Road subgrade: Gravel	Road fill	Soil properties affecting— Highway location	Soil properties affecting— Foundations
Broken alluvial land: Bk. Too variable to be rated.							
Butler: Bu	Good	(1 2)	Poor	Good	Poor: high shrink-swell potential.	High susceptibility to frost action because of clay content; subject to occasional flooding or ponding; may require minimum fills.	Fair to poor bearing value.
Canlon. Mapped only with Nuckolls and Uly soils.	Fair: moderately thick topsoil; mixed with rock in places.	(1 2)	(3)	(3)	Poor: bedrock outcrops numerous.	Moderate to low susceptibility to frost action; sandstone near surface.	Good below depth of 1.5 feet.
*Coly: Ch, CkD2, CmC2. For Hobbs part of Ch, see Hobbs series. For Nuckolls part of CkD2, see Nuckolls series. For Uly part of CmC2, see Uly series.	Fair: steep slopes in places.	(1 2)	Fair	Good	Fair: steep slopes in places.	Susceptible to frost action; slopes highly erodible; deep cuts and high fills necessary because of slopes.	Fair to poor bearing value; excessive consolidation where wetted. and loaded.

See footnotes at end of table.

significant to engineering—Continued

Classification—Con.	Percentage of material less than 3 inches passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity[2]	Shrink-swell potential
AASHO[1]	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
					Pct.	*In./hr.*	*In./in. of soil*	
A-6 or A-4	----------	100	100	95-100	15-27	0. 60-2. 00	0. 22-0. 24	Moderate.
A-6	----------	100	100	95-100	15-27	0. 60-2. 00	0. 20-0. 22	Moderate.

[3] Water table is at a depth too great to be significant to engineering.
[4] Sand or mixed sand and gravel occur below the depth that is normally sampled.

properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions in the first column of of this table]

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Drainage for crops and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Slopes erodible; good to fair stability; fair to poor workability depending on moisture; needs compaction control.	Low seepage; can be used for dugouts; excavation of more than 3 feet can cause excessive seepage.	Subject to occasional overflow or ponding; outlets not available in places; somewhat poorly drained.	High available water capacity; slow intake rate; needs protection from flooding; adequate surface drainage necessary.	Diversion slopes moderately erodible; terraces generally not needed.	Moderately erodible; may need water-tolerant grasses.	Severe: slow permeability; flooding could be hazardous.	Moderate: occasionally flooded in places; sealing or lining needed for excavations of more than 3 feet.
Good stability above sandstone if moisture control is close.	Seepage not a problem.	Rapid surface runoff.	(4) ----------	(4) ----------	(4) ----------	Severe: shallow over sandstone; slopes.	Severe: shallow over sandstone; slopes.
Slopes erodible; good to fair stability; fair to good compaction characteristics with moisture control.	Low to moderate seepage; high vertical seepage.	Well drained; rapid surface runoff.	(4) ----------	Slopes erodible; fertility a problem where subsoil exposed; construction and maintenance costs may be high.	Highly erodible; maintenance costs may be high.	Severe: slopes; moderate limitation of seepage.	Severe: slopes; sealing or lining needed for proper function.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of— Topsoil	Sand or mixed sand and gravel	Road subgrade: Paved	Road subgrade: Gravel	Road fill	Soil properties affecting— Highway location	Foundations
Cozad: CoA, CoB, CoC	Fair: moderately thick topsoil.	(1 2)	Fair to poor.	Good	Fair	Moderate susceptibility to frost action; slopes erodible.	Fair to poor bearing value, depending on density and moisture.
Detroit: DeA	Good; fair below depth of 16 inches.	(1 2)	Poor	Good	Fair: moderate to high shrink-swell potential.	Moderate to high susceptibility to frost action; slopes erodible; high shrink-swell potential in subsoil.	Fair to poor bearing value.
Hall. Mapped only with Hord soil.	Good; fair below depth of 18 inches.	(1 2)	Fair	Good	Fair: moderate shrink-swell potential.	Susceptible to frost action; slopes erodible.	Fair to poor bearing value; excessive consolidation where wetted and loaded.
*Hobbs: HmA, HmB. For McCook part of these units, see McCook series.	Good	(1 2)	Fair	Good	Fair: moderate shrink-swell potential.	High susceptibility to frost action; slopes erodible.	Fair to poor bearing value; excessive consolidation where wetted and loaded.
*Holdrege: HoA, HoB, HoB2, HoC, HpC2. For Uly part of HpC2, see Uly series	Good	(1 2)	Fair	Good	Fair: moderate to high shrink-swell potential.	Susceptible to frost action; slopes erodible.	Fair to poor bearing value; excessive consolidation where wetted and loaded.
*Hord: HrA, HrB. For Hall part of these units, see Hall series.	Good	(1 2)	Fair	Good	Fair	Susceptible to frost action; slopes erodible; compaction control required for fills.	Fair to poor bearing value; excessive consolidation where wetted and loaded.

See footnotes at end of table.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Drainage for crops and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Slopes erodible; good to fair stability.	Low to moderate seepage.	Well drained	High available water capacity.	Slopes erodible.	Erodible	Moderate: moderate permeability.	Moderate: moderate permeability; may require sealing or lining to function.
Slopes erodible; fair stability; good to fair compaction characteristics.	Low seepage for upper 3.5 feet of soil.	Moderately well drained.	High available water capacity.	Moderately erodible.	Moderately erodible.	Severe: slow permeability.	Slight: impervious if compacted.
Slopes erodible; fair to good stability; fair to good compaction characteristics.	Low horizontal seepage; high vertical seepage.	Generally well drained.	High available water capacity.	Moderately erodible.	Erodible; where subsoil is exposed, there may be a fertility problem; maintenance costs may be high.	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; impervious if compacted and sealed.
Slopes erodible; good to fair stability with compaction control.	Low to moderate horizontal seepage; high vertical seepage.	Moderately well drained; subject to overflow in places.	High available water capacity; subject to flooding in places.	Slopes erodible; subject to flooding in places.	Moderately erodible; maintenance costs may be high because of flooding.	Moderate: moderate permeability; subject to flooding in places.	Moderate: moderate permeability; requires protection from overflow; needs sealing and lining for proper function.
Slopes erodible; fair to good stability; fair to good compaction characteristics.	Low horizontal seepage; high vertical seepage.	Well drained	High available water capacity; steeper slopes erodible; development costs may be high in HoB, HoB2, HoC, and HpC2 units.	Moderately erodible.	Erodible; where subsoil is exposed, there may be a fertility problem; maintenance costs may be high.	Moderate: moderate permeability below depth of 3 feet.	Severe: moderate permeability; needs sealing or lining to function; steeper slopes may require higher construction costs.
Slopes erodible; good to fair stability with compaction control; fair to good workability.	High vertical seepage.	Well drained	High available water capacity; erodible by wind and water.	Moderately erodible.	Erodible	Moderate: moderate permeability.	Severe: needs sealing or lining to function.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—					Soil properties affecting—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved	Gravel			
Inavale: InB	Fair	Fair for fine sand; check site for desired gradation.	Good	Poor	Good	Low susceptibility to frost action; slopes are highly erodible; good drainage; good shear strength where compacted.	Good bearing value where confined; check site for depth over water.
Leshara: Le	Good	Good below depth of 4 feet in some places.	Fair	Good to fair in upper 4 feet.	Fair to good: somewhat poorly drained.	Susceptible to frost action; high water table may require raising grade; slopes erodible.	Bearing value depends on depth of footings for structure.
McCook: Mb, Mc	Fair in Mc. Poor in Mb: too coarse.	Check site for depth over and possibility of fine sand.	Fair to poor.	Good to fair.	Good	Susceptible to frost action; slopes erodible; consolidation depends on density; compaction requires close control for strength.	Bearing value depends on density at site; low to very low shrink-swell potential; check site for seepage and depth over water table.
Munjor: MtB, MuB	Fair: moderately thick topsoil.	Sand available; check site for gradation desired.	Fair to good.	Fair	Good	Moderate to high susceptibility to frost action; slopes highly erodible; good drainage; good shear strength with proper compaction.	Good bearing value; check site for seepage potential and depth over water table.
*Nuckolls: NuD, NuE2, NyE. For Uly part of these units, see Uly series. For Canlon part of NyE, see Canlon series.	Fair to poor: slopes.	([3])	Fair	Good	Fair to poor: slopes; moderate shrink-swell potential.	Susceptible to frost action; slopes erodiible; deep cuts and moderate fills necessary because of steep slopes.	Fair to good bearing capacity, depending on in-place density.

See footnotes at end of table.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Drainage for crops and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Good stability if confined; low compressibility; slopes erodible; pervious.	High seepage potential.	Excessively drained; rapid permeability.	Moderate available water capacity; susceptible to soil blowing; low fertility.	([4])	Highly erodible; low fertility; rapid permeability.	Slight for a filter; severe if contamination of underground water supply is possible.	Severe: rapid permeability; needs lining to function properly; check site for depth over water table.
Slopes erodible; horizontal seepage is high in sand strata; fair to good stability if confined; low compressibility; check depth over water table.	Moderately high seepage; check depth to water table; dugouts possible.	Somewhat poorly drained; slow to medium surface drainage; high water table; adequate outlets may not be available.	High available water capacity; adequate drainage necessary; subirrigated.	([4])	Erodible; may need drainage or water-tolerant grasses.	Severe: moderately high water table.	Severe: moderate permeability; excavation may expose sand substrata; sealing or lining needed.
Fair stability; good workability; impervious where compacted.	High seepage potential; check depth over water table; dugouts possible.	Moderately well drained; moderate permeability; sandy material at depth of 3 to 6 feet.	High available water capacity.	([4])	Flat slopes may require special design; 1 to 2 percent slopes erodible.	Slight for soil; severe if possible to contaminate underground water supply.	Severe: permeability of soil below depth of 4 feet will not allow a lagoon to function unless sealed or lined; check depth over water table.
Good stability; slopes erodible; check depth over water table.	High seepage potential; dugouts possible.	Moderately well drained; moderately rapid permeability.	Moderate available water capacity; some drainage may be needed; erodible by wind and water.	Diversion slopes erodible by wind and water.	Erodible by wind and water; low fertility in places.	Severe: high water table.	Severe: needs sealing or lining to function; check depth over water table.
Slopes erodible; fair stability; fair to good workability.	Seepage possible.	Well drained.	([4])	Slopes very erodible.	Slopes erodible; low fertility in places.	Moderate: moderate permeability; slopes.	Severe: needs sealing or lining to function; slopes may be a problem.

TABLE 8.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—					Soil properties affecting—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved	Gravel			
*Platte: Pm. For McCook part of this unit, see McCook series.	Fair: moderately thick topsoil.	Good below depth of 1 foot.	Good	Poor	Fair: somewhat poorly drained.	Low susceptibility to frost action; high water table and flooding may require minimum fills; highly erodible slopes; suitability based on uses of sand strata.	Good bearing capacity if confined; check depth over water table.
Scott: Sc	Poor: thin topsoil; poorly drained.	(1 2)	Poor	Good	Poor: high shrink-swell potential.	Moderate to high susceptibility to frost action; surface ponding may require minimum fills; slopes erodible.	Fair to poor bearing value; moderate to high shrink-swell potential; excessive consolidation when wetted and loaded.
*Uly: UsC, UtE. For Coly part of these units, see Coly series.	Fair: moderately thick topsoil.	(1 2)	Fair to poor.	Good	Fair: moderate shrink-swell potential.	Susceptible to frost action; slopes moderately erodible; compaction control required for fills.	Fair to good bearing capacity, depending on in-place density and moisture.
Wet alluvial land: Wa. Too variable to be rated.							

[1] Sand is generally not available.
[2] Mixed sand and gravel is generally not available.

properties of the soils—Continued

Soil properties affecting—Continued						Soil limitations for sewage disposal	
Embankments, dikes, and levees	Pond reservoir areas	Drainage for crops and pasture	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Subject to horizontal seepage; good stability with compaction control; may require drainage; good workability; low compressibility.	High seepage; high water table; suitable for dugouts.	Somewhat poorly drained; adequate outlets may not be available; seasonal high water table; flooding.	Topsoil to depth of 0.5 to 1.0 foot; low available water capacity; adequate drainage and protection from flooding need to be provided; subirrigated.	(4)	Erodible; low fertility where subsoil exposed; requires protection from flooding; may need water-tolerant grasses.	Severe: moderately high water table; flooding; may contaminate underground water supply.	Severe: moderately rapid permeability; requires protection from flooding; needs sealing or lining.
Subject to shrinkage and cracking; slopes erodible; fair to good stability; impervious; fair to poor workability; compaction control needed.	Low seepage	No surface drainage; very slow permeability; subject to frequent overflow; adequate outlets may not be available at a reasonable cost.	(4)	Diversion slopes erodible; terraces generally not needed.	Highly erodible.	Severe: very slow permeability; ponding.	Severe: needs protection from flooding.
Slopes erodible; fair stability with close control; fair to good workability; impervious.	Moderate seepage.	Surface drainage may be excessive.	(4)	Moderately erodible.	Moderately erodible.	Moderate: moderate permeability and slopes.	Moderate to severe; moderate permeability and slopes; needs sealing or lining to function.

[3] On-site determination needed where bedrock occurs.
[4] Because of position, slope, or other soil characteristics this practice or structure is not needed or applicable.

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 6 and 7, the soils of Harlan County are classified as SP, SP-SM, SM, SC, ML, ML-CL, CL, and CH. Soils that have borderline characteristics of two classifications are given a dual classification.

Engineering Test Data

Table 6 shows engineering test data for several soils. These soils represent some of the most extensive soils of Harlan County, covering about 68 percent of the county. Five soil series, represented by 15 soil samples, were tested for this report. 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 6 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.

The engineering classifications in the last two columns of table 6 are based on data obtained by mechanical analysis and on tests to determine the liquid limit and plastic limit. The mechanical analysis was made by a combination of the sieve and hydrometer methods.

Tests for liquid limit and plastic limit measure the effect of water on the consistency of the soil material. As the moisture content of a clay soil is increased from a dry condition, the soil changes from a solid to a plastic state and then to a liquid state. The *plastic limit* is that moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the soil passes from a solid to a plastic state. The *liquid limit* is that moisture content at which the soil passes from a plastic to a liquid state. The *plasticity index* is the numerical difference in percent moisture between the liquid limit and the plastic limit. It indicates a range of moisture content within which the soil is considered to be plastic. Some silty and sandy soils are nonplastic, which means they will not become plastic at any moisture content.

Engineering Properties of Soils

In table 7 soil properties significant to engineering are estimated. For detailed information about the soils, refer to the section "Descriptions of the Soils," and for information about geology, to the section "Formation and Classification of Soils."

The estimates in table 7 were based on the engineering test data in table 6 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 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 Harlan County that have a significant percentage of coarse materials greater than 3 inches in diameter.

In the AASHO and Unified systems, soil particles retained on the No. 200 sieve are classed as sand and gravel. Silt and clay particles pass this sieve. Particles retained on the No. 4 sieve are classed as gravel. The range of value shown in table 7 for the percent 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-swell potential.

In tables 6 and 7 the clay percentage is based on an analysis that uses the hydrometer method (AASHO Designation T-88). This method can give results that differ slightly from those obtained by the pipette method used by Soil Conservation Service soil scientists to obtain results with standard soil survey procedures.

In table 7, permeability refers to the rate at which water moves through a saturated soil. It depends largely on gradation, structure, and density. The rate is given in inches of water per hour. Rates are given for the major significant soil horizons. Terms used to describe permeability and the equivalent rates are given in the Glossary.

Available water capacity, estimated in inches of water per inch of soil depth, is the approximate amount of capillary water in a soil that is wet to field capacity.

Soil dispersion is not a serious problem because a few areas in Harlan County contain enough salts to produce moderate dispersion. Salinity is generally not a problem. However, in the somewhat poorly drained bottom-land soils along the Republican River, small areas are saline. Onsite investigations are desirable in all areas where salinity is a hazard to construction work.

A generalized rating for shrink-swell potential is given in table 7. Several soils, such as those in the Scott, Butler, and Detroit series, have moderate to high shrink-swell potential. Generally, soils that have a high content of expandable clay, such as montmorillonite, undergo a volume change when the soil moisture is changed. Clean sands and gravels undergo little or no volume change when wetting or drying occurs.

Reaction of a soil is the degree of acidity or alkalinity, expressed as a pH value or reaction class. A soil that has a value of 7.0 is neutral, one that has a lower value is acid, and a soil that has a pH greater than 7.0 is alkaline. In Harlan County, soil materials that have approximate pH values greater than 7.8 and less than 6.3 should be investigated for their potential corrosive hazard to metal structures. The reaction class for most horizons of the representative profiles are given in the section "Descriptions of the Soils." Soils used as construction materials, if moist or wet, need to be tested for corrosive potential.

Engineering Interpretations of Soils

Table 8 indicates a general interpretation of the soils for their use in engineering. This table is a guide to planning and to further investigation of the soils. Onsite determinations of the soils for type, quantities, and engineering properties are important.

In table 8, topsoil is rated *good*, *fair*, or *poor*, depending on depth, fertility, content of organic matter, erodibility, workability, and quantity. Topsoil is used to cover road and dam embankments, on excavated slopes, and on gardens and lawns.

Several soils in Harlan County are a source of sand and gravel. The Platte and Inavale soils are examples of a sand source. Exploration is needed to determine the quantity, gradation, and depth of sand and gravel. Operational sand pits are a guide to locating sources of sand and gravel.

Ratings for use of soil as road fill include suitability as embankment and as foundation for embankments, erodibility of cut slopes, and potential frost action. Sands and gravels are rated *good* to *fair* for subgrades under pavement and *poor* for gravel road subgrades. Silt and clay on the road subgrade surface is more stable for gravel surfacing. Thus, for paved roads, AASHO class soils 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 (foundation) and road fill have the same classification for paved roads because the engineering requirements are approximately the same.

Highway locations are described according to potential problems of frost heave, shrink-swell potential, erodibility of cut and fill slopes, possible flooding, and location of water table and are rated *good*, *fair*, or *poor* for road subgrade. 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, or load-carrying, capacity. Most soils have a high bearing capacity when dry. Some windblown and alluvial soils are subject to high consolidation if saturated under load. Sands and gravels (see AASHO classifications) have high bearing capacity where confined. Specific values for bearing capacity (for example, pounds per square inch) should not be assigned to estimated values as expressed in words in table 8. Wet excavations for buildings can be a problem. Therefore, depth to water table should be determined for building sites. The shrink-swell potential from table 7 is an important concern in planning foundations. The possibility of seepage into foundations or excavations is indicated.

Embankments are subject to seepage and compressibility, which are rated in table 8. Workability includes hauling and compaction characteristics. Potential seepage depends on moisture, gradation, and compaction of the fill. Erodibility of fill slopes is also described. Two methods of compaction are required for soils in Harlan County. In soils that are approximately 15 percent or less silt and clay particles, compaction has to be controlled by the relative density test, which is equivalent to the use of vibratory rather than sheepsfoot rollers. Soils that are approximately 15 percent or more silt and clay particles are generally compacted with sheepsfoot, or tampering, rollers while moisture is controlled at or above a minimum limit.

Dikes and levees are used to control surface water. They are subject to erosion by wind and water and to horizontal seepage if not properly compacted or if constructed of clean sands. Some soils are subject to shrinking and cracking upon drying. Dikes and levees constructed of sandy soils need flat slopes for stability. Steeper slopes are used for dikes and levees constructed of clay soil because the fill is relatively impervious to water.

For farm ponds, potential seepage in the soil and the use of soil for embankments are described in table 8. A high water table indicates the possibility of excavating a dugout for a water supply. In places a low, or deep, water table indicates the need for sealing or lining a pond; it also indicates that construction of a fill can be easier because the foundation is drier.

Drainage for crops and pasture, as described in table 8, 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 such factors as available water capacity, permeability, surface intake rate, steepness of slopes, and possible limiting depths of leveling cuts. Further information on soil use for irrigation is contained in "Nebraska Irrigation Guide," Soil Conservation Service. The ratings for available water capacity are limited to the upper 5 feet of soil. The rating is *high* if the soil holds 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. It is affected by the permeability of the various soil layers being irrigated. Intake ratings are given for some soils in table 8, and a permeability range is given in table 7. The intake rate is *rapid* if the soil takes in more than 2 inches of water per hour, *moderate* if the rate is 0.6 inch to 2 inches per hour, and *slow* if it is less than 0.6 inch per hour.

Use of the soils for terraces, diversions, and grassed waterways is described according to possible erosion by wind and water, difficulty of establishing vegetation, and soil fertility. Maintenance costs of terraces and diversions are greater where siltation occurs from higher elevations. Depth to erodible sands limits cut depths for diversion alignment. Rough topography and steep slopes also are factors in terrace and diversion alignment.

For sewage disposal, the limitations of the soils for use as sewage filter fields and sewage lagoons are given in table 8. Use of soils for sewage disposal can also be related to table 8, including soils classification, 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, and *severe* indicates a high water table or an impervious soil.

For sewage lagoons, water must be retained in the lagoon if aerobic decomposition of the fresh sewage is to occur. Thus, an impervious soil is desired for constructing this facility. The probability that a soil might require sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber is indicated. Some soil has potential for being reworked and compacted to provide a liner. A lagoon constructed in sandy material that has a high water table (rated *severe*) is the least desirable sewage disposal facility. A sewage filter field or disposal lagoon should be located so as not to contaminate wells that furnish domestic water supply to stockwater. Other factors, such as steepness of slope and possibility of flooding, also need to be considered in sewage treatment design.

Formation and Classification of Soils

In this section the factors that have affected the formation of soils in Harlan County are described. The current system of soil classification is explained, and the soil series are placed in the higher categories of that system. The soil series in the county, including a profile representative of each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is produced by soil-forming processes that act on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil 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. 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.

Parent material

The soils of Harlan County formed in several kinds of parent material. The most extensive is light-gray and pale-brown loess, or wind-deposited silty material, that covers the broad uplands and the high-lying stream terraces. Scott, Butler, Detroit, Holdrege, Hord, Uly, and Coly soils formed in this kind of parent material. The soil characteristics of each of these soils are the combined effect of the soil-forming processes. Since all developed in the same kind of parent material, in the same climate, and under prairie grasses, the principal variables are relief and the length of time that soil-forming processes have been acting upon the parent material.

Scott, Butler, Detroit, Holdrege, and Hord soils are on uplands and are nearly level and gently sloping. They are in the most stable sizes in the landscape, and soil-forming processes have acted upon them for a long time. The time has been about the same for all these soils, but relief is variable. Scott soils formed in depressions, where runoff water collects and stands for part of the growing season. Butler soils formed in shallow, basinlike depressions that are seldom ponded or are ponded for only a short time. Detroit soils are nearly level and formed in areas where surface drainage is slow and nearly all of the precipitation is taken into the soil. Holdrege and Hord soils formed on well-drained sites. Hord soils are on sites where wind-deposited silt of local origin has thickened the surface horizons, and Holdrege soils are on sites where erosion has prevented the buildup of these local deposits.

Uly and Coly soils formed in sloping areas or on windwhipped ridges. As the soil material formed, part of it was removed by erosion. This has the same effect as reducing the time during which soil-forming processes have acted; soil formation proceeded slowly, and Uly and Coly soils are weakly developed.

Beneath the light-gray loess is the brown loess that is the parent material for the Nuckolls soils. Nuckolls soils are below Holdrege, Uly, and Coly soils. They are similar to the Holdrege soil except for color of the subsoil and underlying material.

Below the brown loess is sandstone of Tertiary age in which the Canlon soils formed. These soils are shallow. They are on the lower valley sides of some deeply entrenched drainageways.

The alluvium on the bottom lands, foot slopes, and stream terraces is parent material for many soils, but in total acreage these soils are minor compared to the soils of the upland areas. In places the time during which soil-formation processes have acted on the parent material is as long on the stream terrace positions as on the broad uplands, but in most places it is less. The parent material on foot slopes and bottom lands has been in place for only a short time; some has been deposited as recently as the last intense rain shower or snowmelt.

Hall and Hord soils formed in silty parent material on stream terraces. Cozad, McCook, Hobbs, and Leshara soils formed in silty material on bottom lands. Inavale, Munjor, and Platte soils formed in sandy material on bottom lands.

Several other earth materials are present at the surface, but no areas of soils that formed in these materials are of sufficient size to be shown on the soil maps. Northeast of Republican City, sand and gravel is at the surface along tributaries of Turkey Creek. South of the Republican River, dark-colored shale (Pierre Formation) and chalky shale that has thin beds of limestone (Niobrara Formation) are at the surface on slopes that border drainageways. The outcrops of the Niobrara Formation are present only on the valley side south of the Republican River at the eastern edge of the county.

Climate

Through its influence on vegetation, on activity of micro-organisms, and on the physical condition of soil material, climate has been important in the formation of soils in Harlan County.

Climate affects the weathering of parent material directly through rainfall, fluctuation in temperature, and the working of wind. Alternate freezing and thawing hasten physical disintegration of parent material. Summer heat and moisture 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 an agent of deposition of soil material.

Climate affects soil indirectly through its influence on vegetation and the kinds of animal life than can be sustained. The primary source of 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.

Water received as rainfall moves through the drainageways, continually shifting, sorting, and reworking unconsolidated material of all kinds. These sediments are deposited, picked up, and redeposited many times by flowing streams. The alluvial soils in this county are examples of soils that formed in water-deposited sediments.

Precipitation entering the soil moves downward, carrying with it the soluble products produced by soil formation. In a subhumid to semiarid climate, the soils are seldom wet below the depth of live roots, except in very wet years. Low humidity causes a fairly high loss of water through evaporation, which influences soil formation because it reduces the amount of water that percolates through the soil. Carbonates are leached to a depth of 3 to 4 feet in some soils of the county, but there is very little leaching of carbonates in the weakly developed Coly soils. The amount of clay moved from the surface to the subsoil is not so great as in soils in areas where the rainfall is greater. The percentage increase of clay in the subsoil compared to the surface horizon results partly from accumulation of clay by leaching and partly from weathering in place.

Climate is fairly uniform throughout the county, and differences in the soils cannot be attributed to differences in climate. Seasonal variations in temperature and in rainfall are wide. The average annual precipitation in Harlan County is 22.3 inches; the range within the county is 20 to 24 inches. Temperatures fall below 0° F. in winter and exceed 100° F. in summer. The average daily temperature is 26° F. in January and 78° F. in July.

Plant and animal life

The dominant vegetation is mixed tall, mid, and short grasses. During wet cycles the tall grasses flourish, and during dry cycles the short grasses are dominant. Cottonwoods, green ash, box elder, and elm grow along the deep drainageways and on bottom lands.

Much mixing and working of the soil has been done by moles, gophers, and earthworms. This promotes granulation. Such small animals as millipedes, mites, spiders, and other insects aid in the decomposition and mixing of organic residue into the soil.

When the roots of plants decay, they affect the soils by leaving channels for aeration and drainage and by leaving organic matter and promoting good soil structure. Other plant and animal life, such as nematodes, protozoa, fungi, algae, actinomyces, and bacteria, are active in the decomposition of organic matter or the formation of humus, or in other ways provide changes necessary in the soil for use by the plants.

Relief

Many differences among soils can be attributed to variations in relief. Relief affects soil formation through its effects on drainage and runoff. These, in turn, affect plant cover, biological activity, soil temperature, erosion, and deposition of sediments. Runoff is more rapid on steep slopes than on nearly level slopes. Consequently, less water soaks into the soil and there is less leaching on the steeper slopes. Erosion is more severe on steeper slopes if all other factors are equal.

Butler, Coly, Detroit, Holdrege, Scott, and Uly soils formed in similar material, but they have differences that can be associated with relief. Coly soils have the steepest slopes, where runoff is rapid, and on these soils natural erosion has almost kept pace with soil formation. Most Uly soils are not so steep as Coly soils, and in Uly soils carbonates are leached to a depth of about 16 inches. Holdrege soils are normally not quite so steep as Uly soils, and they have lime leached to a depth of 34 inches and a thicker, slightly finer textured subsoil. Detroit soils are nearly level; they have a finer textured subsoil than Holdrege soils and have lime at a depth of 42 inches. Butler and Scott soils are in basins and depressions where water accumulates as runoff from higher soil areas. They have a finer textured subsoil than any other soils in the county. Lime is leached to a depth of more than 60 inches in representative Scott soils.

Soils on bottom lands, such as Leshara, McCook, Platte, and Inavale soils, have low relief, as do soils on stream terraces, such as Hall and Hord soils.

Time

Differences in the time a soil has been affected by soil-forming processes are commonly reflected in the properties of the soil. Mature, or normal, soils have a well-defined dark-gray or dark grayish-brown surface layer 7 to 14 inches thick. The subsoil is 8 to 18 inches thick; is dark brown, grayish brown, or brown in color; and is finer textured than the surface layer. In Harlan County, Butler and Holdrege soils are examples of mature soils. Immature, or young, soils generally are lighter colored and thinner than mature soils. The subsoil is brown to pale brown and has about the same texture as the surface layer. Coly soil is an example of an immature soil in Harlan County.

The time required for a soil to form depends mainly on parent material and climate. The finer the texture of the parent material, the longer the time needed for soil formation. Finer texture retards the downward movement of water, which is necessary to the process of soil formation. Soils in warm, humid regions form faster than soils in cool, dry areas.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study, and readers interested in developments of the current system should search the latest literature available (*2*, *5*). In table 9, the soil series of Harlan County are placed in some categories of the current system. The placement of some soil series in the system, particularly the placement in the the families, may change as more precise information becomes available. The classification used here is current as of September, 1971.

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system, the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. Most of the classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soils orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are Entisols and Histosols, which occur in many different kinds of climate. Table 9 shows that the two soil orders in Harlan County are Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or that 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 that contains colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling.

SUBORDER: Each order has been divided into suborders, primarily on the basis of characteristics that produce classes that have the greatest genetic similarity. The suborder narrows the broad climatic range permitted in the order. The soil properties used to define the suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences that result from climate or vegetation.

GREAT GROUP: Suborders are separated into great groups on the 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 has accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clay, 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 9 because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are divided into subgroups, one representing the central (typic) segment of this group and others, called intergrades, that have properties of the group and also one or more properties of another

TABLE 9.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquolls	Mollisols.
Canlon	Loamy, mixed (calcareous), mesic	Lithic Ustorthents	Entisols.
Coly	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Cozad	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Detroit	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Holdrege	Fine-silty, mixed, mesic	Typic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Inavale [1]	Mixed, mesic	Typic Ustipsamments	Entisols.
Leshara [2]	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols.
McCook	Fine-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Munjor	Coarse-loamy, mixed (calcareous), mesic	Typic Ustifluvents	Entisols.
Nuckolls [3]	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Platte	Sandy, mixed (calcareous), mesic	Mollic Haplaquents	Entisols.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Uly	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.

[1] These soils in Harlan County are taxadjuncts to the Inavale series because the content of calcium carbonate is higher than is defined as the range for the series.

[2] These soils in Harlan County are taxadjuncts to the Leshara series, because the content of calcium carbonate is higher than is defined as the range for the series.

[3] Nuckolls soil in mapping unit NuE2 is a taxadjunct to the series, because it has a surface layer that is thinner and lighter colored than is defined as the range for the series.

great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group.

FAMILY: Families are established within a subgroup primarily on the basis of properties important to growth of plants or behavior of soils where used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. Families are divided into smaller groups of soils, called soil series.

Physical and Chemical Analysis

Samples from soil profiles are collected for physical and chemical analysis by the Soil Conservation Service, Soil Survey Laboratory in Lincoln, Nebraska. Soils of the Hall, Holdrege, Hord, and Leshara series were sampled in nearby counties, and the data were recorded in Soil Survey Investigations Report Number 5 (7).

This information is useful to soil scientists in classifying soils and in developing concepts of soil genesis. It is also helpful in estimating available water capacity, soil blowing, fertility, tilth, and other practical aspects of soil management. Data on reaction, electrical conductivity, and percentage of exchangeable sodium are helpful in evaluating the possibility of reclaiming and managing saline-alkali areas.

General Nature of the County

The first white settlers in Harlan County located in the Republican River Valley in 1871. Within the next few years, settlement spread rapidly throughout the valleys and uplands. The early settlers came chiefly from Iowa, Illinois, Missouri, and other States to the east. Harlan County was considered part of Franklin County for judicial and tax purposes until its boundaries were established by the last territorial legislature. An act of the legislature, passed in June 1871, defined the boundaries of Harlan County; it has remained unchanged since that time.

Much of the land was homesteaded as a result of the Free Homestead Act established by Congress in May 1862, which became effective in Nebraska on January 1, 1863. Under this act, a settler could acquire title to 160 acres of land by living on it for 5 years and paying a nominal fee.

Alma is the county seat. It is located on the stream terrace along the Republican River in the southeastern part of the county. According to the 1970 U.S. census, Alma has a population of 1,299. Orleans has a population of 592, and Republican City has a population of 179. These cities are also located along the Republican River. Stamford, located on Sappa Creek, has a population of 207.

Population trends are downward in Harlan County as the rural population has decreased steadily since 1910. In 1890, the population was 8,158; in 1910, 9,578; in 1930, 8,957; in 1950, 7,189; in 1960, 5,081; and in 1970, 4,352.

The most important natural resource in Harlan County is its deep, easily worked soils, which are well suited to a variety of uses. Water is the second most important resource. Good irrigation water can be obtained at a depth of as much as 250 feet in the uplands north of the Republican River. On stream terraces, depth to ground water is much less, seldom exceeding 100 feet. Gravel and sand is available in the Republican River Valley and in a few areas of Turkey Creek Valley. Small quantities of oil have been found in the south-central part of the county. Bentonite has been mined from an area northwest of Orleans, but most sources are too deep for easy access or for economical mining.

The railroad connects all of the principal towns and shipping points of Harlan County to Omaha and other eastern markets. Good blacktop highways traverse the county. U.S. Highway No. 183 crosses the county from north to south; U.S. Highway No. 136 follows the Republican River Valley closely from the eastern boundary to Orleans and then northwest to U.S. Highway No. 6; and State Highway No. 89 joins Stamford and Orleans and intersects U.S. No. 136 at Orleans.

Climate[8]

Harlan County is located near the center of the United States and lies along the southern border of central Nebraska. The climate is typical of that found near the center of a large continent at this latitude. The summers are warm, and the winters are relatively cold. The moderate rainfall is highly variable in amount from day to day, season to season, and year to year. The only sizable body of water nearby is the Harlan County Reservoir, which lies in the southeastern quadrant of the county. This reservoir is too small to have a noticeable effect on the general climate of the area. The effects on temperature and humidity are limited to the immediate environs of the reservoir and to the time when conditions in the lower layers of the atmosphere are calm and stable.

Most of the precipitation that falls in the area is brought in from the Gulf of Mexico on southerly winds. As a rule, nearly 80 percent of the annual precipitation occurs during the months of April through September, when winds are normally from the south. Very little precipitation falls during midwinter, when the winds are out of the north.

Precipitation early in spring is slow, steady, and well distributed. However, more and more precipitation falls during erratic thundershower activity as spring advances, and by the latter part of May nearly all precipitation falls in this manner. Heavy rain can be reported in one locality, while a spot nearby receives little or no rainfall. Local drought conditions develop if the showers become poorly spaced in time or area.

Thundershowers in spring and early in summer are severe at times and can be accompanied by local downpours, hail, and damaging wind. The hailstorms that sometimes occur in connection with thunderstorms generally are local in extent, are of short duration, and cause damage in an extremely variable and spotted pattern. In the more intense storms there is a total loss of crops in the center of the hail strips.

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[8] By RICHARD E. MYERS, State climatologist, National Weather Service, U.S. Department of Commerce.

As can be seen from table 10, June receives more precipitation than any other month. The peak precipitation is actually reached early in June, followed by a slow decrease in shower activity the latter part of the month. The decrease continues into July. A brief increase occurs again late in July or early in August, but in fall the showers gradually become lighter and further apart. Table 10 shows a decrease from an average of 2.3 inches in September to 1.2 inches in October and 0.6 inch in November. Fall weather is characterized by warm days, cool nights, light rainfall, and an abundance of sunshine.

Winter precipitation is light and rather infrequent and falls mainly as snow, although there is occasional freezing rain. The snow is often accompanied by strong northerly winds and a change to colder weather. Average annual snowfall is about 23 inches, but there is considerable variation from year to year. Snow seldom remains on the ground for long periods and frequently melts before the next snowfall. The average winter has 39 days of snow-covered ground.

The frequency of high and low temperatures is indicated in table 10. For example, column 3 shows that 20 percent of the time at least 4 days in July have a temperature of 103° F. or higher and that the average annual high is 106°. Likewise, column 4 shows that 20 percent of the time at least 4 nights in January have a temperature of 8° below zero or lower. The average annual minimum is 18° below zero. Temperatures have been as high as 116°, in 1934, and as low as 38° below zero, in 1899.

The probabilities of freezing temperatures after specified dates in spring and before certain dates in fall are shown in table 11. For example, in only half the years the air temperature falls below 32° after May 2 (average date of last freeze), but 1 year in 10 it falls below 32° as late as May 17. In fall it falls below 32° before September 23 in 1 year out of 10.

Annual free-water evaporation averages about 54 inches, and approximately 74 percent of the total occurs during the 6-month period of May through October.

Physiography, Relief, and Drainage

Harlan County is part of a broad, eastward-sloping plain. The plain was dissected and modified by the valleys of the Republican River, Sappa Creek, and Prairie Dog Creek. All these drainageways flow in a generally easterly direction. There are numerous north-south, intermittent drainageways that are tributaries of these main streams. These tributaries have carved the loessial plain, except in the extreme northern and northeastern parts of the county, into a series of long, nearly parallel divides. Nearly all the divides are less than 1 mile wide. For the most part, they have nearly level and gently sloping tops and moderately sloping to steep sides. In the northern and northeastern parts of the county on the loessial plain,

TABLE 10.—*Temperature and precipitation*

[Data from Alma and surrounding stations]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with [2]—		Average total [1]	One year in 10 will have [3]—		Days with 1 inch or more snow cover [4]	Average depth of snow on days with snow cover [4]
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Number*	*Inches*
January	39	13	60	−8	0.5	([5])	0.8	12	4
February	44	18	66	0	.7	.1	1.5	9	3
March	52	26	76	8	1.3	.1	2.0	6	6
April	67	39	85	24	2.2	.5	4.9	1	3
May	77	50	90	35	3.3	.8	5.5	([6])	1
June	85	60	100	47	4.2	1.1	6.3	0	0
July	92	65	103	55	3.1	.8	6.1	0	0
August	91	64	102	52	2.7	.7	5.1	0	0
September	82	53	98	36	2.3	.6	4.7	0	0
October	72	41	88	26	1.2	.1	2.9	([6])	1
November	54	26	72	11	.6	([5])	1.8	3	3
December	43	17	60	−4	.4	([5])	1.2	8	4
Year	67	39	[7] 106	[8] −18	22.3	15.5	31.6	39	4

[1] Data in columns 1, 2, and 5, 1937 to 1966 period.
[2] Data in columns 3 and 4, 1900 to 1963 period.
[3] Data in columns 6 and 7, 1896 to 1966 period.
[4] Data in columns 8 and 9, 1938 to 1967 period
[5] Trace.
[6] On less than one-half day.
[7] Average annual maximum.
[8] Average annual minimum.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Alma]

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 14	April 23	May 7	May 17.
2 years in 10 later than	April 1	April 9	April 17	May 1	May 12.
5 years in 10 later than	March 22	March 30	April 7	April 21	May 2.
Fall:					
1 year in 10 earlier than	October 28	October 21	October 15	October 4	September 23.
2 years in 10 earlier than	November 2	October 26	October 20	October 9	September 28.
5 years in 10 earlier than	November 13	November 5	October 30	October 19	October 7.

drainage patterns are not well developed. In these areas surplus water collects in numerous depressions, or potholes. Water in these areas seeps slowly through the soil or evaporates.

In Harlan County there are three distinct topographic positions where soils formed. These are the alluvial bottom lands, the stream terraces, and the uplands. Inavale, Munjor, Hobbs, Leshara, McCook, and Platte soils formed on bottom lands; Cozad, Hall, and Hord soils formed on stream terraces; and Butler, Detroit, Coly, Holdrege, Scott, and Uly soils formed on uplands. Canlon is the only soil in Harlan County that formed in weathered bedrock.

Harlan County is drained almost entirely by the Republican River. Prairie Dog Creek, Sappa Creek, and their small tributaries complete the drainage system. The general slope of the county is from northwest to southeast.

Farming

Farms tend to increase in size. In 1950 the average size was 415 acres. In 1959 it was 507 acres, in 1964 it was 580 acres, and in 1969 it had risen to 615 acres. In 1969, Harlan County had a total of 527 farms.

The acreage of land under irrigation is steadily increasing. In 1959, 15,155 acres were irrigated, and by 1964 this had increased to 18,710 acres. Corn and sorghum are the main irrigated crops.

The use of fertilizer is necessary for satisfactory yields on irrigated soils. Fertilizer is now commonly used on dryfarmed land also. Use of commercial fertilizers is increasing steadily, mostly on corn, sorghum, and wheat.

Winter wheat is grown under a fallow system. In 1964 it was grown on 45,600 acres, which is more than any other crop. Sorghum is grown under both dryland and irrigated management and occupied 42,485 acres in 1964. Corn, both irrigated and dryland, was grown on 17,108 acres. Small acreages of oats, barley, rye, millet, and soybeans are also grown.

From 1949 to 1964, the number of cattle and calves has increased steadily. These are both in cow-calf herds and fattened in feed lots. Swine are raised on many farms. A few sheep are grown, but they are of minor importance.

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Glossary

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

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.

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.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Depth (soil). The total thickness of weathered soil material over mixed sand and gravel or bedrock. In this survey the classes of soil depth are as follows: *very shallow,* 0 to 10 inches; *shallow,* 10 to 20 inches; *moderately deep,* 20 to 40 inches; and *deep,* more than 40 inches.

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.

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.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

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.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

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.

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.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

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.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *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; an 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.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

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 ranges are recognized: *nearly level,* 0 to 1 percent; *very gently sloping,* 1 to 3 percent; *gently sloping,* 3 to 7 percent; *moderately sloping,* 7 to 9 percent; *strongly sloping,* 9 to 15 percent; *steep,* 15 to 31 percent; and *very steep,* more than 31 percent.

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.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

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.

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 grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

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."

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Underlying material. Weathered soil material immediately beneath the solum.

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