SOIL SURVEY OF

Hartley County, Texas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1968–72. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Hartley County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; 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 Hartley 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 range site in which the soil has been placed.

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

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

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Use 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, for industrial buildings, and for recreation areas in the sections "Engineering Uses of the Soils" and "Use of the Soils for Recreational Development."

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

Newcomers in Hartley County may be especially interested in the section "General Soil Map," where broad patterns of soil are described. They may also be interested in the information about the county given at the beginning of the publication and in the section "History, Development, and Settlement."

Cover: Roundup of steers on Clay Loam range site. The soil is Dumas loam, 0 to 1 percent slopes.

Contents

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Index to Soil Mapping Units

Summary of Tables

SOIL SURVEY OF HARTLEY COUNTY, TEXAS

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United States Department of Agriculture, Soil Conservation Service, in cooperation with the Texas Agricultural Experiment Station

HARTLEY COUNTY is in the northwestern part of Texas, at the western edge of the Texas Panhandle (fig. 1). The total area is 952,960 acres, or 1,489 square miles. Elevations range from about 3,200 feet in the southeastern part of the county to about 4,500 feet in the northwestern part.

The economy is based almost entirely on agriculture. Beef production is the main enterprise. About 70 percent of the county is in native range. Main crops of the county are dryland and irrigated wheat and grain sorghum. The number of smaller acreages of sugar beets, corn, alfalfa, and irrigated cool- and warm-season pastures is increasing.

Hartley County is in the southern part of the Great Plains. The northern part of the county is smooth tableland called High Plains, which is broken by a few indented playa basins, shallow drains, and Rita Blanca Canyon. The soils in this part of the county formed from Rocky Mountain outwash (*4*)[1] and overlying loess mantle (*7*). The southern part of the county is Rolling Plains. Geologic erosion in this area has formed a rough landscape which includes numerous small creeks and drainageways. The soils in this part of the county formed mainly from colluvium from the Ogallala formation of the High Plains and exposed Triassic red beds.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Hartley 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. Tascosa and Dumas, 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, Dallam fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Dallam series.

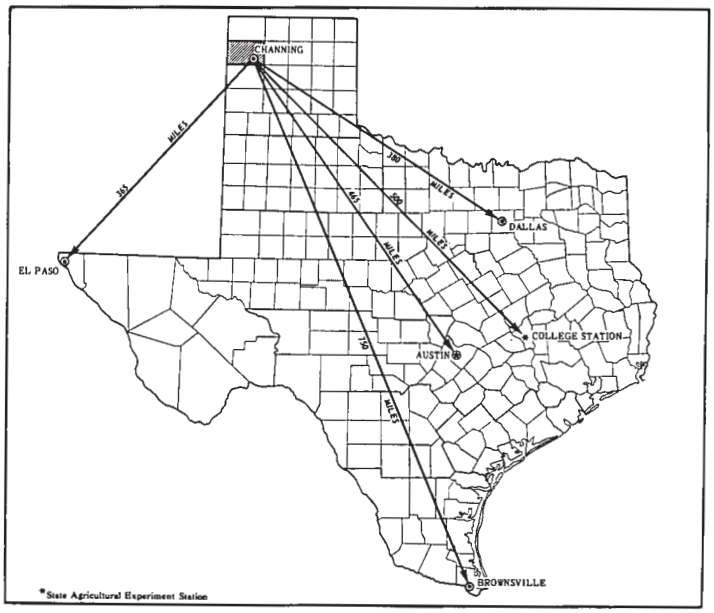

Figure 1.—Location of Hartley County in Texas.

[1] Italic numbers in parentheses refer to Literature Cited, p. 64.

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 buildings, field borders, 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 other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of Hartley County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Glenrio-Knoco complex, 3 to 12 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Mobeetie-Veal association, undulating, is an example.

Undifferentiated groups in Hartley County are made up of soils that have similar morphology; but the soils are variable in the arrangement of horizons or layers, and they also vary in surface texture. Gracemore soils and Lincoln soils are two examples of undifferentiated groups.

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 its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named 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. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under 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 Hartley 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 seven associations in this county are each described in the following pages. The terms for texture used in the title of the associations apply to the texture of the surface layer. For example, in the title of association 1, "fine sandy loams" refers to the texture of the surface layer.

1. Dallam-Perico Association

Deep, nearly level to gently sloping, noncalcareous to calcareous, moderately permeable fine sandy loams

This association consists of areas of nearly level to gently sloping soils. It makes up about 27 percent of the county. Dallam soils account for about 65 percent of the association; Perico soils 10 percent; and less extensive areas of Rickmore, Spurlock, Sunray, and Vingo soils the remaining 25 percent (fig. 2).

Dallam soils have a surface layer of brown fine sandy loam about 9 inches thick. The next layer is reddish brown sandy clay loam about 19 inches thick. This is underlain, to a depth of 80 inches, by reddish yellow sandy clay loam.

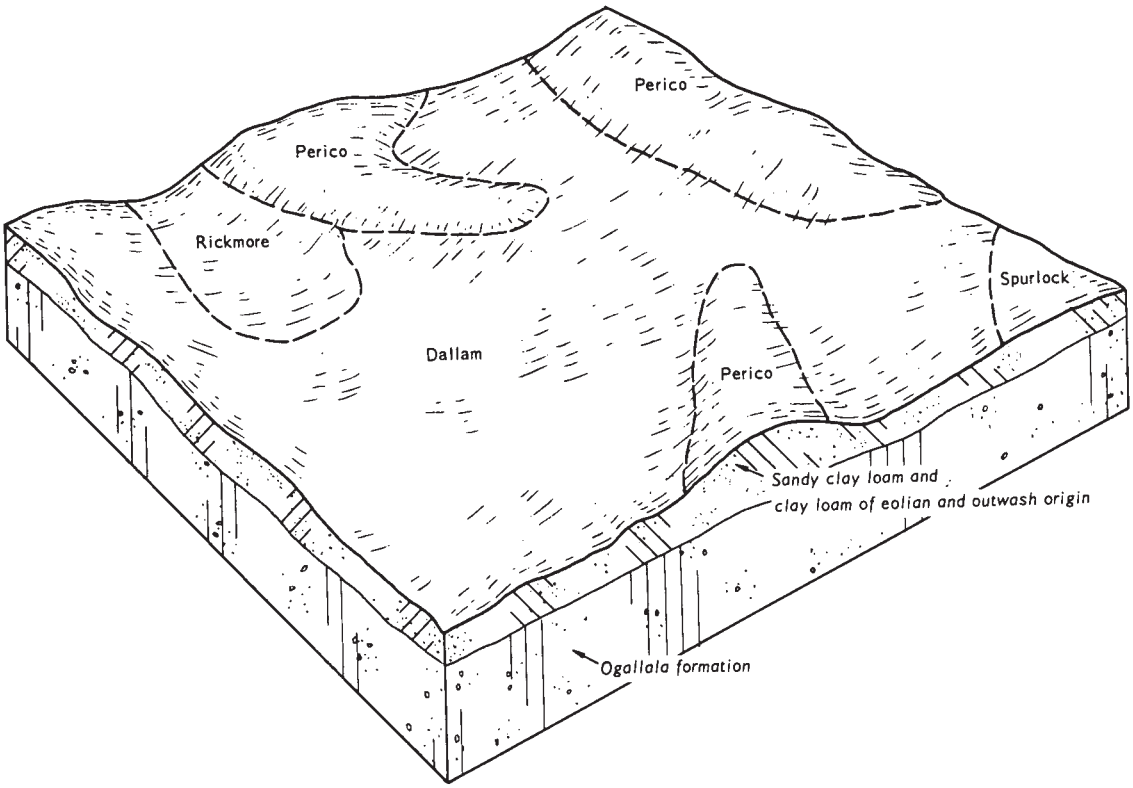

Figure 2.—**Relationship of soils in association 1.**

Perico soils have a surface layer of yellowish brown fine sandy loam about 8 inches thick. The next layer is dark yellowish brown sandy clay loam about 8 inches thick. Below this is yellow clay loam about 10 inches thick. The next layer is pink clay loam about 19 inches thick. This is underlain, to a depth of 84 inches, by reddish yellow clay loam.

About two-thirds of this association is used for range and one-third is used for crops. Some of the acreage is irrigated. The hazard of soil blowing is a major concern of management.

A good supply of irrigation water is under much of this association. Some range is being converted to crops because of the high potential for growing such irrigated crops as grain sorghum, wheat, corn, sugar beets, alfalfa, and vegetables. The soils of this association also have a medium potential for growing dryland wheat and grain sorghum.

2. Sherm-Gruver-Dumas Association

Deep, nearly level, noncalcareous, very slowly to moderately permeable clay loams to loams

This association consists of areas of nearly level soils. It makes up about 23 percent of the county. Sherm soils account for about 32 percent of the association; Gruver soils 21 percent; Dumas soils 21 percent; and less extensive areas of Conlen, Dallam, Ness, Rickmore, and Sunray soils the remaining 26 percent (fig. 3).

Sherm soils have a surface layer of brown clay loam about 6 inches thick. The next layer is brown clay about 30 inches thick. Below this is brown clay loam about 9 inches thick. The next layer is yellowish red clay loam about 27 inches thick. This is underlain, to a depth of 90 inches, by reddish yellow clay loam.

Gruver soils have a surface layer of brown loam about 8 inches thick. The next layer is brown clay loam about 30 inches thick. Below this is yellowish red clay loam about 20 inches thick. The next layer is pink clay loam about 20 inches thick. This is underlain, to a depth of 98 inches, by reddish yellow clay loam.

Dumas soils have a surface layer of brown loam about 10 inches thick. The next layer is brown sandy clay loam and clay loam about 12 inches thick. Below this is yellowish red sandy clay loam about 14 inches thick. The next layer is pink sandy clay loam about 29 inches thick. This is underlain, to a depth of 85 inches, by reddish yellow sandy clay loam.

Most of this association is used for crops, both irrigated and dry farmed. Major crops are grain sorghum and wheat. Many stocker cattle graze the winter wheat. Of all the soils in the county, the soils of this association are best suited for irrigation. They have a high potential for growing other irrigated crops, such as sugar beets, corn, alfalfa, and vegetables, The soils of this association also have a medium potential for growing dryland wheat and grain sorghum.

3. Berda-Veal-Potter Association

Deep to very shallow, gently sloping to very steep, calcareous, moderately permeable loams to fine sandy loams

This association consists of areas of gently sloping to very steep soils. It makes up about 21 percent of

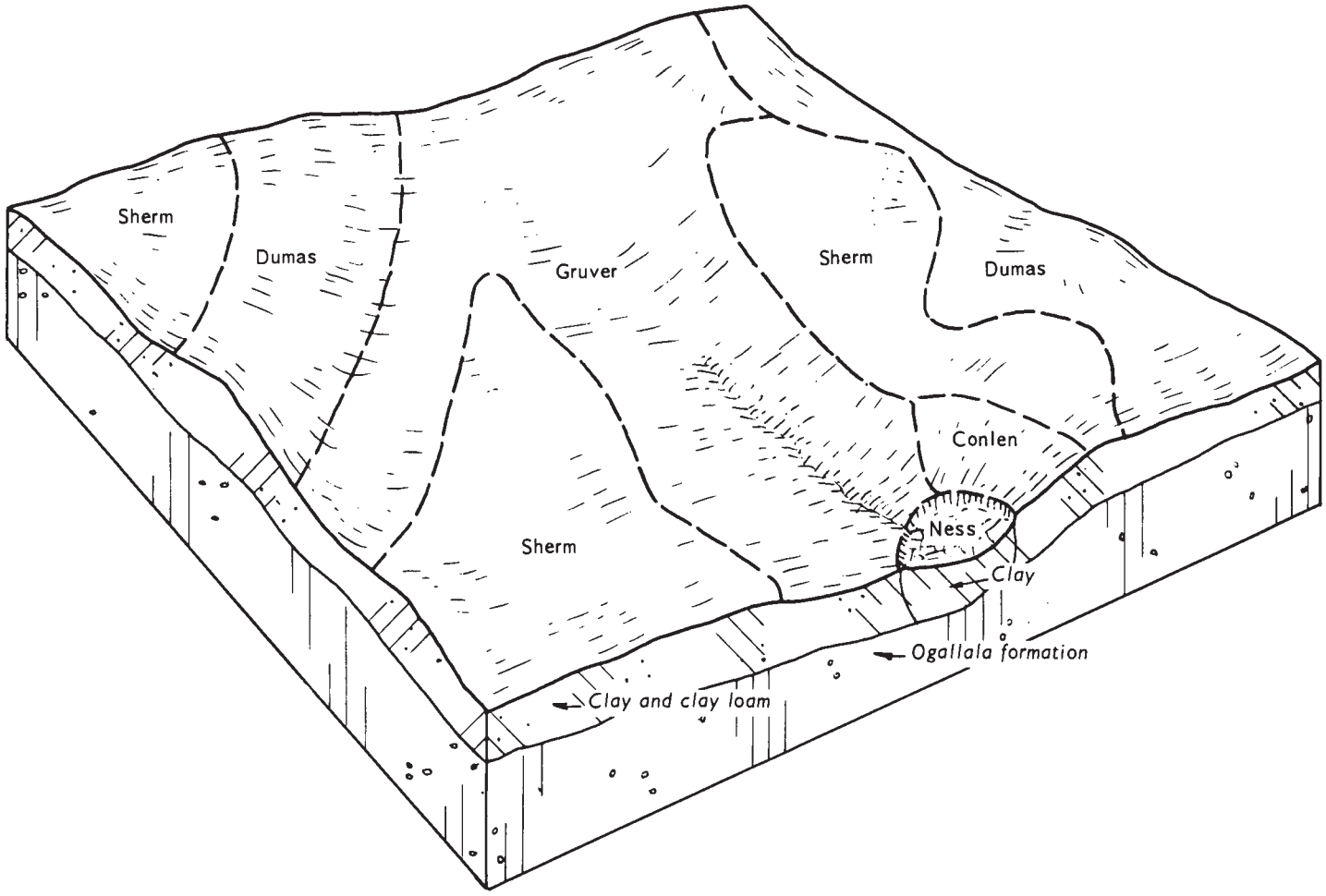

Figure 3.—**Relationship of soils in association 2.**

the county. Berda soils and very similar soils such as Mobeetie account for about 42 percent of the association, Veal soils about 20 percent; Potter soils about 10 percent; and less extensive areas of Bippus, Dallam, Guadalupe, Mobeetie, Perico, Spurlock, and Vingo soils the remaining 28 percent (fig. 4).

Berda soils have a surface layer of grayish brown loam about 5 inches thick. The next layer is yellowish brown sandy clay loam about 37 inches thick. This is underlain, to a depth of 60 inches, by light yellowish brown sandy clay loam.

Veal soils have a surface layer of brown fine sandy loam about 5 inches thick. The next layer is light brown sandy clay loam about 11 inches thick. The next lower layer is pinkish white sandy clay loam about 9 inches thick. This is underlain, to a depth of 60 inches, by light brown sandy clay loam.

Potter soils have a surface layer of brown loam about 8 inches thick. This is underlain, to a depth of 60 inches, by white caliche.

Most of this association is used for range, for which it is best suited. The soils of this association have a low potential for growing crops because of steep slopes, shallow soils, water erosion and soil blowing hazards, and a lack of irrigation water.

4. Dallam-Vingo-Spurlock Association

Deep, undulating, noncalcareous to calcareous, moderately to moderately rapidly permeable loamy fine sands to fine sandy loams

This association consists of areas of undulating soils. It makes up about 17 percent of the county. Dallam soils account for about 50 percent of the association; Vingo soils about 25 percent; Spurlock soils about 15 percent; and less extensive areas of Mobeetie, Perico, Rickmore, and Valentine soils and Dallam fine sandy loam the remaining 10 percent (fig. 5).

Dallam soils have a surface layer of brown loamy fine sand about 16 inches thick. The next layer is brown sandy clay loam about 19 inches thick. Below this is light brown sandy clay loam about 15 inches thick. The next layer is light reddish brown clay loam about 15 inches thick. This is underlain, to a depth of 95 inches, by yellowish red sandy clay loam.

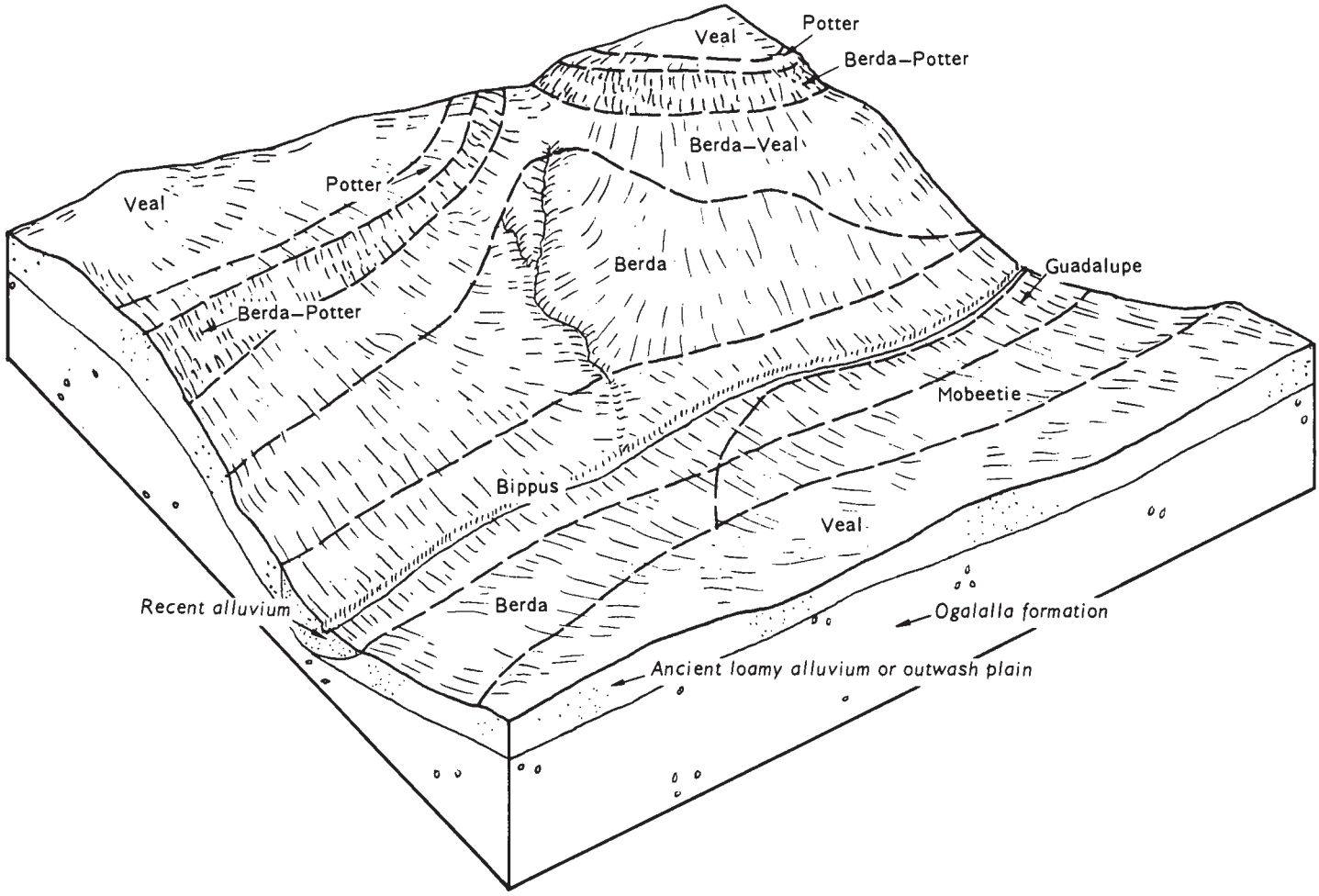

Figure 4.—**Relationship of soils in association 3.**

Vingo soils have a surface layer of brown loamy fine sand about 16 inches thick. The next layer is strong brown fine sandy loam about 14 inches thick. The next lower layer is yellowish red fine sandy loam about 16 inches thick. This is underlain, to a depth of 85 inches, by yellowish red sandy clay loam.

Spurlock soils have a surface layer of dark yellowish brown fine sandy loam about 10 inches thick. The next layer is about 6 inches of brown sandy clay loam. Below this is pink clay loam about 38 inches thick. This is underlain, to a depth of 88 inches, by reddish yellow clay loam.

Most of this association is used for range. Some areas are used for crops, both irrigated and dry farmed. Soil blowing is a severe hazard. The soils of this association have a high potential for growing irrigated crops, such as grain sorghum, wheat, and alfalfa, using sprinkler systems. They have a low potential for growing dryland wheat and grain sorghum.

5. Conlen-Sunray-Dumas Association

Deep, nearly level to gently sloping, calcareous to noncalcareous, moderately permeable loams to clay loams

This association consists of areas of nearly level to gently sloping soils. It makes up about 9 percent of the county. Conlen soils account for about 31 percent of the association; Sunray soils 30 percent; Dumas soils 20 percent; and less extensive areas of Berda, Dallam, Gruver, Ness, Perico, Potter, and Spurlock soils the remaining 19 percent (fig. 6).

Conlen soils have a surface layer of brown loam about 10 inches thick. The next layer is yellowish brown clay loam about 5 inches thick. The next lower layer is very pale brown clay loam about 15 inches thick. This is underlain, to a depth of 80 inches, by reddish yellow clay loam.

Sunray soils have a surface layer of dark grayish brown clay loam about 18 inches thick. The next layer is pale brown clay loam about 12 inches thick. The next lower layer is pink clay loam about 13 inches thick. This is underlain, to a depth of 85 inches, by reddish yellow clay loam.

Dumas soils have a surface layer of brown loam about 10 inches thick. The next layer is brown sandy clay loam and clay loam about 12 inches thick. Below this is yellowish red sandy clay loam about 14 inches thick. The next layer is pink sandy clay loam about

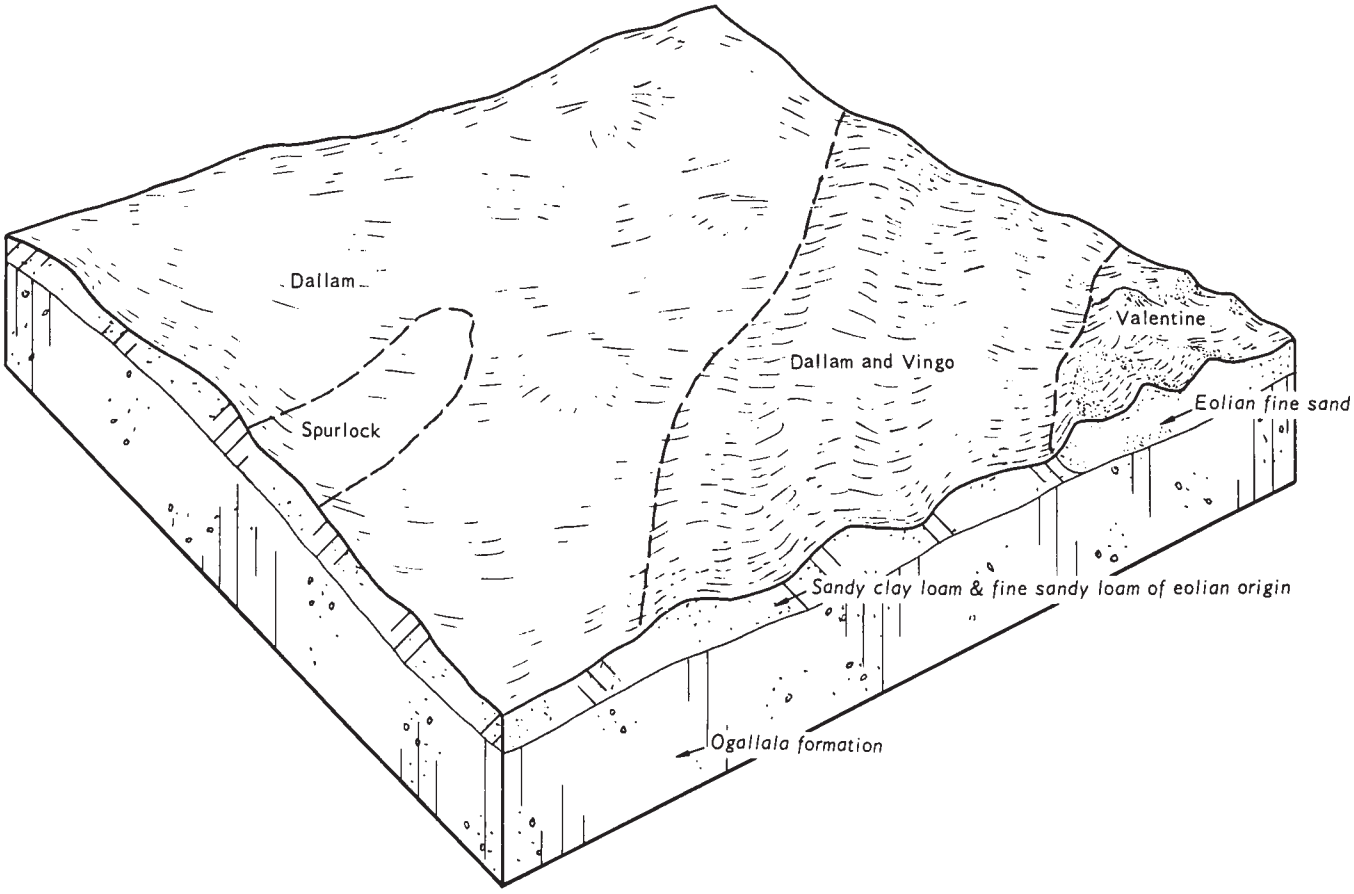

Figure 5.—**Relationship of soils in association 4.**

29 inches thick. This is underlain, to a depth of 85 inches, by reddish yellow sandy clay loam.

Most of this association is used for range, for which it is well suited. It has a low potential for growing dryland wheat and grain sorghum.

6. San Jon-Glenrio Association

Moderately deep to shallow, gently sloping, calcareous, moderately slowly to very slowly permeable clay loams to clays

This association consists of areas of gently sloping soils. It makes up about 2 percent of the county. San Jon soils account for about 39 percent of the association; Glenrio soils about 10 percent; and less extensive areas of Berda, Dumas, Guadalupe, Knoco, Mangum, Spur, and Spurlock soils the remaining 51 percent (fig. 7).

San Jon soils have a surface layer of reddish brown clay loam about 6 inches thick. The next layer is reddish brown clay loam about 14 inches thick. The next lower layer, about 12 inches thick, is red clay loam. This is underlain, to a depth of 60 inches or more, by red clay loam red beds.

Glenrio soils have a surface layer of reddish brown clay about 14 inches thick. This is underlain, to a depth of 60 inches, by red shaly clay red beds.

This association is used for range, for which the soils are best suited. The soils have a very low potential for growing crops because of the droughty nature of the soils and a lack of irrigation water.

7. Berda-Tascosa Association

Deep to shallow, gently sloping to steep, calcareous, moderately permeable loams to gravelly loams

This association consists of areas of gently sloping to steep soils. It makes up about 1 percent of the county. Berda soils account for about 50 percent of the association; Tascosa soils about 20 percent; and less extensive areas of Conlen, Dallam, Mobeetie, Potter, and Spurlock soils the remaining 30 percent.

Berda soils have a surface layer of grayish brown loam about 5 inches thick. The next layer is yellowish brown sandy clay loam about 37 inches thick. This is underlain, to a depth of 60 inches, by light yellowish brown sandy clay loam.

Tascosa soils have a surface layer of brown gravelly loam about 6 inches thick. The next layer is brown very gravelly loam about 12 inches thick. The next layer,

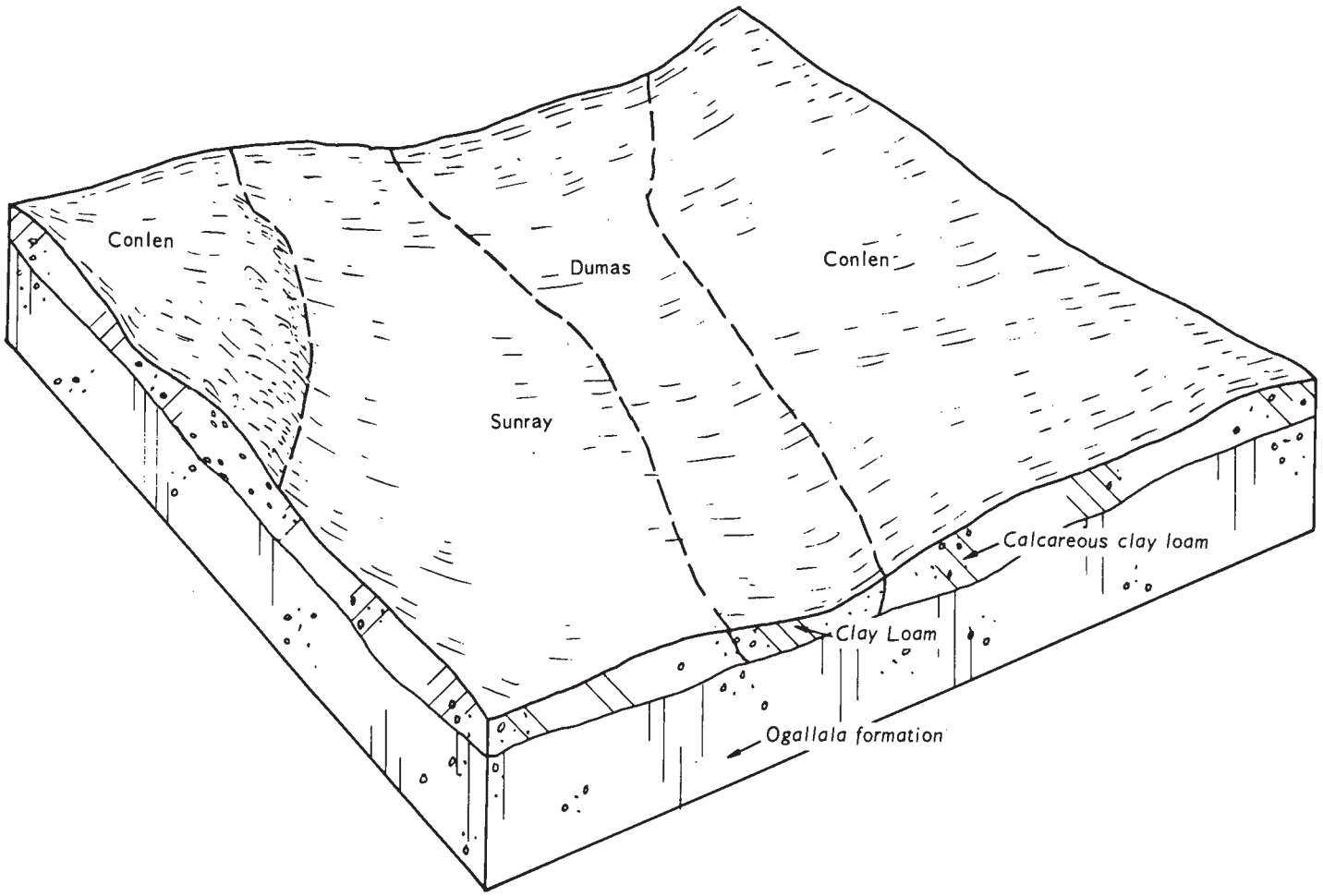

Figure 6.—**Relationship of soils in association 5.**

32 inches thick, is pink gravelly sandy loam. This is underlain, to a depth of 80 inches, by light brown gravelly sandy loam.

This association is used for range, for which it is best suited. It is a good source of gravel.

Descriptions of the Soils

In this section each soil series is described in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, 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 down to rock or other underlying material. Each series contains two descriptions of the profile. The first is brief and in terms familiar to a layman. The second is more detailed and is included for those who need to make thorough and precise studies of soils. The profile described in the series is representative for 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. Color terms are for dry soil unless otherwise stated.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and range site in which the mapping unit has been placed. The page where each capability unit or range site is described is listed in the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in 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 (*15*).

Berda Series

The Berda series consists of deep, well drained, gently sloping to very steep, loamy soils on uplands. These soils formed in calcareous loamy material.

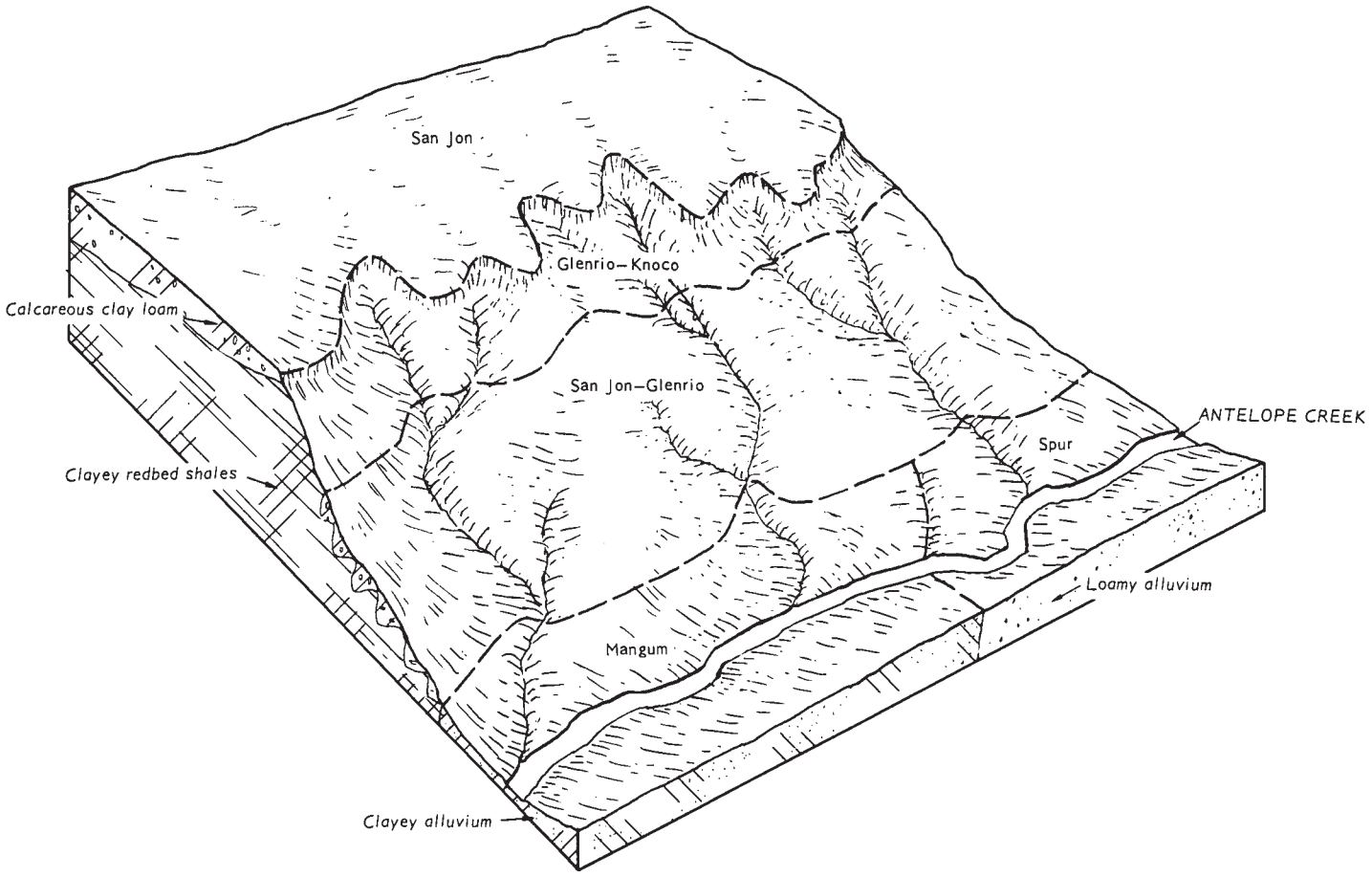

Figure 7.—**Relationship of soils in association 6.**

In a representative profile the surface layer is grayish brown loam about 5 inches thick. The next layer is yellowish brown sandy clay loam about 37 inches thick. The underlying material, to a depth of 60 inches or more, is light yellowish brown sandy clay loam.

Runoff is medium to rapid on these soils. Permeability is moderate, and the available water capacity is high.

Berda soils are used mainly for range. They are also suited to pasture and wildlife areas. Areas of less sloping Berda soils are suited to crops.

Representative profile of Berda loam, 5 to 8 percent slopes, about 2 miles south of Dalhart, 800 feet southeast of Rita Blanca Lake Dam:

A1—0 to 5 inches, grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure that parts to weak medium granular; slightly hard, friable; many fine roots; few fine pores; few wormcasts; calcareous, moderately alkaline; clear smooth boundary.

B2—5 to 42 inches, yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; hard, friable; calcareous, moderately alkaline; gradual smooth boundary.

C—42 to 60 inches, light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; about 5 percent, by volume, calcium carbonate films and threads; calcareous, moderately alkaline.

The A horizon is loam, clay loam, or sandy clay loam that is 20 to 30 percent clay. It ranges from 5 to 12 inches in thickness. The A horizon is brown, grayish brown, reddish brown, dark grayish brown, dark yellowish brown, or very dark grayish brown. The darker colored A horizons are less than 7 inches thick.

The B horizon is loam, sandy clay loam, or clay loam that is 20 to 30 percent clay. It is light yellowish brown, yellowish brown, brown, light brown, brownish yellow, strong brown, or reddish yellow. The B horizon extends downward to depths of 42 inches or more.

The B and C horizons are as much as 12 percent calcium carbonate. Depth to the C horizon ranges from 40 to more than 60 inches.

BeC—Berda loam, 3 to 5 percent slopes. This gently sloping soil is on the side slopes of major drainageways. Areas are mainly long and narrow in shape and range from 20 to 400 acres in size.

The surface layer is grayish brown loam about 8 inches thick. The next layer is brown sandy clay loam about 32 inches thick. The underlying material, to a depth of 60 inches, is brown sandy clay loam.

Included with this soil in mapping are small areas of Sunray, Bippus, and Spur soils.

This Berda soil is used mostly for range.

If this soil is cultivated, the main concerns of man-

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

Soil	Acres	Percent	Soil	Acres	Percent
BeC—Berda loam, 3 to 5 percent slopes	13,200	1.4	MVD—Mobeetie-Veal association, undulating	72,800	7.6
BeD—Berda loam, 5 to 8 percent slopes	5,600	.6	Ne—Ness clay	4,500	.5
BpG—Berda-Potter complex, 15 to 50 percent slopes	8,300	.9	PcB—Perico loamy fine sand, 0 to 3 percent slopes	4,000	.4
BRD—Berda-Veal association, undulating	52,200	5.5	PeA—Perico fine sandy loam, 0 to 1 percent slopes	10,800	1.1
BuA—Bippus clay loam, 0 to 1 percent slopes	1,800	.2	PeB—Perico fine sandy loam, 1 to 3 percent slopes	11,600	1.2
BuB—Bippus clay loam, 1 to 3 percent slopes	2,200	.2	PeC—Perico fine sandy loam, 3 to 5 percent slopes	1,100	.1
Co—Colorado loam	3,000	.3	PoE—Potter soils, 3 to 15 percent slopes	20,500	2.2
CoB—Conlen loam, 0 to 3 percent slopes	27,000	2.8	RcB—Rickmore loamy fine sand, 0 to 3 percent slopes	6,800	.7
DoB—Dallam loamy fine sand, 0 to 3 percent slopes	123,800	13.0	RkA—Rickmore fine sandy loam, 0 to 1 percent slopes	5,100	.5
DfA—Dallam fine sandy loam, 0 to 1 percent slopes	91,100	9.6	SaB—San Jon clay loam, 1 to 3 percent slopes	4,800	.5
DfB—Dallam fine sandy loam, 1 to 3 percent slopes	49,100	5.2	SgD—San Jon-Glenrio complex, 3 to 8 percent slopes	4,900	.5
DfC—Dallam fine sandy loam, 3 to 5 percent slopes	2,900	.3	ShA—Sherm clay loam, 0 to 1 percent slopes	71,100	7.5
DuA—Dumas loam, 0 to 1 percent slopes	64,000	6.7	Sm—Spur loam	1,700	.2
DuB—Dumas loam, 1 to 3 percent slopes	9,400	1.0	SpB—Spurlock fine sandy loam, 0 to 3 percent slopes	26,300	2.8
GkD—Glenrio-Knoco complex, 3 to 12 percent slopes	1,900	.2	SpC—Spurlock fine sandy loam, 3 to 5 percent slopes	6,400	.7
Gm—Gracemore soils	1,000	.1	SrB—Spurlock soils, undulating	1,100	.1
GrA—Gruver loam, 0 to 1 percent slopes	45,600	4.8	SuA—Sunray clay loam, 0 to 1 percent slopes	37,100	3.9
GrB—Gruver loam, 1 to 3 percent slopes	1,600	.2	SuB—Sunray clay loam, 1 to 3 percent slopes	14,600	1.5
Gu—Guadalupe fine sandy loam	3,400	.4	TaE—Tascosa gravelly loam, 3 to 15 percent slopes	3,100	.3
KaB—Karde soils, 1 to 3 percent slopes	800	(1)	Va—Valentine fine sand	22,500	2.4
KaC—Karde soils, 3 to 5 percent slopes	800	(1)	VcE—Valentine-Spurlock complex, hummocky	1,300	.1
Lk—Likes loamy fine sand	5,000	.5	VDD—Vingo-Dallum association, undulating	81,592	8.6
Ln—Lincoln soils	9,500	1.0	Water	768	(1)
Ma—Mangum clay	1,600	.2	Total	952,960	100.0
MoB—Mobeetie fine sandy loam, 1 to 3 percent slopes	5,600	.6			
MoC—Mobeetie fine sandy loam, 3 to 5 percent slopes	5,600	.6			
MoD—Mobeetie fine sandy loam, 5 to 8 percent slopes	2,500	.3			

[1] Less than 0.05 percent.

agement are the control of severe water erosion and moderate soil blowing. Terraces and contour farming help to control water erosion and to conserve soil moisture. Crop residue left on the surface helps to control soil blowing. On this soil, a sprinkler irrigation system is the most effective. Capability unit IVe-4 dryland and IVe-2 irrigated; Hardland Slopes range site.

BeD—Berda loam, 5 to 8 percent slopes. This sloping soil is on long, narrow areas along major drainageways. Slopes are dominantly 5 to 7 percent. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Potter, Veal, and Mobeetie soils.

This Berda soil is suited only for range and wildlife areas. Runoff is rapid and the hazard of water erosion is severe. Capability unit VIe-4 dryland; Hardland Slopes range site.

BpG—Berda-Potter complex, 15 to 50 percent slopes. This complex is in the "caprock" escarpment and the adjoining broken lands between the High Plains and Rolling Red Plains. Soils in the broken lands areas are moderately steep and very steep. The landscape is characterized by escarpments, canyon walls, buttes, and ridges (fig. 8). From the highest to the lowest parts of the area mapped the difference in elevation is about 300 feet.

The soils of this complex are in a pattern but are so intricately mixed or so small in size that they cannot be shown separately at the scale mapped. The average composition is about 40 percent Berda soils and 30 percent Potter soils. The rest is small areas of Mobeetie soils and some shale and rock outcrops.

The Berda soils are on steep side slopes and foot slopes. The Potter soils are on small knolls, benches, and ridges within the areas of Berda soils.

The Berda soils have a surface layer of reddish brown loam, clay loam, or sandy clay loam about 6 inches thick. The next layer is reddish yellow sandy clay loam about 34 inches thick. The underlying layer, to a depth of 60 inches, is reddish yellow sandy clay loam.

The Potter soils have a surface layer of brown sandy clay loam, loam, or clay loam about 6 inches thick. The next layer is light reddish brown caliche.

This unit is used mainly for range. The soils are not suited to crops, because of slopes, rock outcrops, and shallow depth. Capability unit VIIe-1 dryland; Rough Breaks range site.

BRD—Berda-Veal association, undulating. These undulating soils are on alternating convex ridges and side slopes. Slopes are 5 to 8 percent. Most areas are several hundred acres in size.

These soils could be mapped separately; but be-

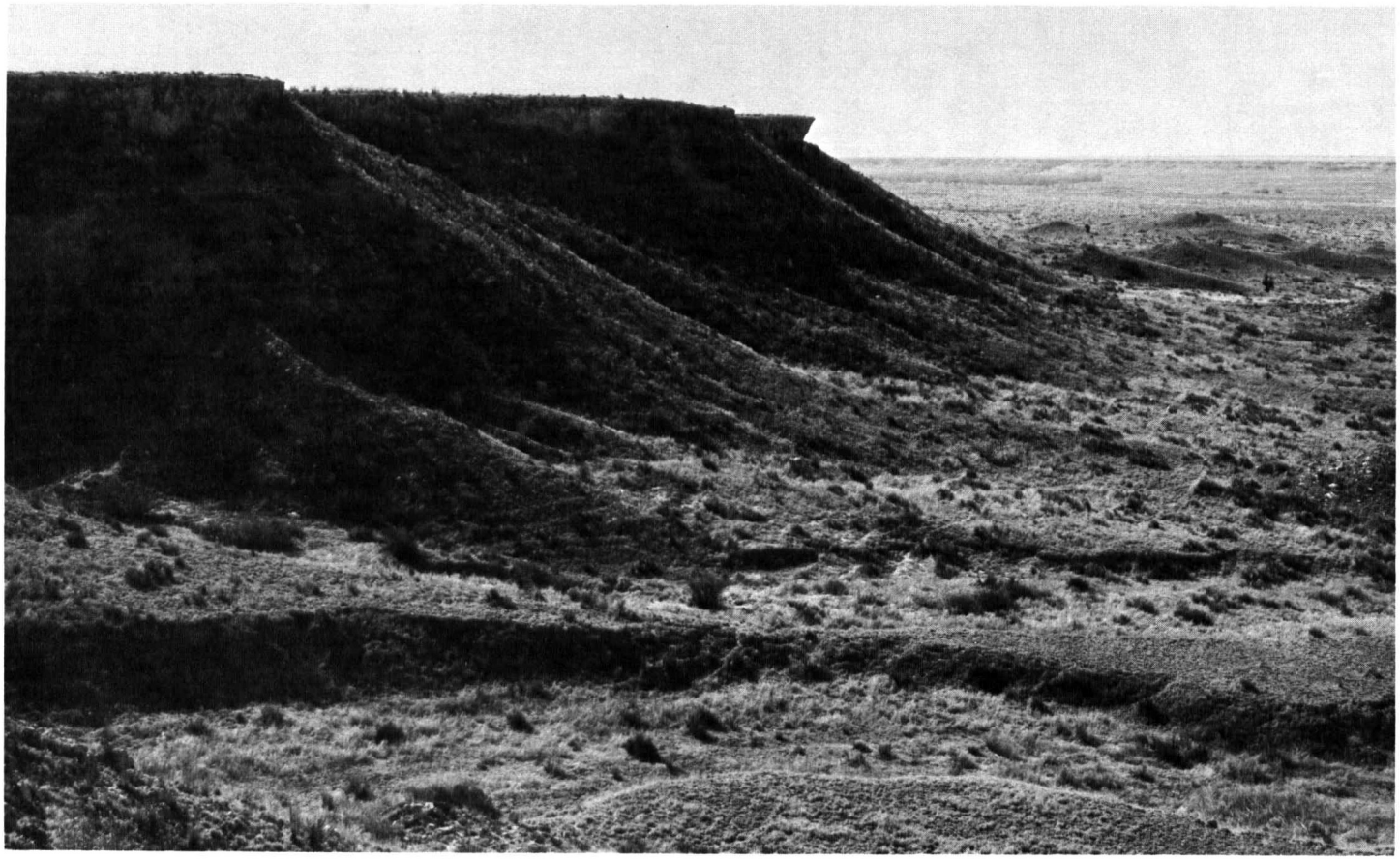

Figure 8.—Landscape of Berda-Potter complex, 15 to 50 percent slopes.

cause use and management are similar, separation is not justified. The delineations are larger and the composition more variable than most other units. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

The side slopes make up about 60 percent of the area. They are commonly about 300 feet long. Convex ridges make up about 30 percent of the area and are commonly 200 to 500 feet from crest to crest. Berda soils occupy the side slopes and Veal soils occupy the convex ridges.

Berda soils have a surface layer of grayish brown loam about 6 inches thick. The next layer is light brown sandy clay loam about 35 inches thick. Below this, to a depth of 60 inches, is brown sandy clay loam.

The Veal soil of this association has the profile described as representative for the Veal series.

This soil association is used for range. It is not suited to crops because of a very severe erosion hazard. Capability unit VIe-4 dryland; Berda part is in Hardland Slopes range site; Veal part is in Mixedland Slopes range site.

Bippus Series

The Bippus series consists of deep, well drained, nearly level to gently sloping soils in valleys. These soils formed in loamy alluvium and colluvium.

In a representative profile the surface layer is dark brown clay loam about 42 inches thick. The lower layers, to a depth of 72 inches, are stratified pale brown, dark grayish brown, and reddish yellow sandy clay loam and clay loam.

Permeability is moderate in these soils, and runoff is slow to medium. The available water capacity is high. The hazard of soil blowing is moderate.

The Bippus soils are well suited to crops. Most areas are in range. A few areas are cultivated.

Representative profile of Bippus clay loam, 0 to 1 percent slopes, 4 miles south of Dalhart, from junction of Farm Road 281 and U.S. Highway 87; 3 miles southeast on U.S. Highway 87; on unsurfaced ranch road 1 mile west and 1 mile south; 1.25 miles west and 0.5 mile north.

A11—0 to 12 inches, dark brown (10YR 3/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky and granular structure; slightly hard, very friable; calcareous; moderately alkaline; gradual smooth boundary.

A12—12 to 42 inches, dark brown (10YR 3/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure that parts to weak medium subangular blocky and fine granular; slightly hard, friable; many roots; many wormcasts; few caliche pebbles and concretions; thin strata of lighter colored materials; calcareous; moderately alkaline; gradual smooth boundary.

B2—42 to 48 inches, pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable; few thin strata of pebbles; calcareous, moderately alkaline; gradual smooth boundary.

Ab—48 to 60 inches, dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; calcareous, moderately alkaline; gradual smooth boundary.

C—60 to 72 inches, reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, friable; thin strata that vary in color and texture; calcareous, moderately alkaline.

Bippus soils are calcareous throughout. The A horizon ranges from 20 to 42 inches in thickness. It is dark brown, very dark brown, or very dark grayish brown. The B horizon is clay loam or sandy clay loam. Faint to distinct strata of sandy loam are common. The C horizon is dominantly sandy clay loam or clay loam but has thin strata of loamy sand and sandy loam. Some profiles lack an Ab horizon.

BuA—Bippus clay loam, 0 to 1 percent slopes. This nearly level soil occupies valley fill positions along major streams. The mapped areas range from 15 to 400 acres in size and are long and narrow in shape. This soil has the profile described as representative for the series.

Included with the soil in mapping are areas of Berda, Spur, and Colorado soils.

This Bippus soil is used mostly for range, but a few areas are used for crops. Dryland crops are grain sorghum, wheat, and forage sorghum. Irrigated crops are wheat and grain sorghum.

The main concerns of management are the maintenance of tilth and the control of water erosion and soil blowing, which are moderate hazards. Crop residue left on the soil surface helps to maintain the tilth and control soil blowing. Irrigated lands need a designed irrigation system that will assist in controlling soil and water losses. A main concern of management of dryland areas is conserving soil moisture. The use of crops that produce large amounts of crop residue on the surface helps conserve soil moisture. Capability unit IIe-1 dryland and IIe-1 irrigated; Draw range site.

BuB—Bippus clay loam, 1 to 3 percent slopes. This gently sloping soil occupies valley fill positions. Areas are long and narrow in shape and 10 to 200 acres in size.

The surface layer is very dark grayish brown clay loam about 10 inches thick. The next layer is dark brown clay loam about 11 inches thick. The underlying material, to a depth of 70 inches, is light yellowish brown clay loam.

Included with this soil in mapping are small areas of Spur, Berda, and Colorado soils. Also included are small areas of Bippus soils that are nearly level.

This Bippus soil is used mostly for range, but it is suited to crops.

If this soil is used for crops, the main concerns of management are the moderate hazard of soil blowing and the severe hazard of water erosion. Terraces and waterways are needed for water management and erosion control where dryland crops are grown. Water erosion and management of irrigation water are problems when the soil is irrigated. Land leveling and irrigation systems of proper length help control erosion and runoff. Capability unit IIIe-6 dryland and IIIe-1 irrigated; Draw range site.

Colorado Series

The Colorado series consists of deep, nearly level soils on bottomland. These soils formed in loamy alluvium.

In a representative profile the surface layer is about 8 inches of brown loam over about 12 inches of reddish brown clay loam that contains thin strata of lighter and darker colored loam and sandy loam. The lower layers, to a depth of 60 inches or more, are stratified loam, sandy clay loam, and fine sandy loam.

Colorado soils are moderately permeable. They flood only during rains of high intensity, and the flooding is of short duration. The available water capacity is high. Runoff is slow. The hazard of soil blowing is moderate.

Colorado soils are well suited to crops, but most areas are in large ranches and are used for grazing.

Representative profile of Colorado loam, 10.25 miles west of Channing, from intersection of Farm Road 767 and Farm Road 2357; 6 miles west on Farm Road 767; 100 feet north of road:

A11—0 to 8 inches, brown (7.5YR 5/4) loam, brown (7.5YR 4/2) moist; weak medium subangular blocky structure; hard, friable; few fine sandy loam and clay loam bedding planes and strata of varying colors; calcareous, moderately alkaline; abrupt smooth boundary.

A12—8 to 20 inches, reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable; few bedding planes and strata of fine sandy loam and loam of varying colors; calcareous, moderately alkaline; abrupt smooth boundary.

C1—20 to 36 inches, brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/2) moist; massive; hard, friable; few thin bedding planes and thin strata of varying colors and textures; calcareous, moderately alkaline; abrupt smooth boundary.

C2—36 to 60 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; massive; loose, very friable; many thin strata of varying colors and textures; calcareous, moderately alkaline.

The A horizon ranges from 10 to 20 inches in thickness. All horizons are brown, reddish brown, or light reddish brown. The upper 40 inches of the solum is 18 to 35 percent clay. Thin lenses and layers of silty clay, loam, fine sandy loams, clay loam, and loamy sand are common throughout the soil material.

Ca—Colorado loam. This nearly level soil is on the flood plains along many major streams. It is flooded during wet years, but for short duration. Areas are 200 to 300 acres in size. Slopes are less than 1 percent.

Included with this soil in mapping are small areas of Lincoln, Bippus, Guadalupe, and Spur soils. These areas make up about 15 percent of the mapping unit.

This soil is well suited to crops, but no areas are now being farmed. All of this soil presently is located within large ranches and is used for range and grazing.

When this soil is cultivated, soil blowing is a moderate hazard. Soil blowing can be controlled by leaving the crop residues on the soil surface. Irrigated areas need a designed irrigation system to control erosion and prevent water losses. Capability unit IIe-1 dryland and IIe-1 irrigated; Loamy Bottomland range site.

Conlen Series

The Conlen series consists of deep, well drained, nearly level to gently sloping soils on uplands. These soils formed in loamy material.

In a representative profile the surface layer is about 10 inches of brown loam over 5 inches of yellowish brown clay loam. The next layer is very pale brown clay loam about 15 inches thick. Below this, to a depth of 80 inches, is reddish yellow clay loam.

Permeability is moderate in these soils, and available water capacity is high. The hazard of soil blowing is severe. The high lime content causes chlorosis in some plants.

Conlen soils are suited to cultivation. About half of the areas of these soils are cultivated, and the other half are used for range.

Representative profile of Conlen loam, 0 to 3 percent slopes, 12 miles east of Dalhart, from intersection of Farm Road 281 and U.S. Highway 87; 12 miles east on Farm Road 281; 1 mile south and 0.25 mile west, then 100 feet north of railroad:

A11—0 to 10 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable; many fine roots; many wormcasts; calcareous, moderately alkaline; gradual smooth boundary.

A12—10 to 15 inches, yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure that parts to weak fine subangular blocky; hard, friable; few roots; many wormcasts; few calcium carbonate concretions; calcareous, moderately alkaline; clear smooth boundary.

B21ca—15 to 30 inches, very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; hard, friable; estimated 50 percent calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

B22tca—30 to 80 inches, reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; hard, friable; estimated 20 percent calcium carbonate; few patchy clay films; calcareous, moderately alkaline.

The solum is more than 60 inches thick. A prominent layer that is 40 to 70 percent calcium carbonate is at a depth of 12 to 20 inches.

The A horizon is brown, grayish brown, or dark grayish brown. It ranges from 10 to 15 inches in thickness.

The B21ca horizon is light yellowish brown, light brown, very pale brown, pale brown, or grayish brown. Calcium carbonate typically makes up 40 to 50 percent of the B21ca horizon and 15 to 30 percent of the B22tca horizon. The calcium carbonate is in the form of soft masses and weakly cemented concretions.

The Btca horizon is reddish yellow, yellowish red, or light red. Texture is sandy clay loam or clay loam.

CoB—Conlen loam, 0 to 3 percent slopes. This nearly level to gently sloping soil is on uplands. The mapped areas are 5 to more than 1,000 acres in size and are irregular in shape.

Included with this soil in mapping are small areas of Sunray and Gruver soils.

This Conlen soil is used for range and crops. Dry and irrigated cropland areas are in grain sorghum, wheat, and forage sorghum. A few areas are in irrigated alfalfa.

The main concern of management is the severe hazard of soil blowing. Crop residue left on the surface helps to control soil blowing. Terraces and contour farming on the gently sloping areas slow water runoff and reduce water erosion. Plowing should be done in such a way that the lower layers that are high in lime are not mixed into the surface layer. Growing high residue crops helps conserve soil moisture in dry cropland areas. Capability unit IVe-2 dryland and IIIe-4 irrigated; Hardland Slopes range site.

Dallam Series

The Dallam series consists of deep, well drained, nearly level to gently sloping and undulating, sandy and loamy soils on uplands.

In a representative profile the surface layer is brown loamy fine sand about 16 inches thick. The next layer is brown sandy clay loam about 19 inches thick. The next lower layer is light brown sandy clay loam about 15 inches thick. Below this is light reddish brown clay loam about 15 inches thick. The next layer, to a depth of 95 inches, is yellowish red sandy clay loam.

Runoff is slow to medium on these soils. Permeability is moderate and the available water capacity is high. The hazard of soil blowing is severe.

Dallam soils are well suited to crops. These soils are dryfarmed and irrigated. Many areas are in range (fig. 9).

Representative profile of Dallam loamy fine sand, 0 to 3 percent slopes, 11 miles southwest of Dalhart, from intersection of Farm Road 998 and U.S. Highway 54; 9 miles southwest on U.S. Highway 54; 100 feet east of road:

A1—0 to 16 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak medium granular structure; soft, very friable; noncalcareous, neutral; gradual smooth boundary.

B21t—16 to 35 inches, brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; weak coarse prismatic structure that parts to weak medium and fine sub-

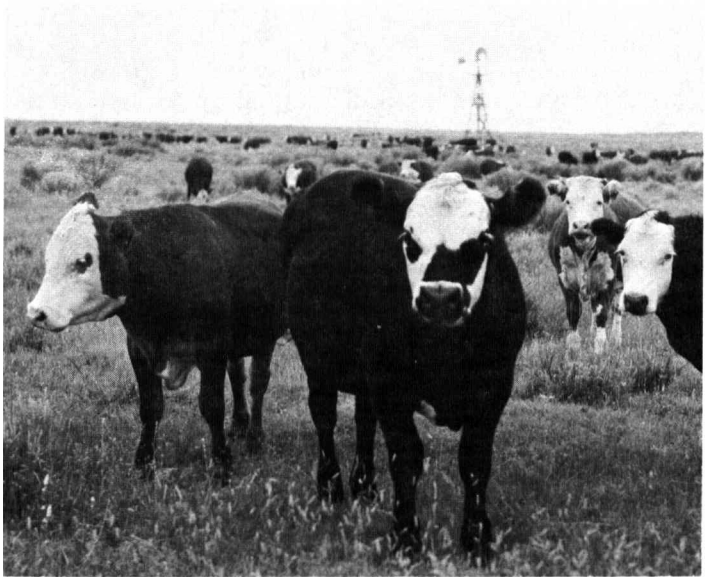

Figure 9.—Stocker cattle grazing native grasses on Dallam loamy fine sand, 0 to 3 percent slopes.

angular blocky; slightly hard, friable; few patchy clay films; many wormcasts; noncalcareous, mildly alkaline; gradual smooth boundary.

B22t—35 to 50 inches, light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; moderate medium and fine subangular blocky structure; hard, friable; few patchy clay films; calcareous, moderately alkaline; gradual wavy boundary.

B23tca—50 to 65 inches, light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) moist, with white coatings; moderate medium and fine subangular blocky structure; hard, friable; estimated 25 percent calcium carbonate as soft lumps and coatings; calcareous, moderately alkaline; gradual smooth boundary.

B24t—65 to 95 inches, yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium and fine subangular blocky structure; hard, friable; many films and threads of calcium carbonate; calcareous, moderately alkaline.

The solum is more than 80 inches thick. Depth to secondary carbonate ranges from 20 to 36 inches. The A horizon is brown, yellowish brown, or grayish brown loamy fine sand and fine sandy loam. It ranges from 6 to 19 inches in thickness. Reaction is neutral or mildly alkaline.

The B21t and B22t horizons are light brown, light reddish brown, reddish brown, brown, or reddish yellow. They are sandy clay loam or clay loam that is 22 to 35 percent clay.

The B23tca horizon is light reddish brown, reddish yellow, pink, or yellowish red. Calcium carbonate content is 2 to 30 percent. The lower part of the Bt horizon is red, reddish yellow, or yellowish red clay loam or sandy clay loam.

DaB—Dallam loamy fine sand, 0 to 3 percent slopes. This nearly level to gently sloping and undulating soil is on upland plains. Areas are broad in shape and average about 700 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Perico and Vingo soils.

The hazard of soil blowing is severe, and the hazard of water erosion is slight. Controlling soil blowing is important where this soil is cultivated. Crop residue left on the surface helps break the force of the wind and reduces soil blowing. A properly designed sprinkler irrigation system is needed where irrigated crops are grown. If the crop grown does not leave enough residue to control soil blowing, chiseling and listing are measures that will roughen the soil surface and help to break the force of the wind. Capability unit IVe-1 dryland and IIIe-3 irrigated; Loamy Sand range site.

DfA—Dallam fine sandy loam, 0 to 1 percent slopes. This nearly level soil occupies smooth uplands of the High Plains. Areas are irregular in shape and average about 200 acres in size.

The surface layer is brown fine sandy loam about 9 inches thick. The next layer is reddish brown sandy clay loam about 19 inches thick. Below this, to a depth of 80 inches, is reddish yellow sandy clay loam.

Included with this soil in mapping are small areas of Dumas, Perico, and Spurlock soils.

This Dallam soil is used for range and crops. Principal dryland and irrigated crops are grain sorghum, wheat, and forage sorghum. A few areas are in irrigated corn, alfalfa, and improved pasture. Several large areas of this soil are used for range.

The main concern of management is the control of soil blowing. Crop residue left on the surface helps to reduce soil blowing. Parallel terraces on dryland areas help to conserve moisture. Irrigated areas need a designed irrigation system that will assist in controlling soil and water losses.

Land leveling is needed in some areas where surface irrigation systems are used. If the crop grown does not leave enough residue, chiseling and listing are effective measures to help control soil blowing. Capability unit IIIe-1 dryland and IIe-3 irrigated; Sandy Loam range site.

DfB—Dallam fine sandy loam, 1 to 3 percent slopes. This gently sloping soil occupies smooth uplands throughout the county. Areas are irregular in shape and average about 100 acres in size.

The surface layer is brown fine sandy loam about 6 inches thick. The next layer is brown sandy clay loam 24 inches thick. Below this is yellowish red sandy clay loam 35 inches thick. The next layer, to a depth of 80 inches, is pink sandy clay loam.

Included with this soil in mapping are small areas of Dumas, Perico, and Spurlock soils.

This Dallam soil is used for range and crops. Principal dryland and irrigated crops are grain sorghum, wheat, and grazing sorghum. A few areas are in irrigated corn, alfalfa, and improved pasture.

The main concerns of management are soil blowing and water erosion. Crop residue left on the surface helps to control soil blowing. Diversions, terraces, and grassed waterways help to control water erosion and to conserve soil moisture. Irrigated lands need a designed irrigation system that will assist in controlling soil erosion and water losses. If crop residues are inadequate to control soil blowing, chiseling and listing can be used. Capability unit IIIe-5 dryland and IIIe-2 irrigated; Sandy Loam range site.

DfC—Dallam fine sandy loam, 3 to 5 percent slopes. This gently sloping soil occupies smooth uplands and footslopes in the more rolling parts of the county. Most areas are long and narrow in shape and average less than 100 acres in size.

The surface layer is brown fine sandy loam 6 inches thick. The next layer is reddish brown sandy clay loam 29 inches thick. The next layer, to a depth of 70 inches, is reddish yellow sandy clay loam.

Included with this soil in mapping are small areas of Berda, Dumas, Perico, and Spurlock soils.

Most of this Dallam soil is in range. When this soil is cultivated, the main concerns of management are soil blowing and water erosion. Crop residues left on the surface help to control soil blowing. Terraces, diversions, and grassed waterways help to control water erosion and to conserve soil moisture. Capability unit IVe-3 dryland and IVe-2 irrigated; Sandy Loam range site.

Dumas Series

The Dumas series consists of deep, well drained, nearly level to gently sloping, loamy soils on uplands. These soils formed in loamy eolian material.

In a representative profile the surface layer is brown loam about 10 inches thick. The next layer is brown sandy clay loam and clay loam about 12 inches thick. The next lower layer is yellowish red sandy clay loam about 14 inches thick. Below this is pink sandy clay

loam about 29 inches thick. The lower layer, to a depth of 85 inches, is reddish yellow sandy clay loam.

Permeability is moderate in these soils, and the available water capacity is high. Runoff is slow to medium. The hazard of soil blowing is moderate.

The Dumas soils provide some of the best cropland in the county. Most of the acreage is cultivated. A few areas are in range.

Representative profile of Dumas loam, 0 to 1 percent slopes, 15 miles southwest and 4 miles west of Dalhart, from intersection of Farm Road 998 and U.S. Highway 54; 13.5 miles southwest on U.S. Highway 54; 4 miles west on county road and 100 feet north of road:

A1—0 to 10 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate medium and fine granular structure; slightly hard, friable; many roots; noncalcareous, neutral; gradual smooth boundary.

B21t—10 to 17 inches, brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; few patchy clay films; noncalcareous, neutral; gradual smooth boundary.

B22t—17 to 22 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium and coarse subangular blocky structure; very hard, friable; many clay films; few wormcasts; noncalcareous, mildly alkaline; gradual smooth boundary.

B23t—22 to 36 inches, yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; few patchy clay films; calcareous, moderately alkaline; gradual smooth boundary.

B24tca—36 to 65 inches, pink (5YR 8/4) sandy clay loam, reddish yellow (5YR 7/6) moist; weak fine subangular blocky structure; hard, friable; about 35 percent by volume calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

B25t—65 to 85 inches, reddish yellow (5YR 7/6) sandy clay loam, yellowish red (5YR 5/6) moist, with white coatings; weak fine subangular blocky structure; hard, friable; few old root channels; calcareous, moderately alkaline.

The solum is more than 60 inches thick. Depth to secondary carbonates ranges from 15 to 34 inches, and depth to the zone of maximum calcium carbonate accumulation ranges from 24 to 50 inches. The A horizon is brown or dark grayish brown. Reaction is neutral or mildly alkaline.

The Bt horizons are clay loam or sandy clay loam that is about 22 to 35 percent clay. The upper part of the Bt horizons are brown, dark brown, dark grayish brown, and reddish brown. The lower part of the Bt horizon, is yellowish red, pink, and reddish yellow. The Btca horizon is 15 to 40 percent calcium carbonate by volume.

DuA—Dumas loam, 0 to 1 percent slopes. This nearly level soil is on smooth upland plains. Areas are 50 to 600 acres in size and are irregular in shape. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Dallam, Gruver, and Sunray soils.

The hazard of soil blowing is moderate, but this soil is well suited to crops. Most areas are irrigated and are used for growing wheat and grain sorghum (fig. 10). Corn, alfalfa, and sugar beets are other crops. A small acreage is used for range.

Good management practices help to control soil

Figure 10.—**Combining irrigated wheat on Dumas loam, 0 to 1 percent slopes.**

blowing, conserve moisture, and maintain good soil tilth. Crop residue left on or near the surface helps to control soil blowing and maintain soil tilth. Where the soil is irrigated, fertilizers and high residue crops help to keep the soil in good condition. Good irrigation systems, properly used, conserve water and control erosion. Parallel terraces help to conserve moisture in dryfarmed areas. Grassed waterways are needed in places to remove excess water safely following high intensity rains. Tillage practices, such as chiseling or listing, that roughen the soil surface are emergency measures used to control soil blowing where crop residues do not control it adequately. Cover crops also help to control soil blowing. Capability unit IIIe-3 dryland and IIe-2 irrigated; Clay Loam range site.

DuB—Dumas loam, 1 to 3 percent slopes. This gently sloping soil is on smooth upland plains. Areas are 20 to 200 acres in size and are mainly long and narrow.

The surface layer is brown loam about 10 inches thick. The next layer is brown sandy clay loam about 9 inches thick. The underlying material, to a depth of 80 inches, is reddish yellow sandy clay loam that becomes yellowish red with depth.

Included with this soil in mapping are small areas of Dallam, Gruver, and Sunray soils.

Most areas of this Dumas soil are used for range. A few of the cultivated areas are in dryland and irrigated wheat and grain sorghum or in irrigated corn and alfalfa.

The main concerns of management are the control of soil blowing and water erosion. Crop residues left on the surface help to maintain tilth and control soil blowing. Diversions, terraces, and grassed waterways are needed to control water erosion where washing is a problem. These practices also help to conserve soil moisture in dryfarmed areas. Irrigated lands need a designed irrigation system that will assist in controlling soil erosion and runoff. If crop residues are inadequate to control soil blowing, chiseling or listing are effective emergency measures. Additions of fertilizers and management of crop residues help to maintain the fertility of this soil and are important in irrigated areas. Capability unit IIIe-6 dryland and IIIe-1 irrigated; Clay Loam range site.

Glenrio Series

The Glenrio series consists of shallow, well drained, gently sloping to strongly sloping, clayey soils on uplands in the 'Rolling Plains' parts of the county. These soils formed in red bed material.

In a representative profile the upper 14 inches are reddish brown clay. The underlying material, to a depth of 60 inches, is red bed shaly clay.

Glenrio soils are very slowly permeable. The available water capacity is very low. Runoff is rapid. The hazard of soil blowing is slight.

Glenrio soils are not suited to crops. All areas are in range.

Representative profile of Glenrio clay, in an area of Glenrio-Knoco complex, 3 to 12 percent slopes, 26 miles west of Channing, from intersection of U.S. Highway 54 and Farm Road 767; 10 miles east on Farm Road 767; 0.25 mile south of Farm Road 767 and 1.75 miles east of paved road leading to ranch headquarters:

A1—0 to 4 inches, reddish brown (5YR 5/4) clay, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; hard, firm; calcareous, moderately alkaline; gradual smooth boundary.

B2—4 to 14 inches, reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; hard, firm; calcareous, moderately alkaline; gradual smooth boundary.

C—14 to 60 inches, red (2.5YR 5/6), red bed shaly clay; structureless (massive).

The solum is 10 to 20 inches thick. The A horizon is red, reddish brown, or yellowish red clay, silty clay, or clay loam. The B2 horizon is red, reddish brown, or yellowish red. The C horizon is clayey or shaly red bed material in shades of red, olive, and gray. A few coarse fragments are on the surface in places.

GkD—Glenrio-Knoco complex, 3 to 12 percent slopes. The soils in this unit are gently sloping to strongly sloping. They are the result of backwashing and backcutting of local streams in the southern parts of the county. Most areas are irregular in shape and range from 50 to 500 acres in size.

The soils of this complex are in a pattern but are so intricately mixed or so small in size that they cannot be shown separately at the scale mapped. The composition of this mapping unit is about 30 percent Glenrio clay and 30 percent Knoco clay. The rest is small areas of San Jon, Mangum, and Berda soils, and some shale and rock outcrops.

The Glenrio soils are droughty and have shallow Knoco soils are on the more sloping, severely eroded slopes and knolls.

The profiles of Glenrio and Knoco soils are those described as representative for their respective series.

The soils of this mapping unit are used entirely for range.

The Glenrio soils are droughty and have shallow rooting depths. The Knoco soils are very droughty and very shallow. Water erosion and invasion of undesirable brush are the main problems. Capability unit VIIs-1 dryland; Shallow Clay range site.

Gracemore Series

The Gracemore series consists of deep, somewhat poorly drained, nearly level, subirrigated soils on bottom land. These soils are along the major creeks in the county.

In a representative profile the surface layer is gray clay loam about 3 inches thick. The underlying material, to a depth of 60 inches or more, is very pale brown fine sand that contains thin strata of darker colored and finer textured material.

Gracemore soils are moderately rapidly permeable. They flood several times most years. Runoff is slow. The available water capacity is high. Most of the time the water table is at a depth of 8 to 14 inches.

Gracemore soils are not suited to cultivation because of wetness and susceptibility to flooding. All areas are in range and are used as subirrigated hayland and for grazing.

Representative profile of Gracemore soils, 6 miles west and 1 mile north of Channing, from intersection of Farm Roads 767 and 2357; 2 miles west on Farm Road 767; 0.5 mile north and 2.25 miles west on unsurfaced road; 50 feet north of road:

A1—0 to 3 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; weak fine granular structure; hard, firm; many roots; thin strata of fine sand of lighter colors; calcareous, moderately alkaline; clear smooth boundary.

C—3 to 60 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grained; soft, loose; many thin fine sandy loam and clay loam strata of various colors; calcareous, moderately alkaline.

The A horizon is clay loam, sandy clay loam, fine sandy loam, or loamy fine sand. It ranges from 2 to 4 inches in thickness. The C horizon is loamy fine sand or fine sand that contains thin strata of more clayey materials.

Gm—Gracemore soils. These soils are on the flood plains of major streams. They are flooded during most years for short periods and have a permanent high water table. Soil areas are long and narrow and follow stream channels. They are 10 to 300 acres in size. Slopes are less than 0.5 percent.

The Gracemore soils in this unit are similar to the one described as representative for the series. The texture of the surface layer is variable and includes clay loam, sandy clay loam, fine sandy loam, and loamy fine sand.

Included with these soils in mapping are small areas of Lincoln, Guadalupe, and Colorado soils.

These soils are not suited to cultivation because of flooding and a high water table. They are used for range and hay.

The main management concerns are flooding and low fertility. Capability unit Vw-1 dryland; Wet Bottomland range site.

Gruver Series

The Gruver series consists of deep, well drained, nearly level to gently sloping soils on uplands. These soils formed in loamy and clayey eolian material.

In a representative profile the surface layer is brown loam about 8 inches thick. The next layer is brown clay loam about 30 inches thick. The next lower layer is yellowish red clay loam about 20 inches thick. Below this is pink clay loam about 20 inches thick. It is underlain to a depth of 98 inches by reddish yellow clay loam.

Permeability is moderately slow in these soils, and the available water capacity is high. Runoff is slow to medium. Soil blowing is a moderate hazard.

Gruver soils are well suited to crops. In most areas the soils are both dryfarmed and farmed under irrigated conditions. Some large areas are still in range.

Representative profile of Gruver loam, 0 to 1 percent slopes, 4 miles west of Dalhart, from intersection of Farm Road 998 and U.S. Highway 54; 2.8 miles south on Farm Road 998; 100 feet east of highway:

Ap—0 to 8 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak medium and fine subangular blocky and granular structure; soft, friable; noncalcareous; neutral; abrupt smooth boundary.

B21t—8 to 19 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, firm; few wormcasts; many clay films; common pores; noncalcareous, mildly alkaline; clear smooth boundary.

B22t—19 to 28 inches, brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate medium and fine subangular blocky structure; very hard, firm; calcareous, moderately alkaline; clear smooth boundary.

B23t—28 to 38 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm; few patchy clay films; films and threads of calcium carbonate; calcareous, moderately alkaline; clear smooth boundary.

B24t—38 to 50 inches, yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; about 10 percent calcium carbonate in hard and soft masses; calcareous, moderately alkaline; clear smooth boundary.

B25tca—50 to 58 inches, yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; very hard, firm; about 12 percent calcium carbonate in hard and soft masses; calcareous, moderately alkaline; clear smooth boundary:

B26tca—58 to 78 inches, pink (7.5YR 8/4) clay loam, reddish yellow (7.5YR 7/6) moist; weak medium subangular blocky structure; very hard, firm; about 30 percent calcium carbonate in soft powdery form; calcareous, moderately alkaline; clear smooth boundary.

B27tca—78 to 98 inches, reddish yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; weak medium subangular blocky structure; very hard, firm; about 15 percent calcium carbonate in the form of soft and hard masses; calcareous, moderately alkaline.

The solum is more than 60 inches thick. Depth to secondary carbonates ranges from 19 to 28 inches. Depth to the zone of maximum carbonate accumulation ranges from 25 to 50 inches.

The A horizon ranges from 5 to 11 inches in thickness. Colors are brown, dark brown, or dark grayish brown.

The upper part of the Bt horizon is brown, dark brown, dark grayish brown, or reddish brown clay or clay loam. The upper 20 inches of the Bt horizon is 35 to 45 percent clay. The lower part of it is yellowish red, pink, or reddish yellow clay loam or sandy clay loam. The Btca horizon is 10 to 40 percent calcium carbonate by volume.

GrA—Gruver loam, 0 to 1 percent slopes. This nearly level soil is on smooth upland plains. Areas range from 25 to 800 acres in size and are irregular in shape. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Dumas, Rickmore, Sherm, and Sunray soils.

This soil has a moderate hazard of soil blowing, but it is well suited to crops. Most areas are irrigated and used for growing wheat and grain sorghum. Corn, alfalfa, and sugar beets are other crops. A small acreage is used for range.

Good management practices help to control soil blowing, conserve moisture, and maintain soil tilth. Crop residue left on or near the surface helps to control soil blowing and maintain soil tilth. Where the soil is irrigated, fertilizers and high residue crops help to keep the soil in good condition. Good irrigation systems, properly used, conserve water and control erosion. Terraces and contour farming help to conserve moisture and control erosion in dryfarmed areas. In places grassed waterways are needed for safe removal of excess water following high intensity rains. Where the

use of crop residue does not control soil blowing, chiseling or listing are effective emergency measures. Cover crops also help to control soil blowing. Capability unit IIIe-3 dryland and IIe-2 irrigated; Clay Loam range site.

GrB—Gruver loam, 1 to 3 percent slopes. This gently sloping soil is on smooth upland plains and gently sloping areas above playa lakes. Most areas are long and narrow and 20 to 200 acres in size.

The surface layer is dark grayish brown loam about 4 inches thick. The next layer is dark grayish brown clay loam 14 inches thick. The next lower layer is yellowish red clay loam 20 inches thick. Below this, to a depth of 85 inches, is reddish yellow clay loam.

Included with this soil in mapping are small areas of Dallam, Dumas, and Sunray soils.

This Gruver soil is used mostly for range. A few areas are farmed to dryland and irrigated wheat and grain sorghum.

The main concerns of management are the control of soil blowing and water erosion. Crop residue left on the surface helps to maintain tilth and control soil blowing. Diversions, terraces, and grassed waterways are needed to control water erosion where washing is a problem. Irrigated lands need a designed irrigation system that will help to control soil and water losses. Capability unit IIIe-6 dryland and IIIe-1 irrigated; Clay Loam range site.

Guadalupe Series

The Guadalupe series consists of deep, well drained, nearly level, loamy soils on flood plains. These soils formed in loamy alluvium.

In a representative profile the surface layer is brown fine sandy loam about 10 inches thick. The next layer, about 26 inches thick, is brown fine sandy loam. The underlying material, to a depth of 60 inches or more, is light yellowish brown fine sandy loam.

Permeability is moderately rapid in these soils, and the available water capacity is medium. Some areas flood occasionally, but most areas are seldom flooded. The flooding is of very short duration. Runoff is slow. The hazard of soil blowing is moderate.

Guadalupe soils are well suited to crops, and a few areas are cultivated. Most areas are in range.

Representative profile of Guadalupe fine sandy loam, 13 miles south of Dalhart, from intersection of Farm Road 998 and U.S. Highway 54: 13 miles south and 2.5 miles east on Farm Road 998; 50 feet south of highway and 50 feet east of Rita Blanca Creek channel:

A1—0 to 10 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; distinctly stratified with recent loamy fine sand and sandy clay loam deposits of various colors; calcareous, moderately alkaline; gradual smooth boundary.

B21—10 to 21 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; coarse prismatic structure that parts to weak fine granular; slightly hard, friable; thin lenses and strata of sandy clay loam and loamy fine sand of various colors; calcareous, moderately alkaline; clear smooth boundary.

B22—21 to 36 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable; few thin loamy fine sand and sandy clay loam strata of various colors; calcareous, moderately alkaline; clear smooth boundary.

C—36 to 60 inches, light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; structureless (massive); slightly hard, friable; few thin loamy fine sand and sandy clay loam strata of various colors; calcareous, moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. The soil is calcareous throughout. The upper 40 inches is 10 to 18 percent clay.

The A horizon is light brown, light brownish gray, brown, or dark brown. It ranges from 5 to 12 inches in thickness. It is fine sandy loam that has thin strata of loamy fine sand and sandy clay loam.

The B2 horizons are brown, dark brown, or light brown. Thin strata of sandy clay loam and loamy fine sand are common.

The C horizon is stratified fine sandy loam, loamy fine sand, or sandy clay loam.

Gu—Guadalupe fine sandy loam. This nearly level soil occupies smooth bottom land adjacent to major streams in the county. The areas are long and narrow in shape and range from 20 to 200 acres in size. Slopes are less than 1 percent.

Included with this soil in mapping are small areas of Spur, Bippus, and Lincoln soils. Most areas of this soil are used for range. The soil is well suited to cultivation. A few areas are planted to irrigated wheat and grain sorghum or to dryland forage crops.

The main concern of management is the control of soil blowing. Crop residue left on the surface helps to control soil blowing. It also helps to conserve soil moisture and to maintain good soil tilth. Irrigated areas need an irrigation system that is designed to control soil losses and keep water losses at a minimum. Capability unit IIIe-2 dryland and IIe-4 irrigated; Loamy Bottomland range site.

Karde Series

The Karde series consists of deep, well drained, gently sloping, loamy soils on uplands. These soils formed in loamy sediment blown from playas.

In a representative profile the surface layer is light brownish gray sandy clay loam about 6 inches thick. The underlying material, to a depth of 60 inches or more, is white sandy clay loam.

Karde soils are moderately permeable. The available water capacity is high. Runoff is moderate. Because of the high content of carbonates, soil blowing is a severe hazard.

Karde soils are suited to cultivation. A few areas are dry farmed and a few are irrigated by sprinkler systems. Most areas are in range.

Representative profile of Karde sandy clay loam in an area of Karde soils, 3 to 5 percent slopes, 1 mile south and 5 miles west of Dalhart, from intersection of U.S. Highway 54 and Farm Road 694; 5.25 miles west on Farm Road 694; 100 feet south of highway:

A—0 to 6 inches, light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable; few roots; calcareous, moderately alkaline; gradual smooth boundary.

C—6 to 60 inches, white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) moist; structureless (massive);

slightly hard, friable; calcareous, moderately alkaline.

Karde soils are more than 60 inches deep. The A horizon ranges from 4 to 16 inches in thickness. Colors are light brownish gray, gray, grayish brown, or dark grayish brown. Structure is weak coarse prismatic or weak coarse subangular blocky. Textures are sandy clay loam, loam, fine sandy loam, or clay loam.

The C horizon is white, gray, brownish gray, light gray, grayish brown, or light grayish brown loam, clay loam, or sandy clay loam.

KaB—Karde soils, 1 to 3 percent slopes. These gently sloping soils are on crescent-shaped low ridges that are on the eastern sides of playas. Areas are 200 to 600 feet wide and 15 to 300 acres in size.

These soils are similar to the soil described as representative of the series, but the textures of their surface layer vary and include sandy clay loam, clay loam, and loam.

Included with these soils in mapping are small areas of Conlen, Perico, Spurlock, and Sunray soils.

Most areas of these soils are in range. A few areas are farmed to grain sorghum and wheat.

The main concerns of management are the control of erosion and improvement of soil productivity. These soils blow readily. Large amounts of crop residue left on the surface help to prevent soil blowing. Diversions, terraces, and grassed waterways help to control water erosion. Productivity in irrigated areas can be improved by using fertilizers and by returning crop residue to the soil. Irrigated lands need an irrigation system designed to control soil and water losses. Where crop residues are inadequate to control soil blowing, chiseling and listing are helpful emergency measures. Capability unit IVe-5 dryland and IIIe-5 irrigated; High Lime range site.

KaC—Karde soils, 3 to 5 percent slopes. These gently sloping soils are on crescent-shaped low ridges that curve around the eastern sides of playas. Areas are 20 to 30 acres in size. They are long and narrow.

These soils are similar to the soil described as representative of the series. The textures of their surface layer vary, however, and include sandy clay loam, clay loam, and loam. Karde sandy clay loam, the soil that has the profile described as representative of the series, is in an area of these soils.

Included with these soils in mapping are small areas of Conlen, Perico, Sunray, and Spurlock soils.

These soils are mostly in range. Cropped areas are in grain sorghum, wheat, and grazing sorghum.

The main concerns of management are the control of erosion and improvement of soil productivity. This soil blows easily. Large amounts of crop residue left on the surface help to prevent soil blowing. Diversions, terraces, and grassed waterways help to control water erosion. Under irrigation, soil productivity can be improved by the use of fertilizer for growing crops and the return of crop residue to the soil. Irrigated areas need an irrigation system designed to control soil and water losses. Where crop residues are inadequate to control soil blowing, chiseling and listing are helpful emergency measures. Capability unit VIe-3 dryland and IIIe-5 irrigated; High Lime range site.

Knoco Series

The Knoco series consists of very shallow, excessively drained, gently sloping to strongly sloping, clayey soils. These soils formed in clayey red beds.

In a representative profile the surface layer is reddish brown clay about 8 inches thick. The underlying material, to a depth of 60 inches or more, is greenish gray clayey shale.

Knoco soils are very slowly permeable. Runoff is rapid on these soils. The available water capacity is low.

The Knoco soils are not suited to crops. All areas are in range. They are mapped only in a complex with Glenrio soils.

Representative profile of Knoco clay in an area of Glenrio-Knoco complex, 3 to 12 percent slopes, 26 miles west of Channing, from intersection of U.S. Highway 54 and Farm Road 767; 0.25 mile south of Farm Road 767 and 1.75 miles east of paved road leading to ranch headquarters:

A—0 to 8 inches, reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak fine subangular blocky structure; hard, firm; calcareous, moderately alkaline; gradual smooth boundary.

C—8 to 60 inches, greenish gray (5G 6/1) with layers of yellowish red (5YR 4/6) clayey shale; weak platy structure that parts to fine angular fragments; very hard, firm; calcareous, moderately alkaline.

The A horizon ranges from 3 to 11 inches in thickness. It is dark red, red, reddish brown, dark reddish brown, and yellowish red. The C horizon is stratified clayey shale and shale.

Likes Series

The Likes series consists of deep, well drained undulating to hummocky soils on uplands. These soils formed in wind modified sandy alluvium. Areas are 20 to 400 acres in size and are irregular in shape.

In a representative profile the surface layer is 6 inches of light yellowish brown loamy fine sandy over 12 inches of yellowish brown loamy fine sand. The underlying material, to a depth of 60 inches or more, is very pale brown loamy fine sand.

Permeability is moderately rapid in these soils, and runoff is slow. The available water capacity is low. The hazard of soil blowing is severe.

Likes soils are not suited to crops. All areas are in range.

Representative profile of Likes loamy fine sand, 6 miles west and 2 miles north of Channing; from intersection of Farm Roads 797 and 2357; 1.5 miles west on Farm Road 797; 3.25 miles west on county road; 1 mile north of road:

A11—0 to 6 inches, light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure; loose, very friable; many roots; calcareous, moderately alkaline; gradual smooth boundary.

A12—6 to 18 inches, yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; loose; very friable; many roots; calcareous, moderately alkaline; gradual smooth boundary.

C—18 to 60 inches, very pale brown (10YR 7/4) loamy fine sand, light yellowish brown (10YR 6/4) moist;

structureless (single grained); loose, very friable; calcareous, moderately alkaline.

These soils are calcareous and are loamy fine sand to a depth of 40 inches or more.

The colors of all horizons are light yellowish brown, yellowish brown, very pale brown, pale brown, brown, or light brown. The C horizon below a depth of 40 inches is fine sand or loamy fine sand.

Lk—Likes loamy fine sand. This undulating to hummocky soil is in sandy, calcareous areas mainly in the western and southern parts of the county. Slopes are 5 to 12 percent.

Included with the soil in mapping are small areas of Mobeetie, Valentine, and Veal soils.

This soil is not suited to cultivation. All areas are in range. Grazing must be managed properly or the soil will blow. Capability unit VIe-1 dryland; Loamy Sand range site.

Lincoln Series

The Lincoln series consists of deep, somewhat excessively drained, nearly level, sandy soils on bottom lands. These soils formed in sandy alluvium from local streams.

In a representative profile the surface layer is about 8 inches of dark yellowish brown loamy fine sand over 10 inches of very pale brown loamy fine sand. The underlying material, to a depth of 64 inches or more, is brown loamy fine sand that has thin strata of various colors and textures.

Permeability is rapid in these soils, and the available water capacity is low. Runoff is slow. Most areas are flooded occasionally. The hazard of soil blowing is severe.

Lincoln soils are not suited to crops. All areas are in range.

Representative profile of Lincoln loamy fine sand in an area of Lincoln soils, 26.5 miles southwest of Dalhart; 150 feet east of U.S. Highway 54 and 50 feet north of Punta De Agua Creek:

A11—0 to 8 inches, dark yellowish brown (10YR 4/4) loamy fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; calcareous, moderately alkaline; gradual smooth boundary.

A12—8 to 18 inches, very pale brown (10YR 7/4) loamy fine sand, light yellowish brown (10YR 6/4) moist; weak fine grandular structure; soft, very friable; calcareous, moderately alkaline; clear smooth boundary.

C—18 to 64 inches, brown (10YR 5/3) loamy fine sand; brown (10YR 4/3) moist; structureless (single grained); loose, very friable; thin strata of pebbles; thin lenses and strata of fine sandy loam; calcareous, moderately alkaline.

These soils are calcareous throughout. The A horizon is brown, dark yellowish brown, or very pale brown fine sand or loamy fine sand. It ranges from 6 to 14 inches in thickness.

Thin layers and lenses of finer textures occur throughout the soil. They range from 1 to 5 inches in thickness. These layers are very fine sandy loam, fine sandy loam, sandy clay loam, and clay loam. Thick beds of gravel and coarse sands occur below a depth of 40 inches in places.

Ln—Lincoln soils. These nearly level soils are on bottom land along creeks. Most areas are flooded occasionally. Extensive areas are along Punta De Agua and Rita Blanca Creeks, parallel to the creek beds. Slopes are 0 to 1 percent.

These soils are similar to the soil described as representative of the series. The texture of their surface layer varies, however, and includes fine sand or loamy fine sand.

Included with these soils in mapping are narrow, gravelly and sandy stream channels and small areas of Gracemore, Guadalupe, and Valentine soils.

All areas of these soils are range. The soils are not suited to crops. Capability unit Vw-1 dryland; Sandy Bottomland range site.

Mangum Series

The Mangum series consists of deep, well drained, nearly level, clayey soils on bottom land. These soils formed in clayey alluvium.

In a representative profile the surface layer is reddish brown clay about 10 inches thick. The next layer, 15 inches thick, is red clay that has thin, lighter colored strata. The lower layer, to a depth of 60 inches or more, is red silty clay that has thin, lighter colored strata.

Permeability is very slow in these soils, and the available water capacity is high. Runoff is slow. The hazard of soil blowing is slight.

Mangum soils are suited to crops, but all areas of these soils in this survey area are in range.

Representative profile of Mangum clay, 27 miles west of Channing, from intersection of Farm Road 767 and U.S. Highway 54; 11.0 miles east on Farm Road 767 to Romero Creek; 100 feet north of highway on east bank of creek:

A11—0 to 4 inches, reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky and fine granular structure; hard, friable; many roots; calcareous, moderately alkaline; gradual smooth boundary.

A12—4 to 10 inches, reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky and granular structure; extremely hard, firm; many roots; calcareous, moderately alkaline; gradual smooth boundary.

C1—10 to 25 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; structureless (massive); extremely hard, firm; few roots; thin clay loam strata of lighter color; calcareous, moderately alkaline; gradual smooth boundary.

C2—25 to 60 inches, red (2.5YR 5/6) silty clay, red (2.5YR 4/6) moist; structureless (massive); extremely hard, firm; thin clay loam strata of lighter color; calcareous, moderately alkaline.

The A horizon ranges from 5 to 15 inches in thickness. It is reddish brown, dark reddish brown, red, or dark red. Texture in the upper 40 inches is clay or silty clay.

The C horizons are red or dark red clay or silty clay. Thin strata of lighter colored fine sandy loam, silt loam, loam or clay loam are in these horizons.

Ma—Mangum clay. This nearly level soil occupies broad bottomland areas in the southern parts of the county. Areas are 100 to 600 acres in size. They are long and narrow and are parallel to stream beds. Slopes are less than 0.5 percent. The soil occasionally floods.

All areas of this Mangum soil are in range. This soil is suited to cultivation.

If this soil is cultivated, the main concerns of management are maintenance of soil tilth and control of

erosion. Management of crop residues on the soil surface will help to maintain soil tilth and control soil blowing and water erosion. Irrigated lands need a designed irrigation system that will assist in controlling soil erosion and water losses. Capability unit IIIw-1 dryland and IIIw-1 irrigated; Clay Flat range site.

Mobeetie Series

The Mobeetie series consists of deep, well drained, gently sloping to sloping, loamy soils on side slopes above drainageways in uplands. These soils formed in loamy alluvium or collvuim.

In a representative profile the surface is reddish brown fine sandy loam about 6 inches thick. The next layer is reddish brown fine sandy loam about 24 inches thick. The underlying material, to a depth of 60 inches or more, is yellowish red fine sandy loam.

Permeability is moderately rapid in these soils, and runoff is slow to medium. The available water capacity is medium. These soils blow readily. Soil blowing is a severe hazard if the soils are cultivated.

The less sloping Mobeetie soils are suited to crops. All areas are in range.

Representative profile of Mobeetie fine sandy loam in an area of Mobeetie-Veal association, undulating, 17 miles west of Channing, from intersection of Farm Roads 767 and 2357; 13 miles west of Farm Road 767; 1.5 miles south of highway:

A1—0 to 6 inches, reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular and subangular blocky structure; slightly hard, friable; calcareous, moderately alkaline; gradual smooth boundary.

B2—6 to 30 inches, reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure; slightly hard, friable; calcareous, moderately alkaline; gradual smooth boundary.

C—30 to 60 inches, yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; calcareous, moderately alkaline.

The A horizon ranges from 5 to 12 inches in thickness. Colors are brown, light reddish brown, or reddish brown. Most of the A horizon is calcareous, but in places it is noncalcareous.

The B2 horizon is light brown, brown, reddish brown, light reddish brown, or strong brown fine sandy loam that is 10 to 17 percent clay. Structure ranges from weak, coarse, prismatic, and granular to weak, fine, subangular blocky.

The C horizon is at a depth of 30 to 50 inches. It is fine sandy loam or sandy clay loam. Thin strata of cemented calcium carbonate are common in this horizon. Films and threads of calcium carbonate in this horizon range from 2 to 8 percent.

MoB—Mobeetie fine sandy loam, 1 to 3 percent slopes. This gently sloping soil is on the sides of major drainageways. Areas are mainly long and narrow in shape and range from 20 to 300 acres in size.

The surface layer is brown fine sandy loam about 6 inches thick. The next layer is brown fine sandy loam 32 inches thick. The underlying material, to a depth of 60 inches, is brown sandy clay loam.

Included with this soil in mapping are small areas of Berda, Likes, and Perico soils.

This Mobeetie soil is used mostly for range.

If this soil is cultivated, the main concerns of management are the control of erosion and the maintenance of soil productivity. Crop residue left on the surface helps to control soil blowing and to maintain soil productivity. Diversions, terraces, and grassed waterways help to control water erosion. Irrigated lands need a designed irrigation system that assists in controlling soil and water losses. Capability unit IIIe-5 dryland and IIIe-2 irrigated; Mixedland Slopes range site.

MoC—Mobeetie fine sandy loam, 3 to 5 percent slopes. This gently sloping soil is on the sides of major drainageways. Areas are long and narrow in shape and range from 15 to 200 acres in size.

The surface layer is brown fine sandy loam about 12 inches thick. The next layer is strong brown fine sandy loam 18 inches thick. The underlying material to a depth of 60 inches is reddish yellow fine sandy loam.

Included with this soil in mapping are small areas of Berda, Likes, Perico, and Veal soils.

This Mobeetie soil is used for range.

If this soil is cultivated, both soil blowing and water erosion are hazards. Crop residue left on the surface helps to control soil blowing and water erosion. Diversions, terraces, and grassed waterways help to control water erosion. Capability unit IVe-3 dryland and IVe-2 irrigated; Mixedland Slopes range site.

MoD—Mobeetie fine sandy loam, 5 to 8 percent slopes. This sloping soil is on long, narrow areas along major drainageways. Slopes are dominantly 5 to 7 percent.

The surface layer is brown fine sandy loam about 5 inches thick. The next layer is strong brown fine sandy loam 25 inches thick. The lower layer, to a depth of 60 inches, is reddish yellow fine sandy loam.

Included with this soil in mapping are small areas of Berda, Likes, Perico, Potter, and Veal soils.

This Mobeetie soil is in range. It is not suited to cultivation. Capability unit VIe-2 dryland; Mixedland Slopes range site.

MVD—Mobeetie-Veal association, undulating. These undulating soils are on alternating convex ridges, knolls, and side slopes. Areas are mostly several hundred acres in size. Slopes are dominantly 5 to 8 percent.

These soils could be mapped separately; but because use and management are similar, separation is not justified. The delineations are larger and the composition more variable than in most other units. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

The Mobeetie soil of this association has the profile described as representative for the series.

Veal soils have a surface layer of brown, calcareous fine sandy loam about 5 inches thick. The next layer is pinkish gray, calcareous sandy clay loam about 9 inches thick. The next layer is pink, calcareous sandy clay loam, about 16 inches thick, that contains about 50 percent calcium carbonate. Below this, to a depth of 60 inches, is light brown, calcareous sandy clay loam.

This soil association is not suited to cultivation. It is used for range. Capability unit VIe-2 dryland; Mixedland Slopes range site.

Ness Series

The Ness series consists of deep, somewhat poorly drained, nearly level, clayey soils in playa lakes. These soils formed in clayey lacustrine material.

In a representative profile the upper layer, to a depth of 48 inches, is dark gray clay. The lower layer, to a depth of 80 inches, is gray clay.

Most areas of these soils are inundated for a few weeks each year. Permeability is very slow and the available water capacity is high. Soil blowing is a severe hazard where the surface is barren as a result of previous killing of vegetation by inundation. These soils develop large cracks when dry, and they swell and expand when wet.

Ness soils are mostly in range. A few small playas are farmed. These areas have a potential for development as wildlife habitat.

Representative profile of Ness clay, 9 miles east of Hartley on U.S. Highway 87; 150 yards south of highway:

A11— 0 to 14 inches, dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine granular and subangular blocky structure; extremely hard, very firm; shiny ped surfaces; noncalcareous, moderately alkaline; gradual wavy boundary.

A12—14 to 48 inches, dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium blocky structure; extremely hard, very firm; few parallelepipeds; many short intersecting slickensides; shiny ped surfaces; few faint mottles; noncalcareous, moderately alkaline; gradual wavy boundary.

AC—48 to 80 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine and medium blocky structure; extremely hard, very firm; few parallelepipeds; many short intersecting slickensides; shiny ped surfaces; few faint mottles; calcareous, moderately alkaline.

The surface relief is wavy. It includes microknolls and microdepressions. The differences in elevation range from 3 to 8 inches. The A horizon ranges from 30 to 50 inches in thickness. The thicker A horizon is in the microdepressions. The A horizon is gray, dark gray, or very dark gray. In places soils have thin accumulations of fine sandy loam and clay loam on the surface. When dry these soils have cracks that extend to a depth of more than 20 inches. Depth to calcareous material ranges from 40 to more than 60 inches.

Ne—Ness clay. This nearly level soil occupies the bottoms of playas or depressions that dot the smooth featureless 'High Plains' parts of the county. The playas range from small depressions called "buffalo wallows" to areas 200 acres in size. They are round to oval in shape. The bottoms are a few inches to about 5 feet below the surrounding well drained soils. Areas are slightly concave and have low, slightly mounded microrelief (gilgai). Slopes are less than 0.5 percent.

Included with this soil in mapping are narrow areas of gently sloping Gruver, Sherm, and Sunray soils around the edges of the playas.

Ness clay is used mainly for grazing. During wet seasons it produces aquatic plants such as smartweed, sedges, rushes, ragweed, and knotgrass. Western wheatgrass is common in the drier playas.

A few smaller areas of Ness soil are farmed when they are in larger fields of other soils.

The main management concern is the prevention of soil blowing. Controlling grazing so that a good cover remains on the surface helps to prevent soil blowing. Emergency chiseling is an effective measure where vegetative cover is lacking. Capability unit VIw-1 dryland. Included with surrounding range site.

Perico Series

The Perico series consists of deep, well drained, nearly level to gently sloping soils on uplands. These soils formed in loamy material.

In a representative profile the surface layer is yellowish brown fine sandy loam about 8 inches thick. The next layer, 8 inches thick, is dark yellowish brown sandy clay loam. The next lower layer is yellow clay loam 10 inches thick. Below this is pink clay loam about 19 inches thick. This is underlain, to a depth of 84 inches, by reddish yellow clay loam.

Permeability is moderate in these soils, and runoff is slow. The available water capacity is high. The hazard of soil blowing is severe. Large amounts of lime in the soil cause chlorosis in some plants.

Perico soils are suited to crops. Most areas are used for range. Some areas are planted to dryland and irrigated wheat and grain sorghum.

Representative profile of Perico fine sandy loam, 0 to 1 percent slopes, 1.5 miles west of Dalhart, from junction of Farm Road 694 and U.S. Highway 54; 1.25 miles west on Farm Road 694 and 1 mile north on county road; 50 feet west of road:

Ap—0 to 8 inches, yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; few roots; few wormcasts; calcareous, moderately alkaline; abrupt smooth boundary.

B21t—8 to 16 inches, dark yellowish brown (10YR 4/4) sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak coarse prismatic structure that parts to coarse medium and fine subangular blocky; slightly hard, friable; few roots; many wormcasts; calcareous, moderately alkaline; gradual smooth boundary.

B22t—16 to 26 inches; yellow (10YR 7/6) clay loam, brownish yellow (10YR 6/6) moist; weak medium subangular blocky structure; slightly hard, friable; many wormcasts: calcareous, moderately alkaline; gradual smooth boundary.

B23tca—26 to 45 inches, pink (7.5YR 8/4) clay loam, pink (7.5YR 7/4) moist; weak medium subangular blocky structure; hard, friable; about 30 percent calcium carbonate; clear smooth boundary.

B24t—45 to 84 inches, reddish yellow (5YR 6/8) clay loam, yellowish red (5YR 5/8) moist; weak medium subangular blocky structure; hard, friable; few patchy clay films about 10 percent calcium carbonate; calcareous, moderately alkaline.

The A horizon is light brown, brown, pale brown, reddish brown, grayish brown, or yellowish brown fine sandy loam or loamy fine sand. It ranges from 4 to 16 inches in thickness. The Bt horizons are grayish brown, yellowish brown, dark yellowish brown, light brown, brown, pink, reddish yellow, yellow, strong brown, or yellowish red sandy clay loam or clay loam that is 20 to 35 percent clay. The Btca horizon is 10 to 40 percent calcium carbonate.

PcB—Perico loamy fine sand, 0 to 3 percent slopes. This nearly level to gently sloping and gently undulating soil is on plains. Areas are irregular in shape and average about 200 acres in size.

The surface layer is brown loamy fine sand about 8 inches thick. The next layer is grayish brown sandy

clay loam 20 inches thick. Below this, to a depth of 80 inches, is reddish yellow clay loam.

Included with this soil in mapping are small areas of Dallam, Spurlock, and Vingo soils.

This Perico soil is used mostly for range. A few areas are farmed.

Soil blowing is the major hazard to overcome in managing this soil. Crop residues left on the surface are essential in controlling soil blowing. If the crop residues do not provide enough control, chiseling and listing are helpful measures. Irrigation water can be applied properly by the sprinkler method. Capability unit IVe-1 dryland and IIIe-3 irrigated; Loamy Sand range site.

PeA—Perico fine sandy loam, 0 to 1 percent slopes. This soil is nearly level. Areas are irregular in shape and average about 200 acres in size. The profile of this soil is the one described as representative for the series.

Included with this soil in mapping are small areas of Dallam, Spurlock, and Sunray soils.

This Perico soil is used for range and crops. Dry cropland areas are in grain sorghum and wheat. Irrigated areas are in wheat, grain sorghum, grazing sorghum, alfalfa, corn, and improved pasture.

The main concerns of management are soil blowing and loss of soil moisture. Crop residue needs to be left on the surface. Parallel terraces help to conserve moisture in dryfarmed areas. Irrigated areas need irrigation systems that are properly designed to reduce soil and water losses. If crop residues do not provide enough control of soil blowing, chiseling and listing are effective measures. Capability unit IIIe-1 dryland and IIe-3 irrigated; Mixedland Slopes range site.

PeB—Perico fine sandy loam, 1 to 3 percent slopes. This gently sloping soil is on ridges that are long and narrow. Areas average about 100 acres in size.

The surface layer is yellowish brown fine sandy loam about 7 inches thick. The next layer, 20 inches thick, is brown sandy clay loam that becomes light brown with depth. Below this, to a depth of 80 inches, is strong brown sandy clay loam.

Included with this soil in mapping are small areas of Dallam, Spurlock, and Sunray soils.

This Perico soil is used for range and crops. Dry cropland areas are in wheat and grain sorghum. Irrigated areas are in alfalfa, wheat, grain sorghum, improved pasture, and corn.

Practices that conserve soil moisture and control soil blowing are needed in managing this soil. Minimum tillage and stubble mulching leave residues on the soil surface and thus reduce soil blowing. Terracing and contour farming help to reduce runoff and enable water to soak into the soil. Properly designed irrigation systems are needed to prevent soil and water losses. Capability unit IIIe-5 dryland and IIIe-2 irrigated; Mixedland Slopes range site.

PeC—Perico fine sandy loam, 3 to 5 percent slopes. This gently sloping soil is on ridges and breaks along drains in the 'High Plains' parts of the county. Areas are mainly long and narrow and average about 80 acres in size.

The surface layer is reddish brown fine sandy loam about 6 inches thick. The next layer is yellowish red sandy clay loam 24 inches thick. Below this, to a depth of 80 inches, is pink sandy clay loam.

Included with this soil in mapping are small areas of Berda, Dallam, Spurlock, and Sunray soils.

This Perico soil is used mostly for range. A few small areas within larger fields are cultivated.

The main concern of management is the control of erosion. Crop residue left on the surface helps to control soil blowing. Diversions, terraces, and grassed waterways help to control water erosion. Irrigated areas need an irrigation system that is designed to assist in the control of soil and water losses. Capability unit IVe-3 dryland and IVe-2 irrigated; Mixedland Slopes range site.

Potter Series

The Potter series consists of very shallow, well drained, gently sloping to very steep soils on uplands and breaks (fig. 11). These soils formed in caliche beds. Soil areas are mainly very narrow and are on the edge of escarpments.

In a representative profile the surface layer is brown loam about 8 inches thick. The underlying material, to a depth of 60 inches or more, is white, weakly to strongly cemented caliche material.

Permeability is moderate in these soils. Runoff is medium to rapid. The available water capacity is very low.

All areas of the Potter soils are in range. These soils are not suited to crops.

Representative profile of Potter soils, 3 to 15 percent slopes, 2.5 miles west of Channing, from intersection of Farm Road 767 and Farm Road 2357; 1.75 miles east on Farm Road 767; 50 feet south of road:

A1—0 to 8 inches, brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak coarse prismatic structure; soft,

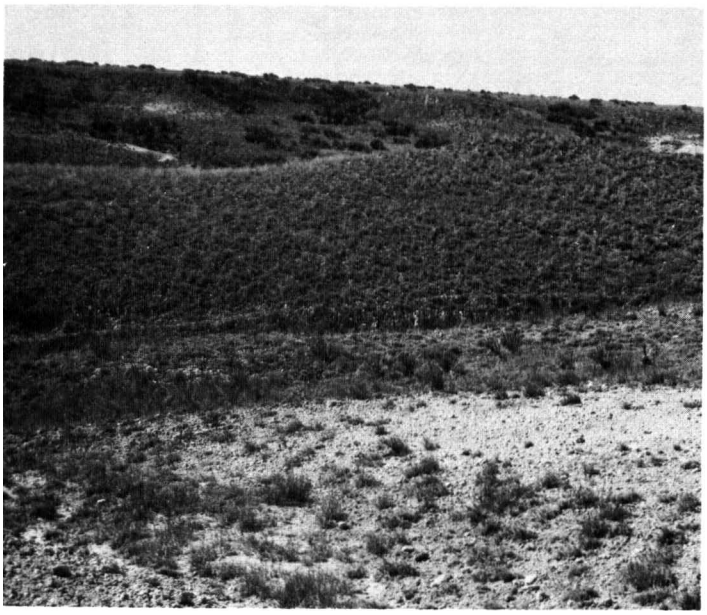

Figure 11.—Landscape of Potter soils, 3 to 15 percent slopes.

very friable; many fine roots; many calcium carbonate concretions; calcareous, moderately alkaline; clear smooth boundary.

C1ca—8 to 14 inches, white (10YR 8/2) caliche, light gray (10YR 7/2) moist; caliche consists of weakly to strongly cemented fragments; an estimated 75 percent calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

C2ca—14 to 60 inches, white (10YR 8/2) caliche, an estimated 90 percent calcium carbonate as soft masses and concretions.

The A horizon ranges from 6 to 10 inches in thickness. It is dark yellowish brown and brown sandy clay loam, loam, or clay loam. The C horizon is caliche that is powder and coarse fragments.

PoE—Potter soils, 3 to 15 percent slopes. These gently sloping and strongly sloping soils are on upland breaks and ridges. The mapped areas are mainly 300 to 800 feet wide. They follow the edges of escarpments.

The profile described as representative for the series is in an area of these soils.

The other soils in this unit are similar to the one described as representative for the series.

The texture of the surface layer varies. Texture includes sandy clay loam, clay loam, and loam.

Included with these soils in mapping are small areas of Berda, Spurlock, and Veal soils.

These soils are not suited to crops. All areas are in range. Capability unit VIIs-1 dryland; Very Shallow range site.

Rickmore Series

The Rickmore series consists of deep, nearly level to gently sloping soils on uplands. These soils formed in loamy eolian material.

In a representative profile the surface layer is brown fine sandy loam about 8 inches thick. The next layer, 8 inches thick, is brown sandy clay loam. The next lower layer, 32 inches thick, is brown clay loam. Below this, to a depth of 85 inches, is yellowish red and reddish yellow sandy clay loam.

Rickmore soils are well drained. Runoff is slow. Permeability is moderately slow, and the available water capacity is high. Soil blowing is a severe hazard.

Rickmore soils are suited to crops. Most areas are in range, but some areas are cultivated.

Representative profile of Rickmore fine sandy loam, 0 to 1 percent slopes, 3.75 miles west of Dalhart, from intersection of Farm Road 694 and U.S. Highway 54; 3.25 miles west on Farm Road 694; 1 mile north on county road; 0.4 mile east and 100 feet north:

A1—0 to 8 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine granular and subangular blocky structure; slightly hard, friable; noncalcareous, neutral; gradual smooth boundary.

B21t—8 to 16 inches, brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; few patchy clay films; noncalcareous, neutral; gradual smooth boundary.

B22t—16 to 28 inches, brown (7.5YR 4.2) clay loam, dark brown (7.5YR 3/2)) moist; strong medium blocky and subangular blocky structure; extremely hard, friable; many clay films; noncalcareous, mildly alkaline; clear smooth boundary.

B23t—28 to 38 inches, brown (7.5YR 4/4) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; extremely hard, firm; many clay films; calcareous, moderately alkaline; gradual smooth boundary.

B24t—38 to 48 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; extremely hard, friable; few patchy clay films, calcareous, moderately alkaline; gradual smooth boundary.

B25t—48 to 70 inches, yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6)) moist; moderate medium and fine subangular blocky structure; hard, friable; few films and threads of calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

B26tca—70 to 85 inches, reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak medium and fine subangular blocky structure; hard, friable; about 15 percent calcium carbonate; calcareous, moderately alkaline.

Depth to calcareous material ranges from 20 to 50 inches. The A horizon is fine sandy loam or loamy fine sand 8 to 14 inches thick. It is brown, yellowish brown, or dark yellowish brown. The B21t horizon is sandy clay loam that is 25 to 35 percent clay. The lower Bt horizons are yellowish red or reddish yellow clay loam that is 35 to 40 percent clay and 10 to 40 percent calcium carbonate.

RcB—Rickmore loamy fine sand, 0 to 3 percent slopes. This gently sloping and undulating soil occupies sandy uplands. Areas are irregular in shape and average 200 acres in size.

The surface layer is brown loamy fine sand about 8 inches thick. The next layer, 10 inches thick, is dark brown sandy clay loam. The next lower layer, 32 inches thick, is dark brown clay loam. The lower layer, to a depth of 80 inches, is yellowish red clay loam.

Included with this soil in mapping are small areas of Dallam soils and Rickmore fine sandy loam.

This Rickmore soil is mostly in range. A few areas are farmed. The soil is suited to crops.

The main concern of management is soil blowing. Crop residue left on the soil surface helps to control this; but if there is not enough residue to provide this control, chiseling or listing can be used. Irrigated lands need irrigation systems designed to assist in controlling soil and water losses. Capability unit IVe-1 dryland and IIIe-3 irrigated; Loamy Sand range site.

RkA—Rickmore fine sandy loam, 0 to 1 percent slopes. This nearly level soil occupies somewhat depressional uplands. Areas are 20 to 500 acres in size and are irregular in shape. The soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Dallam, Gruver, and Sunray soils.

This Rickmore soil is used for range and crops. Principal dryland crops are wheat and grain sorghum. Irrigated crops are wheat, grain sorghum, corn, and pasture plants.

The main concern of management is the control of soil blowing. Crop residue left on the surface helps to maintain tilth and control soil blowing. Irrigated lands need an irrigation system designed to assist in controlling soil and water losses. Additions of fertilizer are necessary on irrigated soils. Parallel terraces help to conserve soil moisture in dryfarmed areas. Capability unit IIIe-1 dryland and IIe-3 irrigated; Sandy Loam range site.

San Jon Series

The San Jon series consists of moderately deep, well drained, gently sloping soils on uplands. These soils formed in loamy or clayey red beds.

In a representative profile the surface layer is reddish brown clay loam about 6 inches thick. The next layer, 14 inches thick, is reddish brown clay loam. The next lower layer is red clay loam about 12 inches thick. The underlying material, to a depth of 60 inches or more, is slightly altered red beds of red clay loam.

Permeability is moderately slow in these soils, and runoff is medium to rapid. The available water capacity is medium. Soil blowing is a moderate hazard.

San Jon soils are suited to cultivation if they are irrigated. All areas are in range. Mesquite is invading many areas of rangeland (fig. 12).

Representative profile of San Jon clay loam, 1 to 3 percent slopes, 26 miles west of Channing, from intersection of Farm Road 767 and U.S. Highway 54; 10 miles east on Farm Road 767; 100 feet south of road:

A1—0 to 6 inches, reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, friable; common wormcasts; calcareous, moderately alkaline; gradual smooth boundary.

B21—6 to 20 inches, reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; weak coarse prismatic structure that parts to weak coarse subangular blocky; slightly hard, friable; many wormcasts; calcareous, moderately alkaline; gradual smooth boundary.

B22ca—20 to 32 inches, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable; many wormcasts; an estimated 15 percent calcium carbonate as films, threads, and concretions; calcareous, moderately alkaline, gradual smooth boundary.

C—32 to 60 inches, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; structureless (massive); slightly hard, friable; calcareous, moderately alkaline. [This horizon is slightly altered red beds.]

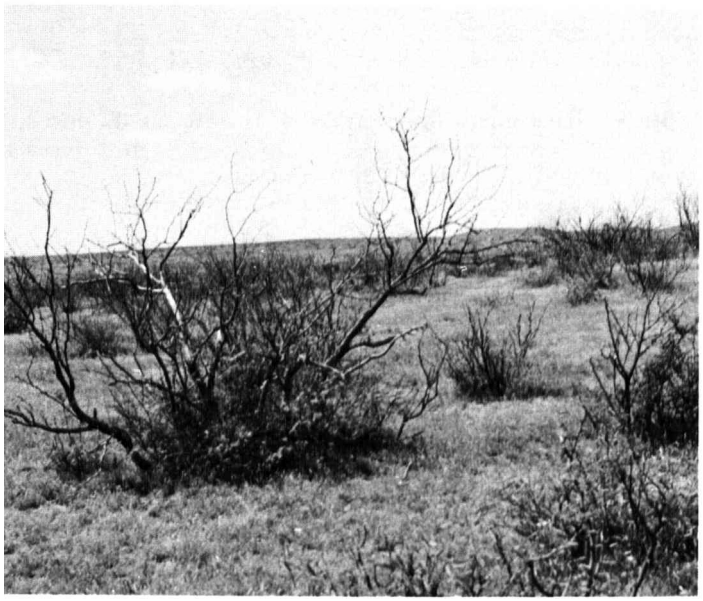

Figure 12.—**Mesquite infested rangeland. The soil is San Jon clay loam, 1 to 3 percent slopes.**

The A horizon is reddish brown, red, yellowish red, or brown. The B2 horizon is sandy clay loam, silty clay loam, or clay loam. Colors are yellowish red, reddish brown, reddish yellow, or red. The B22ca horizon is 5 to 30 percent calcium carbonate.

SaB—San Jon clay loam, 1 to 3 percent slopes. This gently sloping soil occupies uplands in the rolling plains of the county. Areas are irregular in shape and average about 200 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Berda, Dumas, Glenrio, and Sunray soils. All areas of this soil are in range. The soil is suited to irrigated crops. If the soil were cultivated, crop residues left on the surface would help to control soil blowing. An irrigation system that will control soil and water losses is needed. Capability unit VIe-5 dryland and IIIe-1 irrigated; Clay Loam range site.

SgD—San Jon-Glenrio complex, 3 to 8 percent slopes. This gently sloping to sloping complex is on uplands in the rolling plains part of the county. Soil areas are irregular in shape and average about 400 acres in size. The soils of this complex are in a pattern, but they are so intricately mixed or the areas are so small in size that they cannot be shown separately at the scale mapped.

The gently sloping San Jon soils make up about 55 percent of the unit. The more sloping Glenrio soils occur as knolls and make up about 30 percent of the areas mapped.

Included with these soils in mapping are small areas of Berda and Knoco soils.

San Jon soils have a reddish brown clay loam surface layer about 6 inches thick. The next layer, 20 inches thick, is reddish brown clay loam. The lower layer, to a depth of 60 inches, is red beds of red shale and clay.

Glenrio soils have a surface layer of red clay or clay loam about 4 inches thick. The next layer, to a depth of 12 inches, is red clay that contains thin streaks of blue shale. The underlying material, to a depth of 60 inches, is red and blue shaly clay.

This unit is not suited to cultivation. All areas are in range. Capability unit VIe-5 dryland; San Jon part in Clay Loam range site, Glenrio part in Shallow Clay range site.

Sherm Series

The Sherm series consists of deep, well drained, nearly level soils on uplands. These soils formed in clayey and loamy eolian material.

In a representative profile the surface layer is brown clay loam about 6 inches thick. The next layer, 30 inches thick, is brown clay. The next lower layer, 9 inches thick, is brown clay loam. The next lower layer, 27 inches thick, is yellowish red clay loam. This is underlain, to a depth of 90 inches, by reddish yellow clay loam.

These soils are very slowly permeable. Runoff is slow, and the available water capacity is high. The hazard of soil blowing is moderate.

Sherm soils are well suited to crops. Most cropland is irrigated. A few areas are in range.

Representative profile of Sherm clay loam, 0 to 1 percent slopes, 1 mile south and 4.5 miles east of Dalhart, from intersection of Farm Road 281 and U.S. Highway 87; 4.5 miles east on Farm 281; 100 feet south of road:

A1—0 to 6 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky and granular structure; slightly hard, friable; noncalcareous, neutral; abrupt smooth boundary.

B21t—6 to 18 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; strong medium blocky structure; hard, friable; continuous clay films on ped surfaces; noncalcareous, mildly alkaline; gradual smooth boundary.

B22t—18 to 36 inches, brown (7.5YR 5/4) clay, brown (7.5YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; many clay films: calcareous, moderately alkaline; gradual smooth boundary.

B23t—36 to 45 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, firm; few patchy clay films; calcareous, moderately alkaline; gradual smooth boundary.

B24t—45 to 55 inches, yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; hard, firm; few patchy clay films; calcareous, moderately alkaline; gradual smooth boundary.

B25tca—55 to 72 inches, yellowish red (5YR 5/8) clay loam, yellowish red (5YR 4/8) moist; weak medium subangular blocky structure; hard, friable; few patchy clay films; about 15 percent calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

B26t—72 to 90 inches, reddish yellow (5YR 6/8) clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; hard, friable; few clay films; calcareous, moderately alkaline.

The solum is more than 80 inches thick. Depth to secondary carbonates ranges from 15 to 28 inches. Depth to prominent layers of calcium carbonate ranges from 30 to 60 inches.

The A horizon is brown, dark brown, dark grayish brown, or grayish brown clay loam. It ranges from 4 to 10 inches in thickness. The upper part of the B2t horizon is brown, dark brown, grayish brown, or dark grayish brown. It is 40 to 55 percent clay. The lower part of the B2t horizon is brown, reddish brown, yellowish red, or reddish yellow. Texture of the lower part of the B2t horizon is clay, silty clay, silty clay loam, or clay loam. The B2tca horizon is 15 to 50 percent calcium carbonate.

ShA—Sherm clay loam, 0 to 1 percent slopes. This nearly level soil occupies smooth uplands. Slopes average less than 0.5 percent. Most of the soil is in broad continuous areas that are marked by playas and areas of other soils. Most areas are more than 500 acres in size and irregular in shape.

Included with this soil in mapping are small areas of Conlen, Gruver, Rickmore, and Sunray soils.

This Sherm soil has a moderate soil blowing hazard, but it is well suited to crops. The slow water intake rate and broad nearly level areas of the soil make it suitable for long irrigation runs. This soil is used for range and for dry and irrigated crops. Principal crops are wheat and grain sorghum, but some areas are in corn, alfalfa, and sugar beets (fig. 13).

Good management practices are needed to control soil blowing, conserve moisture, and maintain good soil tilth. Crop residue left on or near the surface helps to control soil blowing and maintain tilth. Where the soil is irrigated, fertilizers and high residue crops help to keep the soil in good condition. Good irrigation systems, properly used, conserve water and control erosion. Parallel terraces help to conserve moisture and control erosion in dryfarmed areas. Grassed waterways are needed in places for safe removal of excess water following high intensity rains. Where crop residues are inadequate to control soil blowing, chiseling and listing are effective measures. Cover crops also help to control soil blowing. Capability unit IIIe-4 dryland and IIs-1 irrigated; Clay Loam range site.

Spur Series

The Spur series consists of deep, well drained, nearly level soils on bottom land. These soils formed in loamy alluvium.

In a representative profile the surface layer is dark brown and brown loam about 19 inches thick. The underlying material, to a depth of 60 inches or more, is light brown loam that has thin strata of material of other textures and colors.

These soils are moderately permeable. Runoff is slow, and the available water capacity is high. Flooding is rare to occasional and of short duration. The hazard of soil blowing is moderate.

Spur soils are well suited to crops. Most areas are in range. A few areas are cultivated.

Representative profile of Spur loam, 6 miles west and 1 mile north of Channing, from intersection of Farm Road 767 and Farm Road 2357; 1.5 miles west on Farm Road 767; 2.8 miles west on county road; 100 feet north of road:

A11—0 to 12 inches, dark brown (10YR 3/3) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable;

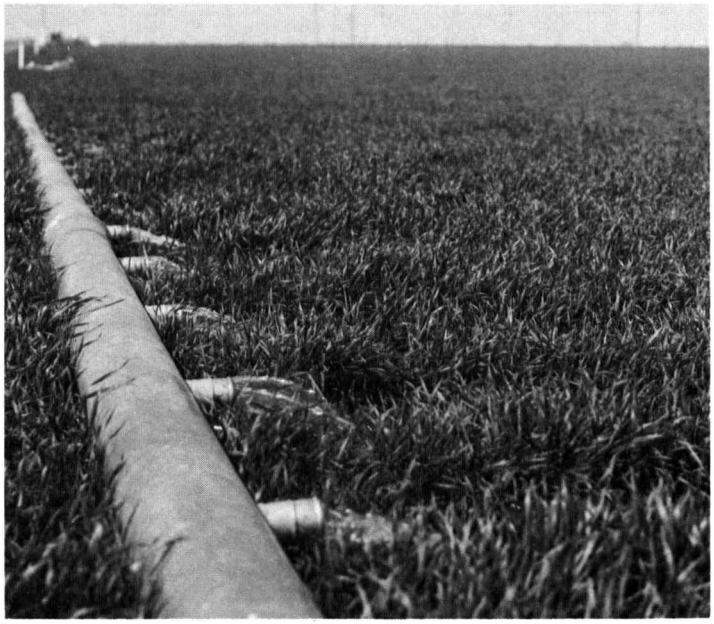

Figure 13.—**Irrigating hard red winter wheat on Sherm clay loam, 0 to 1 percent slopes.**

many roots; few wormcasts; calcareous, moderately alkaline; gradual smooth boundary.

A12—12 to 19 inches, brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable; many roots; few wormcasts; calcareous, moderately alkaline; gradual smooth boundary.

C—19 to 60 inches, light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; structureless (massive); hard, friable; few wormcasts; thin strata of fine sandy loam and clay loam that vary in color; calcareous, moderately alkaline.

Spur soils are calcareous throughout. The A horizon is 11 to 19 inches thick. Colors are dark brown, brown, or dark grayish brown. The C horizon is light brown, brown, or reddish brown loam, sandy clay loam, or clay loam. Faint to distinct lenses and thin layers of fine sandy loam and loamy fine sand are common in this horizon.

Sm—Spur loam. This nearly level soil occupies bottom land along creeks and streams. Flooding is frequent but of short duration. The areas are long and narrow in shape and range from 15 to 200 acres in size. They parallel stream channels. Slopes are less than 1 percent.

Included with this soil in mapping are small areas of Bippus, Gracemore, Guadalupe, and Lincoln soils.

Most of this soil is in range. A few areas are in crops. The soil is well suited to grain sorghum, grazing sorghum, wheat, and improved pasture.

The main concerns of management are the maintenance of tilth, control of soil blowing, and control of water erosion. Crop residue left on the surface helps to maintain the tilth and control soil blowing. Irrigated lands need an irrigation system that is designed to assist in controlling soil and water losses. Capability unit IIe-1 dryland and IIe-1 irrigated; Draw range site.

Spurlock Series

The Spurlock series consists of deep, well drained, nearly level to gently sloping soils on uplands. These soils formed in calcareous loamy material.

In a representative profile the surface layer is dark yellowish brown fine sandy loam about 10 inches thick. The next layer, 6 inches thick, is brown sandy clay loam. The next lower layer is pink clay loam about 38 inches thick. This is underlain, to a depth of 88 inches, by reddish yellow clay loam.

These soils are moderately permeable. Runoff is slow to medium. The available water capacity is medium. The hazard of soil blowing is severe.

The less sloping Spurlock soils are suited to crops. Most areas are in range, but a few areas are cultivated.

Representative profile of Spurlock fine sandy loam, 0 to 3 percent slopes, 6.5 miles northeast of Channing, from intersection of U.S. Highway 385 and Farm Road 722; 0.8 mile east on Farm Road 722; 100 feet north of road:

A1—0 to 10 inches, dark yellowish brown (10YR 4/4) fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many roots; calcareous, moderately alkaline; gradual smooth boundary.

B21—10 to 16 inches, brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 3/4) moist; weak coarse prismatic structure that parts to weak fine subangular blocky; hard, friable; many roots; calcareous, moderately alkaline; clear smooth boundary.

B22ca—16 to 36 inches, pink (7.5YR 8/4) clay loam, pink (7.5YR 7/4) moist; weak fine and medium subangular blocky structure; hard, firm; about 50 percent calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

B23ca—36 to 54 inches, pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; weak fine and medium subangular blocky structure; hard, friable; about 60 percent calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

B24tca—54 to 88 inches, reddish yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; weak fine and medium subangular blocky structure; about 40 percent calcium carbonate; calcareous, moderately alkaline.

The solum is more than 60 inches thick. The A horizon is dark yellowish brown, reddish brown, dark brown, brown, or yellowish brown. It ranges from 6 to 13 inches in thickness.

The B21 horizon is sandy clay loam or clay loam. Depth to the ca horizon ranges from 11 to 19 inches. In the zone of maximum accumulation the material is 40 to 60 percent calcium carbonate. The Bt horizons below the horizons of maximum carbonate accumulation are reddish yellow and yellowish red clay loam or sandy clay loam.

SpB—Spurlock fine sandy loam, 0 to 3 percent slopes. This nearly level to gently sloping soil occupies upland plains in all parts of the county. Areas are irregular in shape and 15 to 400 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Conlen, Dallam, Mobeetie, Perico, Potter, and Veal soils.

Most areas of this Spurlock soil are in range. This soil is not well suited to crops because of high lime content and a severe hazard of soil blowing. Grain sorghum yields are low because plants in these limy soils develop chlorosis.

The main concern of management is the control of soil blowing. Crop residue left on the surface helps to control soil blowing. Terraces help to conserve moisture and control water erosion. Irrigated lands need an irrigation system that is designed to assist in controlling soil and water losses. Capability unit IVe-2 dryland and IIIe-4 irrigated; Mixedland Slopes range site.

SpC—Spurlock fine sandy loam, 3 to 5 percent slopes. This gently sloping soil occupies upland ridges in all parts of the county. Areas are long and narrow and average about 150 acres in size.

The surface layer is brown fine sandy loam about 8 inches thick. The next layer is brown sandy clay loam about 10 inches thick. Below this, to a depth of 50 inches, is pink, soft, powdery lime. The lower layers are reddish yellow sandy clay loam.

Included with this soil in mapping are small areas of Berda, Dallam, Mobeetie, Perico, Potter, and Veal soils.

All areas of this soil are in range. The soil is not well suited to crops.

The main concern of management is the control of water erosion and soil blowing. Crop residue left on the soil surface helps to control soil blowing. Diversions, terraces, and grassed waterways help to control water erosion. Irrigated lands need an irrigation system that is designed to control soil and water losses. Capability unit IVe-4 dryland and IVe-3 irrigated; Mixedland Slopes range site.

SrB—Spurlock soils, undulating. These undulating, eroded soils are on gently sloping and hummocky uplands. Soil areas are mainly rectangular, are the shape of the area that was cultivated, or they are circular areas around windmills. Slopes are 1 to 3 percent.

In a representative area the surface layer has been reworked or removed by wind. The areas are windblown caliche flats that have slight accumulations around clumps of vegetation.

The original surface layer has been removed by soil blowing, and the exposed surface layer is pink, calcareous sandy clay loam about 8 inches thick. It is about 30 percent calcium carbonate. The next layer is reddish yellow, calcareous sandy clay loam that is about 40 percent calcium carbonate. It extends to a depth of 60 inches.

Included with these soils in mapping are small areas of Dallam, Perico, and Vingo soils.

All areas of these soils are in range. If leveled and plowed, these soils are poorly suited to crops. Under these conditions grain sorghum, for example, would develop chlorosis because of the high level of carbonates. Wheat and pasture can be produced.

The main concern of management is soil blowing. Crop residue properly managed helps to control soil blowing. Irrigated lands need designed irrigation systems that will assist in controlling soil and water losses. Capability unit IVe-2 dryland and IIIe-4 irrigated; Mixedland Slopes range site.

Sunray Series

The Sunray series consists of deep, well drained, nearly level to gently sloping soils in the smooth plains areas of the county. These soils formed in calcareous loamy material.

In a representative profile the upper 18 inches is dark grayish brown clay loam. The next layer, 12 inches thick, is pale brown clay loam. The next lower layer is pink clay loam about 13 inches thick. This is underlain, to a depth of 85 inches, by reddish yellow clay loam.

Permeability is moderate in these soils, and runoff is slow to medium. The available water capacity is high. The hazard of soil blowing is moderate.

Sunray soils are well suited to crops. The soil is farmed and is used for range.

Representative profile of Sunray clay loam, 0 to 1 percent slopes, 1.5 miles west of Exum, from intersection of Farm Roads 281 and 2577; 4.5 miles east on Farm Road 281 and 100 feet south of road:

Ap—0 to 8 inches, dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium to fine granular structure; slightly hard, friable; calcareous, moderately alkaline; clear smooth boundary.

B21t—8 to 18 inches, dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; coarse prismatic structure that parts to moderate medium granular and subangular blocky; slightly hard, friable; few thin patchy clay films on ped surfaces; calcareous, moderately alkaline; gradual smooth boundary.

B22t—18 to 30 inches, pale brown (10YR 6/3) clay loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable; few thin patchy clay films on ped surfaces; calcareous, moderately alkaline; gradual wavy boundary.

B23tca—30 to 43 inches, pink (7.5YR 8/4) clay loam, pink (7.5YR 7/4) moist; weak fine subangular blocky structure; slightly hard, friable; 40 percent calcium carbonate in soft powdery form; calcareous, moderately alkaline; gradual smooth boundary.

B24tca—43 to 52 inches, reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; weak fine and medium subangular blocky structure; slightly hard, friable; about 25 percent calcium carbonate in films, threads, and soft masses; calcareous, moderate alkaline; gradual smooth boundary.

B25tca—52 to 85 inches, reddish yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) moist; weak fine and medium subangular blocky structure; slightly hard, friable; about 50 percent calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 6 to 14 inches in thickness. The A and B21t horizons are dark brown, dark grayish brown, very dark grayish brown, or very dark brown. These dark colors extend to a depth ranging from 11 to 19 inches.

The upper part of the B2t horizon is clay loam or sandy clay loam and is about 10 percent calcium carbonate. The B2tca horizon is sandy clay loam or clay loam. Colors are pink, pinkish white, yellowish red, reddish yellow, yellowish brown, or brownish yellow. The material is 25 to 70 percent calcium carbonate.

SuA—Sunray clay loam, 0 to 1 percent slopes. This nearly level soil occupies smooth upland plains. The mapped areas are 20 to 400 acres in size. The soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Conlen, Dallam, Dumas, Gruver, and Sherm soils.

This Sunray soil is used for crops and range. Dry cropland areas are in grain sorghum and wheat. Grain sorghum, corn, alfalfa, and wheat are grown in irrigated areas (fig. 14).

The main concern of management is the control of soil blowing. Crop residue left on the soil surface helps to reduce soil blowing. If the crop grown does not leave enough residue to control soil blowing, chiseling and listing are effective emergency measures. Irrigated lands need an irrigation system that is designed to as-

Figure 14.—**Stocker cattle grazing irrigated wheat on Sunray clay loam, 0 to 1 percent slopes.**

sist in controlling soil and water losses. Dry farmed areas benefit from parallel terrace systems that help to conserve moisture. Capability unit IIIe-3 dryland and IIe-2 irrigated; Clay Loam range site.

SuB—Sunray clay loam, 1 to 3 percent slopes. This gently sloping soil occupies uplands mainly surrounding playa lakes. Areas are long and narrow and range from 10 to 300 acres in size.

The surface layer is very dark grayish brown clay loam about 11 inches thick. The next layer, 7 inches thick, is dark brown clay loam. The next lower layer, 8 inches thick, is brown clay loam. The next layer, 15 inches thick, is a pinkish white clay loam. The underlying material, to a depth of 80 inches, is reddish yellow sandy clay loam.

Included with this soil in mapping are small areas of Conlen, Dumas, and Gruver soils.

This soil is used for crops and range. Cropped areas are in grain sorghum and wheat.

The main concerns of management are the control of water erosion and soil blowing. Crop residue left on the soil surface helps to reduce soil blowing. Terraces, diversions, and grassed waterways help to control washing and aid in conserving soil moisture. Irrigated lands need an irrigation system that is designed to control soil and water losses. Capability unit IIIe-6 dryland and IIIe-1 irrigated; Clay Loam range site.

Tascosa Series

The Tascosa series consists of shallow, well drained, gently sloping to moderately steep, gravelly soils on uplands in the southern parts of the county. These soils formed in gravelly outwash material.

In a representative profile the surface layer is brown gravelly loam about 6 inches thick. The next layer, about 12 inches thick, is brown, calcareous, very gravelly loam. The next lower layer, about 32 inches thick, is pink, calcareous, gravelly sandy loam that is about 30 percent calcium carbonate. The next layer, to a depth of 80 inches or more, is light brown gravelly sandy loam that is about 40 percent by volume quartz gravel.

Permeability is moderate in these soils, and runoff is rapid. The available water capacity is low.

All areas of Tascosa soils are in range. These soils are not suited to crops.

Representative profile of Tascosa gravelly loam, 3 to 15 percent slopes, 13 miles west and 4.5 miles south of Channing, from intersection of Farm Roads 767 and 2357; 9 miles west on Farm Road 767; 4.5 miles south on ranch road; ½ mile west on ridge:

A1—0 to 6 inches, brown (7.5YR 4/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; 40 percent quartzite pebbles 5 to 20 millimeters in diameter; calcareous, moderately alkaline; gradual smooth boundary.

B2—6 to 18 inches, brown (7.5YR 4/2) very gravelly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; 60 percent quartzite pebbles 5 to 20 millimeters in diameter; calcareous, moderately alkaline; clear wavy boundary.

Cca—18 to 50 inches, pink (7.5YR 8/4) gravelly sandy loam, pink (7.5YR 7/4) moist; structureless (massive); hard, friable; 50 percent quartzite pebbles 5 to 20 millimeters in diameter; 30 percent carbonate; calcareous, moderately alkaline; gradual smooth boundary.

C—50 to 80 inches, light brown (7.5YR 6/4) gravelly sandy loam, brown (7.5YR 5/4) moist; structureless (massive); hard, loose; 40 percent quartzite pebbles 5 to 20 millimeters in diameter; calcareous, moderately alkaline.

Thickness of the solum (to the Cca horizon) ranges from 12 to 20 inches. Gravelly loam, gravelly sandy loam, very gravelly loam, or very gravelly sandy loam are between depths of 10 and 40 inches. Quartzite pebbles make up 35 to 80 percent of this section.

The A horizon is brown, grayish brown, or dark grayish brown. The B2 horizon is brown, light brown, or grayish brown. The Cca horizon is pink, reddish yellow, or very pale brown. It is 5 to 30 percent calcium carbonate.

TaE—Tascosa gravelly loam, 3 to 15 percent slopes. This gently sloping to moderately steep soil occupies gravelly hills in the southern part of the county. Areas average about 200 acres in size.

Included with this soil in mapping are small areas of Berda, Conlen, and Veal soils.

All areas of this Tascosa soil are in range. This soil is not suited to crops. It has high potential as a source of gravel for construction material. Capability unit VIs-1 dryland; Gravelly range site.

Valentine Series

The Valentine series consists of deep, excessively drained, undulating and duned, neutral soils on uplands. These soils formed in eolian sands.

In a representative profile the surface layer is light yellowish brown fine sand 6 inches thick. The next layer, to a depth of 60 inches or more, is reddish yellow fine sand.

Permeability is rapid in these soils, and runoff is very slow. The available water capacity is low. The hazard of soil blowing is severe.

All areas of the Valentine soils are range. These soils are not suited to crops.

Representative profile of Valentine fine sand, 2.5 miles northeast of Romero, from intersection of Farm Road 767 and U.S. Highway 54; 1.8 miles northwest on U.S. Highway 54; 100 feet east of road:

A1—0 to 6 inches, light yellowish brown (10YR 6/4) fine sand, brown (10YR 5/3) moist; weak fine granular structure and structureless (single grained); loose, very friable; noncalcareous; neutral; gradual smooth boundary.

C—6 to 60 inches, reddish yellow (7.5YR 6/8) fine sand, strong brown (7.5YR 5/8) moist; structureless (single grained); loose, very friable; noncalcareous, neutral.

The A horizon ranges from 4 to 8 inches in thickness. It is dark brown, light brown, light yellowish brown, brown, or yellowish brown.

The C horizon is reddish yellow, yellowish red, brown, or yellowish brown.

Va—Valentine fine sand. This undulating and duned soil occupies sandy areas along creeks and in the western parts of the county. The topography consists of hummocks and dunes that rise 3 to 30 feet above the surrounding country. The side slopes of the dunes and hummocks have gradients of 3 to about 15 percent. The areas are 20 to more than 1,000 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Likes and Vingo soils.

This Valentine soil is entirely in range. It is not suited to cultivation. Capability unit VIIe-2 dryland; Sand Hills range site.

VcE—Valentine-Spurlock complex, hummocky. This hummocky unit consists of alternating billowy, deep sands and bare areas where the soil is severely eroded. Mapped areas of this unit are blown out and duned and range from 15 to more than 300 acres in size. The soils are in a pattern, but they are so intricately mixed or areas are so small that the soils cannot be shown separately at the scale mapped.

The Valentine fine sand occurs as billowy, wind deposited, partly stabilized dunes. The dunes are 20 to 30 feet higher than the areas of Spurlock soils. They have a general southwest to northeast direction and make up about 60 percent of the mapped area.

A representative profile of Valentine fine sand is reddish yellow fine sand more than 60 inches thick.

The Spurlock soils are bare and severely eroded. They have many caliche pebbles on their surface. Winds have removed all of the surface layer and exposed the layers of soft powdery lime.

A representative profile of Spurlock soils is yellowish red sandy clay loam more than 60 inches thick.

Included with this unit in mapping are areas of Dallam, Perico, and Vingo soils that are severely eroded.

All areas of this complex are in range. The soils are not suited to crops. Vegetation is sparse and reseeding has not been successful because of low moisture content and low fertility (fig. 15). Capability unit VIIe-2 dryland; Sand Hills range site.

Veal Series

The Veal series consists of deep, well drained, undulating soils on uplands. These soils are on ridges and knolls. They formed in calcareous loamy materials.

In a representative profile the surface layer is brown fine sandy loam about 5 inches thick. The next layer, 11 inches thick, is light brown sandy clay loam. The next lower layer, 9 inches thick, is pinkish white sandy clay loam. Below this, to a depth of 60 inches, is light brown sandy clay loam.

Permeability is moderate in these soils, and runoff is medium. The available water capacity is medium. Soil blowing is a moderate hazard.

All areas of Veal soils are in range. These soils are not suited to crops.

Representative profile of Veal fine sandy loam in an area of Berda-Veal association, undulating, 6 miles south of Dalhart, from intersection of U.S. Highway 87 and Farm Road 281; 3.25 miles south on U.S. Highway 87; 2 miles west of highway:

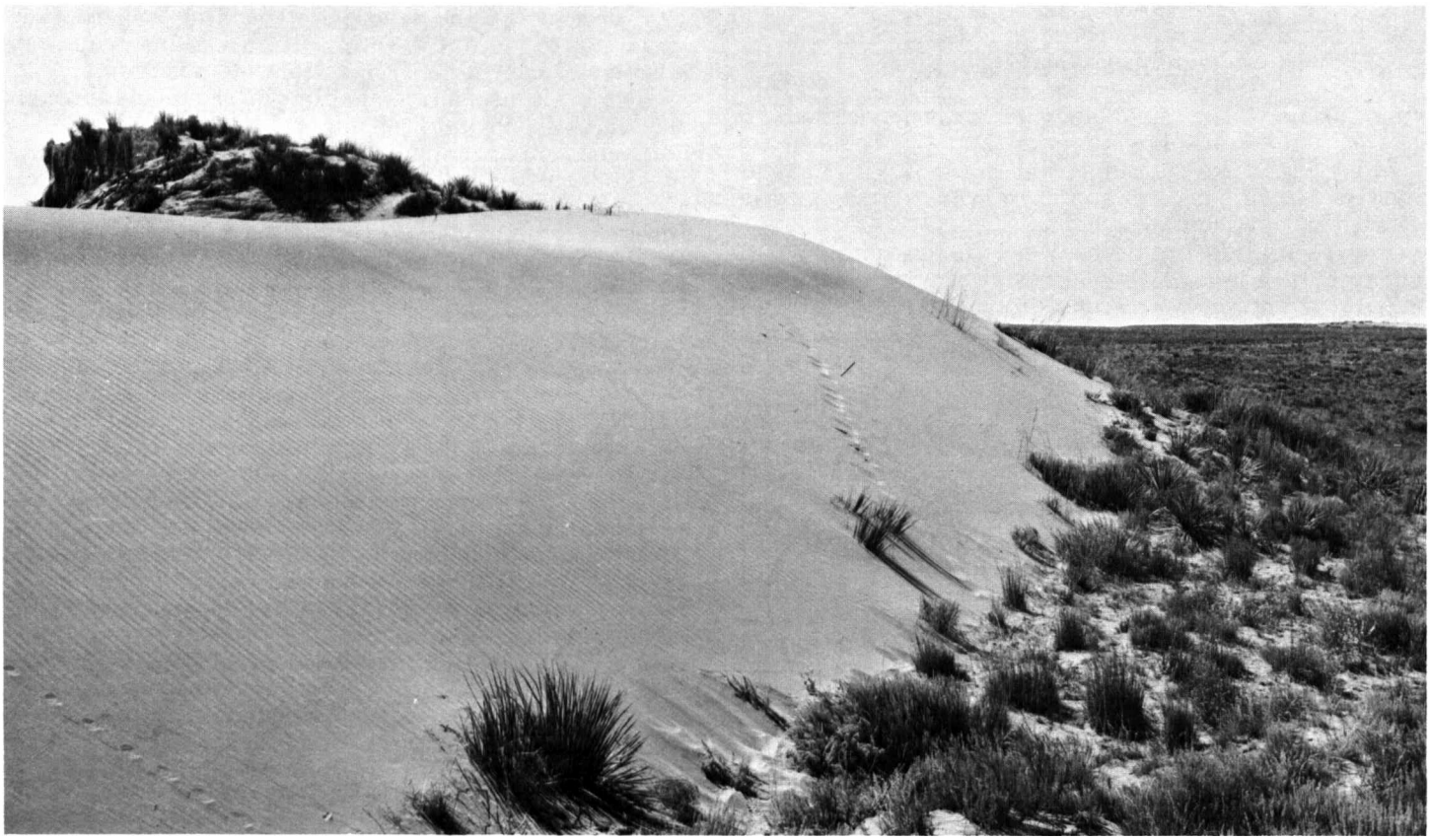

Figure 15.—**Active dune in Valentine-Spurlock complex, hummocky.**

A1—0 to 5 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, friable; calcareous, moderately alkaline; gradual smooth boundary.

B21—5 to 16 inches, light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure; slightly hard, friable; calcareous, moderately alkaline; gradual smooth boundary.

B22ca—16 to 25 inches, pinkish white (7.5YR 8/2) sandy clay loam, pink (7.5YR 7/4) moist; weak subangular blocky structure; slightly hard, friable; about 60 percent calcium carbonate as soft and hard masses; calcareous, moderately alkaline; gradual smooth boundary.

B23ca—25 to 60 inches, light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; slightly hard, friable; about 30 percent calcium carbonate; calcareous, moderately alkaline.

Depth to the B2ca horizon ranges from 12 to 20 inches. The B22ca horizon is an estimated 15 to 60 percent visible calcium carbonate.

The A horizon is brown, light brown, yellowish brown, and reddish brown. The B horizon is sandy clay loam or clay loam.

Veal soils are mapped only with Berda or Mobeetie soils.

Vingo Series

The Vingo series consists of deep, well drained, noncalcareous, undulating sandy soils on uplands. These soils formed in sandy eolian material.

In a representative profile the surface layer is brown loamy fine sand about 16 inches thick. The next layer, 14 inches thick, is strong brown fine sandy loam. The next lower layer, 16 inches thick, is yellowish red fine sandy loam. This is underlain, to a depth of 85 inches, by yellowish red sandy clay loam.

Permeability is moderately rapid in these soils, and runoff is slow. The available water capacity is medium. The hazard of soil blowing is severe.

Most areas are in range, but a few areas are cultivated. Vingo soils are suited to crops if they are irrigated with sprinkler systems.

Representative profile of Vingo loamy fine sand in an area of Vingo-Dallam association, undulating, 16 miles south of Dalhart, from intersection of U.S. Highway 54 and Farm Road 998; 13 miles south on Farm Road 998; 1 mile south and 2.5 miles southwest on ranch road; 50 feet west of road:

A1—0 to 16 inches, brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; noncalcareous, neutral; gradual smooth boundary.

B21t—16 to 30 inches, strong brown (7.5YR 5/6) fine sandy loam, brown (7.5YR 4/4) moist; weak coarse prismatic structure that parts to weak medium subangular blocky; slightly hard, friable; few patchy clay films; noncalcareous, neutral; gradual smooth boundary.

B22t—30 to 46 inches, yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; noncalcareous, mildly alkaline; gradual smooth boundary.

B23t—46 to 85 inches, yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; few patchy clay films; noncalcareous, mildly alkaline.

The A horizon is brown, light brown, grayish brown, light yellowish brown, and yellowish brown. It ranges from 5 to 18 inches in thickness.

The Bt horizon is fine sandy loam in the upper part and fine sandy loam or sandy clay loam in the lower part. The B22t and B23t horizons are calcareous or noncalcareous. Depth to calcareous material ranges from 40 to more than 80 inches. A weak ca horizon is present in some profiles.

VDD—Vingo-Dallam association, undulating. This mapping unit is made up of undulating and hummocky soils in irregularly shaped areas that average about 600 acres in size. Slopes range from 3 to 8 percent.

The landscape is made up of alternating ridges and low areas. The ridges make up about 55 percent of the mapped areas. They are about 10 feet high and have short side slopes. Ridges are about 300 feet from crest to crest. Vingo soils occupy these ridges. The low areas between the ridges make up about 40 percent of the mapped areas. They are occupied by Dallam loamy fine sand. Small areas of Rickmore soils are also included.

These soils could be mapped separately; but because use and management are similar, separation is not justified. The delineations are larger and the composition more variable than most other units in the county. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

The profile for the Vingo soil of this mapping unit is the one described as representative of the Vingo series.

Dallam soils have a surface layer of brown loamy fine sand about 18 inches thick. The next layer, 18 inches thick, is brown sandy clay loam. The lower layer, to a depth of 80 inches, is light reddish brown sandy clay loam.

These soils are better suited to range than to other uses. Because of the severe soil blowing hazard they are not suited to dry farming. High residue crops can be grown if a sprinkler irrigation system is used.

The main concern in managing these soils is the control of soil blowing. Minimum tillage and stubble mulching help to manage crop residues on the soil surface and thus help to control soil blowing. If the crop does not leave enough residue to control soil blowing, chiseling or listing are suitable emergency measures. Capability unit VIe-1 dryland, IVe-1 irrigated; Loamy Sand range site.

Use and Management of the Soils

In this section the land capability classification system used by the Soil Conservation Service is described, and some of the general management practices for crops and for range are explained. Management for individual mapping units is included in the section "Descriptions of the Soils." Predicted yields of the major crops grown on dryland and irrigated soils and use and management of the soils for range are presented in this section. Interpretations of soils to be used for wildlife and recreational purposes are also given. In addition, estimated properties and interpretations of soils for engineering purposes are presented.

Capability Grouping

Some readers, particularly those who farm on a large scale, may find it practical to use and manage alike some of the different kinds of soil on their farms.

These readers can make good use of the capability classification system, a grouping that shows, in a general way, the suitability of soils for most kinds of farming.

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when these soils are farmed, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible, but unlikely, major reclamation projects; and does not apply to horticultural crops or other crops 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 for range or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the class, the subclass, and the unit. The broadest grouping, the capability class, is designated by Roman numerals I through VIII. In class I are the soils that have the fewest limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops or forage. The subclass indicates major kinds of limitations within the classes. Within most of the classes there can be as many as 4 subclasses. The subclasses are indicated 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" means 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" indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils are subject to little or no erosion but have other limitations that confine their use largely to pasture, range, or wildlife.

Subclasses are further divided into groups called capability units. These are groups of soils that are so much alike that they are suited to the same crops and pasture plants, require about the same management, and have generally similar productivity and other response to management. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-4.

The six classes in the capability system and the subclasses and units in Hartley County are described in the list that follows. The unit designation is given in the Guide to Mapping Units.

Class 1. Soils have few limitations that restrict their use. (No Class I soils in Hartley County.)

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

Subclass IIe. Soils subject to moderate erosion unless protected.

Unit IIe-1 Dryland. Deep, moderately permeable, nearly level, calcareous loams and clay loams on flood plains.

Unit IIe-1 Irrigated. Deep, moderately permeable, nearly level, calcareous loams and clay loams on flood plains.

Unit IIe-2 Irrigated. Deep, moderately to slowly permeable, nearly level, neutral to calcareous loams and clay loams on uplands.

Unit IIe-3 Irrigated. Deep, moderately and moderately slowly permeable, nearly level, neutral to calcareous fine sandy loams on uplands.

Unit IIe-4 Irrigated. Deep, moderately rapidly permeable, nearly level, calcareous fine sandy loams on flood plains.

Subclass IIs. Soils moderately limited because of very slow permeability.

Unit IIs-1 Irrigated. Deep, very slowly permeable, nearly level, neutral clay loams on uplands.

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

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Unit IIIe-1 Dryland. Deep, moderately to slowly permeable, nearly level, neutral to calcareous fine sandy loams on uplands.

Unit IIIe-1 Irrigated. Deep, moderately to slowly permeable, gently sloping, neutral to calcareous loams and clay loams on uplands.

Unit IIIe-2 Dryland. Deep, moderately rapidly permeable, nearly level, calcareous fine sandy loams on flood plains.

Unit IIIe-2 Irrigated. Deep, moderately to moderately rapidly permeable, gently sloping, neutral to calcareous fine sandy loams on uplands.

Unit IIIe-3 Dryland. Deep, moderately to slowly permeable, nearly level, neutral to calcareous loams and clay loams on uplands.

Unit IIIe-3 Irrigated. Deep, moderately to moderately slowly permeable, nearly level to gently sloping, neutral to calcareous loamy fine sands on uplands.

Unit IIIe-4 Dryland. Deep, slowly permeable, nearly level, neutral clay loams on uplands.

Unit IIIe-4 Irrigated. Moderately deep and deep, moderately permeable, nearly level to gently sloping, calcareous loams and fine sandy loams on uplands.

Unit IIIe-5 Dryland. Deep, moderately and moderately rapidly permeable, gently sloping, neutral to calcareous fine sandy loams on uplands.

Unit IIIe-5 Irrigated. Deep, moderately per-

meable, gently sloping to sloping, calcareous loams and fine sandy loams on uplands.
Unit IIIe-6 Dryland. Deep, moderately to slowly permeable, gently sloping, neutral to calcareous loams and clay loams on uplands.
Subclass IIIw. Soils severely limited to cultivation because of excess water.
Unit IIIw-1 Dryland. Deep, very slowly permeable, nearly level, calcareous clays on flood plains.
Unit IIIw-1 Irrigated. Deep, very slowly permeable, nearly level, calcareous clays on flood plains.

Class IV. Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.
Unit IVe-1 Dryland. Deep, moderately to moderately slowly permeable, nearly level to gently sloping, neutral to calcareous loamy fine sands on uplands.
Unit IVe-1 Irrigated. Deep, moderately to moderately rapidly permeable, nearly level to gently sloping, neutral loamy fine sands on uplands.
Unit IVe-2 Dryland. Moderately deep, moderately permeable, nearly level to gently sloping, calcareous loams and fine sandy loams on uplands.
Unit IVe-2 Irrigated. Deep, moderately permeable, sloping, neutral to calcareous loams and fine sandy loams on uplands.
Unit IVe-3 Dryland. Deep, moderately and moderately rapidly permeable, sloping, neutral to calcareous loams and fine sandy loams on uplands.
Unit IVe-3 Irrigated. Moderately deep, moderately permeable, sloping, calcareous fine sandy loams on uplands.
Unit IVe-4 Dryland. Deep and moderately deep, moderately permeable, sloping, calcareous loams and fine sandy loams on uplands.
Unit IVe-5 Dryland. Deep, moderately permeable, gently sloping, calcareous loams and fine sandy loams on uplands.

Class V. Soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, or wildlife habitat.
Subclass Vw. Soils too wet for cultivation; drainage or protection from flooding is not feasible.
Unit Vw-1. Deep, rapidly and moderately rapidly permeable, nearly level, calcareous loamy fine sands on flood plains that are frequently flooded.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, or wildlife habitat.
Subclass VIe. Soils severely limited, chiefly by risk of erosion, unless protective cover is maintained.
Unit VIe-1. Deep, moderately rapidly permeable, gently sloping to hummocky, neutral to calcareous loamy fine sands on uplands.
Unit VIe-2. Deep and moderately deep, moderately permeable, strongly sloping, calcareous fine sandy loams on uplands.
Unit VIe-3. Deep, moderately permeable, sloping, calcareous loams on uplands.
Unit VIe-4. Deep and moderately deep, moderately permeable, strongly sloping, calcareous loams on uplands.
Unit VIe-5. Deep and moderately deep, moderately slowly and very slowly permeable, gently sloping to sloping, calcareous loams and clays on uplands.
Subclass VIs. Soils have severe limitations for use as cultivated land, chiefly because of limited soil depths.
Unit VIs-1 Moderately deep, moderately rapidly permeable, sloping, calcareous, loams on uplands.
Subclass VIw. Soils too wet for cultivation or permanent vegetation. Inundated for several weeks annually.
Unit VIw-1. Deep, very slowly permeable, nearly level, neutral clays in playa bottoms.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to range or wildlife food and cover.
Subclass VIIe. Soils very severely limited, chiefly by risk of erosion, unless protective cover is maintained.
Unit VIIe-1. Moderately deep and shallow, moderately permeable, very steep, calcareous loams on escarpments.
Unit VIIe-2. Deep, rapidly permeable, undulating and duned, neutral to calcareous fine sands on uplands.
Subclass VIIs. Soils very severely limited, chiefly by limited soil depths.
Unit VIIs-1. Very shallow and shallow, moderately permeable to very slowly permeable, strongly sloping, calcareous loams and clays on uplands.

Predicted Yields

Table 2 gives predicted yields of the principal crops grown in the county. The predictions are based on estimates made by farmers, soil scientists, and others who have knowledge of yields in the county and on information taken from research data. The predicted yields are average yields per acre good commercial farmers can expect at a level of management that tends to produce the highest economic returns.

The yields are given for both dryland and irrigated soils if the soils are used for both methods of farming. If only one method is practical, yields for only this method of farming are given. Not included in this table are soils that are used only as range or for recreation.

Crops other than those shown in table 2 are grown in the county, but their predicted yields are not in-

TABLE 2.—*Predicted average yields of principal crops on dryland and irrigated arable soils under a high level of management*

[Absence of figure indicates that crop is not generally grown on the soil named]

Soil	Wheat		Grain sorghum		Corn	Alfalfa
	Dryland	Irrigated	Dryland	Irrigated	Irrigated	Irrigated
	Bu per acre	*Bu per acre*	*Lb per acre*	*Lb per acre*	*Bu per acre*	*Tons per acre*
Berda loam, 3 to 5 percent slopes	10	30	1000	3000	50	4.0
Bippus clay loam, 0 to 1 percent slopes	20	60	1500	6250	125	5.0
Bippus clay loam, 1 to 3 percent slopes	15	50	1250	5500	100	5.0
Colorado loam	20	50	1500	6000	100	5.0
Conlen loam, 0 to 3 percent slopes	12	30	900	4500	70	4.0
Dallam fine sandy loam, 0 to 1 percent slopes	15	45	1500	6000	125	4.6
Dallam fine sandy loam, 1 to 3 percent slopes	12	40	1250	5500	100	4.6
Dallam fine sandy loam, 3 to 5 percent slopes	10	30	1000	4000	70	4.0
Dallam loamy fine sand, 0 to 3 percent slopes	10	30	1000	4500	100	5.0
Dumas loam, 0 to 1 percent slopes	16	55	1250	6000	125	4.5
Dumas loam, 1 to 3 percent slopes	14	50	1000	5500	100	4.5
Gruver loam, 0 to 1 percent slopes	16	55	1250	6000	125	4.5
Gruver loam, 1 to 3 percent slopes	14	50	1000	5500	100	4.0
Guadalupe fine sandy loam	15	35	1000	6000	100	5.0
Karde soils, 1 to 3 percent slopes	10	30	600	4000	------	4.0
Karde soils, 3 to 5 percent slopes	10	30	600	4000	------	4.0
Mangum clay	12	35	1000	4000	------	------
Mobeetie fine sandy loam, 1 to 3 percent slopes	15	35	1000	4000	------	4.5
Mobeetie fine sandy loam, 3 to 5 percent slopes	8	30	900	3500	------	3.5
Perico fine sandy loam, 0 to 1 percent slopes	12	35	1250	5250	100	4.0
Perico fine sandy loam, 1 to 3 percent slopes	10	35	1000	4000	90	4.0
Perico fine sandy loam, 3 to 5 percent slopes	8	30	900	3500	80	3.5
Perico loamy fine sand, 0 to 3 percent slopes	10	30	800	3500	90	4.5
Rickmore fine sandy loam, 0 to 1 percent slopes	15	45	1500	6250	125	5.0
Rickmore loamy fine sand, 0 to 3 percent slopes	12	35	1200	5000	125	5.0
San Jon clay loam, 1 to 3 percent slopes	12		900	------	------	------
Sherm clay loam, 0 to 1 percent slopes	15	45	1000	6500	125	4.5
Spur loam	20	60	1500	6000	125	5.4
Spurlock fine sandy loam, 0 to 3 percent slopes	10	35	900	4000	90	4.0
Spurlock fine sandy loam, 3 to 5 percent slopes	8	30	750	3500	------	4.0
Sunray clay loam, 0 to 1 percent slopes	15	50	1250	5500	100	4.5
Sunray clay loam, 1 to 3 percent slopes	14	45	1100	5000	90	4.5
Vingo-Dallam association, undulating	----	30	900	4000	100	4.5

cluded because their acreage is small or reliable data on yields are not available.

The predicted yields given in table 2 can be expected if the following high level management practices are used for dryland and irrigated soils:

Dryland soils—

1. Crop residue is managed in such a way that erosion is effectively controlled and the soil is protected.
2. A cropping sequence that maintains an adequate supply of organic material is used.
3. Fertility is maintained by timely application of fertilizer and by growing soil improving crops.
4. Rainwater is conserved.
5. Insects, diseases, and weeds are controlled.
6. Tillage is kept to a minimum and done only when the moisture content is such that compaction is minimized.
7. Improved crop varieties are planted, and terraces and other mechanical aids are used to maintain them.

Irrigated soils—

The same high level management required for dryland soils plus:

1. Applying water according to the needs of the crops and the soil.
2. Coordinating tillage operations with irrigation operations.
3. Using properly designed irrigation systems and land treatments to help reduce erosion.

Use of the Soils for Range [2]

Ranching and livestock production are important enterprises in Hartley County. Native grass covers about 670,000 acres, or 70 percent, of the county. The average size of a ranch is about 12,000 acres.

Most of the ranches in Hartley County have varying amounts of cropland and pasture. The soil is used primarily for production of grazing crops, such as

[2] By JOHN A. WRIGHT, range conservationist, Soil Conservation Service.

wheat or sorghums. Several ranches in the county have irrigated grasses for both warm season and cool season grazing.

Livestock operations include cow-calf and stocker cattle enterprises. The most common livestock operation is for stocker cattle. Stocker calves are bought and are run on grazing lands for 4 to 8 months. Then they are placed in feedlots for finishing. Interest in feedlot operations is growing. The cow-calf type of operation consists of raising calves that are marketed at weaning time.

Several kinds of grassland are in the county. The most abundant is the Loamy Sand site, which produces mid and tall grasses. Two kinds of grassland are in areas of more sloping soils of the county: the Hardland Slopes site, which produces mid and short grasses, and the Mixedland Slopes site, which produces mid and tall grasses. Other grassland in the county is made up of steep and shallow soils which support sparse vegetation. Small areas of bottom land adjacent to stream courses produce tall grasses.

Range sites and condition classes

Soils differ in their capacity to produce grass and other plants for grazing. The soils that produce about the same kind and amount of vegetation, if the range is in similar condition, make up a range site.

Range sites are kinds of rangeland that have the capability to produce the same kind and amount of climax vegetation. Throughout the prairie and the plains areas, the climax vegetation consists of the plants that were growing when the region was first settled. If cultivated crops are not to be grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax plant community that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax plant community that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter then decreasers and are generally less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. They come in and grow along with increasers after the climax vegetation has been altered by grazing. Many of the invaders are annual weeds; some are shrubs that have some grazing value; but others have little value for grazing.

Four range condition classes indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the composition of the present plant community growing on a range site in relation to the climax plant community. A range site is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax plant community. It is in good condition if the percentage is between 51 to 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is less than 25.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

A primary objective of good range management is to keep the rangeland in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. Recognizing important changes in the kind of cover on a range site is difficult. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods, under the supervision of a careful manager, may have a deteriorated appearance that temporarily conceals its quality and ability to recover.

Descriptions of range sites

In the following pages, the soils of the range sites of Hartley County are described and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential annual yield of air dry herbage for each site when the site is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey.

CLAY FLAT RANGE SITE

This site consists of deep, well drained, very slowly permeable, nearly level, calcareous clayey soils on bottom land. The hazards of soil blowing and water erosion are slight. The surface becomes hard and massive after heavy trampling during wet weather.

The climax vegetation is dominantly short grasses and a few perennial forbs. The composition by weight of the climax vegetation is 45 percent galletagrass; 15 percent blue grama; 15 percent buffalograss; 10 percent sideoats grama; 5 percent alkali sacaton; 5 percent western wheatgrass and vine-mesquite; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air-dry herbage is about 2,000 pounds per acre in favorable years and about 800 pounds in unfavorable years. Cattle use these species at various seasons.

Continued heavy grazing by cattle on this site results in a decrease of sideoats grama, blue grama, western wheatgrass, and vine-mesquite. Other species, including alkali sacaton, buffalograss, and annual weeds, increase under heavy grazing. Mesquite, pricklypear, and cholla also invade the deteriorated site.

CLAY LOAM RANGE SITE

This site consists of deep, moderately permeable to very slowly permeable, nearly level to gently sloping clays, clay loams, and loams on uplands. The available water capacity is high to medium. Runoff is slow

to rapid. The hazards of soil blowing and water erosion are slight to moderate. In many places the intake of moisture is reduced by surface crusting, and downward movement is slowed by compacted layers, or "hoofpans."

The climax vegetation is dominantly short grass and a few mid grasses. The composition by weight of the climax vegetation is about 50 percent blue grama; 20 percent buffalograss; 5 percent sideoats grama; 5 percent galleta or tobosagrass; 5 percent western wheatgrass; 5 percent vine-mesquite; 5 percent silver bluestem; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 2,000 pounds per acre in favorable years and about 1,000 pounds in unfavorable years. Cattle graze almost all of these plants during various periods of the year.

Continuous heavy grazing by cattle on this site results in a decrease of blue grama, sideoats grama, western wheatgrass, and vine-mesquite, or these plants are grazed out. Other species, including buffalograss, perennial threeawn, sand dropseed, and annual weeds, increase under heavy grazing. Mesquite, cholla, pricklypear, and some yucca invade the deteriorated site.

DRAW RANGE SITE

This site consists of deep, well drained, moderately permeable, nearly level and gently sloping, calcareous clay loams and loams on bottom land and in valleys that seldom flood. Runoff is slow to medium, and available water capacity is high. The hazard of soil blowing is moderate, and the hazard of water erosion is moderate to severe.

The climax vegetation is dominantly short and mid grasses. The composition by weight of the climax vegetation is 20 percent blue grama; 15 percent vine-mesquite; 15 percent buffalograss; 10 percent sideoats grama; 10 percent western wheatgrass; 5 percent alkali sacaton; 5 percent other perennial grasses; 10 percent woody plants; and 10 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 2,600 pounds per acre in favorable years and about 1,800 pounds in unfavorable years. Cattle graze the herbage during various periods of the year.

Continuous heavy grazing by cattle on this site results in a decrease of sideoats grama, blue grama, vine-mesquite, and western wheatgrass. Other species, including buffalograss, threeawn, and silver bluestem, increase under heavy grazing. Mesquite, pricklypear, and annual weeds invade the deteriorated site.

GRAVELLY RANGE SITE

This site is in rolling landscape near stream channels. The significant soils are well drained, and moderately permeable gravelly loams. Runoff is rapid, and available water capacity is low.

The climax vegetation is dominantly mid grasses and some tall and short grasses. The composition by weight of the climax vegetation is 30 percent sideoats grama; 15 percent black grama; 10 percent hairy grama; 10 percent little bluestem; 5 percent indiangrass; 5 percent sand bluestem; 5 percent blue grama; 5 percent other perennial grasses; 5 percent catclaw: 5 percent other woody plants; and 5 percent perennial forbs.

If this site is in excellent condition the total annual yield of air dry herbage is about 1,800 pounds per acre in favorable years and about 1,100 pounds in unfavorable years. Cattle graze all grasses and forbs and browse the woody species during certain seasons.

Continued heavy grazing on this site results in a decrease of sand bluestem, sideoats grama, little bluestem, indiangrass, and black grama. Blue grama, buffalograss, hairy grama, threeawn, and yucca increase under heavy grazing. Juniper and annual weeds invade the deteriorated site.

HARDLAND SLOPES RANGE SITE

This site consists of moderately permeable, nearly level to sloping, calcareous loamy soils on uplands. The available water capacity is high. Runoff is medium to rapid.

The climax vegetation is a mixture of mid and short grasses and a small amount of yucca and forbs. The composition by weight of the climax vegetation is 35 percent sideoats grama; 25 percent blue grama; 5 percent vine-mesquite; 5 percent little bluestem, 5 percent buffalograss; 5 percent silver bluestem; 5 percent Wright threeawn; 5 percent sand dropseed; 5 percent woody plants; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 2,200 pounds per acre in favorable years and about 1,400 pounds in unfavorable years. Cattle graze the grasses and forbs and will browse the woody species in certain seasons.

Continued heavy grazing by cattle and antelope on this site results in a decrease of sideoats grama, blue grama, vine-mesquite, and little bluestem. Buffalograss, silver bluestem, sand dropseed, Wright threeawn, and yucca increase under heavy grazing. Mesquite and annual weeds invade the deteriorated site.

HIGH LIME RANGE SITE

This site consists of deep, moderately permeable, gently sloping, calcareous loamy soils on uplands. The soils are associated with playas on the High Plains. The available water capacity is high. Water erosion is a slight to moderate hazard. High amounts of calcium carbonate in the surface layer create a severe hazard of soil blowing.

The climax vegetation is dominantly short and mid grasses. The composition by weight of this vegetation is 30 percent sideoats grama; 20 percent blue grama; 15 percent buffalograss; 5 percent switchgrass; 5 percent little bluestem; 5 percent other perennial grasses; 10 percent woody plants; and 10 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 1,800 pounds per acre in favorable years and about 1,100 pounds in unfavorable years. Cattle graze the grasses and forbs and, on occasion, the woody species.

Continuous heavy grazing by cattle on this site results in a decrease or a disappearance of sideoats grama, blue grama, switchgrass, and little bluestem. Other species, including buffalograss, threeawn, sand

dropseed, and annual weeds increase as the other species decrease. Pricklypear and yucca also invade the deteriorated site.

LOAMY BOTTOMLAND RANGE SITE

This site consists of deep, moderately permeable and moderately rapidly permeable, loamy soils on bottom land. Most areas seldom become flooded. The available water capacity is medium to high. Runoff is slow.

The climax vegetation is a mixture of tall and mid grasses and cottonwood, hackberry, and willow. The composition by weight of the climax vegetation is 15 percent switchgrass; 15 percent indiangrass; 15 percent sand bluestem; 10 percent little bluestem; 10 percent western wheatgrass; 10 percent sideoats grama; 5 percent vine-mesquite; 5 percent alkali sacaton; 5 percent other perennial grasses; 5 percent perennial forbs; and 5 percent woody plants.

If this site is in excellent condition, the total annual yield of air dry herbage is about 3,400 pounds per acre in favorable years and about 1,200 pounds in unfavorable years. In areas where the water table is high, production may vary from 5,000 to 9,000 pounds of air dry forage per acre. Cattle graze most species of this herbage to some degree.

Continued heavy grazing by cattle on this site results in a sparse growth of indiangrass, switchgrass, sand bluestem, and little bluestem. Other species, including alkali sacaton, vine-mesquite, sideoats grama, buffalograss, silver bluestem, wild plum, and annual weeds, become dense.

LOAMY SAND RANGE SITE

This site consists of deep, moderately slowly to moderately rapidly permeable, undulating loamy fine sands. The available water capacity is low to high. Runoff is slow. The hazard of soil blowing is severe. The hazard of water erosion is slight.

The climax vegetation is a mixture of tall and mid grasses and sand plum and shin oak. The composition by weight of the climax vegetation is 20 percent sideoats grama; 15 percent sand bluestem; 15 percent little bluestem; 10 percent switchgrass; 10 percent hairy grama; 5 percent indiangrass; 5 percent needleandthread grass; 5 percent blue grama; 5 percent other perennial grasses; 5 percent woody plants; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 3,000 pounds per acre in favorable years and about 1,300 pounds in unfavorable years. Cattle graze most species of this herbage.

Continued heavy grazing by cattle on this site results in a decrease of sand bluestem, switchgrass, little bluestem, sideoats grama, and indiangrass. Other species, including blue grama, hairy grama, sand dropseed, threeawn, sand sagebrush, and shin oak, increase under heavy grazing. Red lovegrass, gummy lovegrass, tumble lovegrass, and annual weeds invade the deteriorated site.

MIXEDLAND SLOPES RANGE SITE

This site consists of deep, moderately to moderately rapidly permeable, nearly level to sloping, calcareous fine sandy loams on smooth uplands. Runoff is slow to medium. The available water capacity is medium to high. Heavily grazed areas blow readily. In some areas the soils are eroded.

The climax vegetation is dominantly short, mid, and tall grasses. The composition by weight of the climax vegetation is 30 percent sideoats grama; 20 percent blue grama; 10 percent little bluestem; 10 percent sand bluestem; 5 percent indiangrass; 5 percent buffalograss; 5 percent hairy grama; 5 percent other perennial grasses; 5 percent small soapweed; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 2,300 pounds per acre in favorable years and about 1,500 pounds in unfavorable years. Cattle graze all species of this herbage to some degree.

Continuous heavy grazing by cattle and antelope on this site results in a decrease or a disappearance of sideoats grama, blue grama, little bluestem, and sand bluestem. Other species, including buffalograss, hairy grama, threeawn, sand dropseed, and annual weeds, increase under continuous heavy grazing. Sand sagebrush, shin oak, and pricklypear invade the deteriorated site.

ROUGH BREAKS RANGE SITE

This site consists of very shallow and deep, moderately steep to very steep, calcareous loams on rough and broken areas. The available water capacity is high to very low. The hazard of water erosion is severe. The areas of this site are characterized by scenic escarpments, canyon walls, buttes, mesas, sharp hogbacks, and ridges.

The climax vegetation is a mixture of tall, mid, and short grasses and redberry juniper and mountainmahogany. The composition by weight of the climax vegetation is 20 percent sideoats grama; 15 percent little bluestem; 10 percent hairy grama; 10 percent indiangrass, switchgrass, sand bluestem, and Canada wildrye; 20 percent other perennial grasses; 20 percent woody plants; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 800 pounds per acre in favorable years and almost no available forage in unfavorable years. Cattle graze most species of this herbage to some degree if they are accessible to grazing.

Continued heavy grazing on this site results in a decrease of sideoats grama, little bluestem, indiangrass, sand bluestem, switchgrass, and Canada wildrye. Other species, including silver bluestem, Wright threeawn, sand dropseed, redberry juniper, and catclaw, increase under heavy grazing. Annual weeds invade the deteriorated site.

SAND HILLS RANGE SITE

This site consists of deep, rapidly permeable, undulating, and duned fine sands on uplands. The available water capacity is low. Runoff is very slow. The hazard of soil blowing is severe in heavily grazed areas.

The climax vegetation is a mixture of tall and mid grasses and shin oak, sand plum, and skunkbush sumac. The composition by weight of the climax vegetation is

15 percent little bluestem; 10 percent sand bluestem; 10 percent sideoats grama; 10 percent big sandreed; 5 percent switchgrass; 5 percent indiangrass; 5 percent sand dropseed; 5 percent needleandthread; 5 percent hairy grama; 5 percent perennial threeawn; 15 percent woody plants; and 10 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 4,000 pounds per acre in favorable years and about 1,500 pounds in unfavorable years. Cattle graze most species of this herbage to some degree.

Continued heavy grazing by cattle on this site results in a decrease of switchgrass, indiangrass, little bluestem, and big sandreed. Other species, including sand dropseed, perennial threeawn, hairy grama, sand sagebrush, and annual forbs, increase under heavy grazing. Yucca invades the deteriorated site.

SANDY BOTTOMLAND RANGE SITE

This site consists of deep, rapidly permeable, nearly level, calcareous loamy fine sands on bottom land. Most areas are flooded occasionally. The available water capacity is low. Runoff is slow. The hazard of soil blowing is severe.

The climax vegetation is a mixture of tall and mid grasses and cottonwood, hackberry, willow, and forbs. The composition by weight of the climax vegetation is 20 percent switchgrass; 20 percent sand bluestem; 15 percent woody plants; 10 percent alkali sacaton; 10 percent perennial forbs; 5 percent little bluestem; 5 percent indiangrass; 5 percent sideoats grama; 5 percent plains bristlegrass; and 5 percent tall dropseed.

If this site is in excellent condition, the total annual yield of air dry herbage is about 3,400 pounds per acre in favorable years and about 2,200 pounds in unfavorable years. Cattle graze all species of the herbage to some degree.

Continued heavy grazing by cattle on this site results in a decrease of switchgrass, sand bluestem, little bluestem, indiangrass, sideoats grama, Engelmann-daisy, heath aster, and catclaw sensitivebrier. Other species, including western wheatgrass, sand dropseed, blue grama, vine-mesquite, inland saltgrass, and American licorice, increase under heavy grazing. Buffalograss, mesquite, sand sagebrush, and some annual weeds invade the deteriorated site.

SANDY LOAM RANGE SITE

This site consists of deep, moderately and moderately slowly permeable, nearly level and gently sloping fine sandy loams. The available water capacity is high. Runoff is slow to medium. The hazard of soil blowing is severe, and the hazard of water erosion is slight to moderate.

The climax vegetation is a mixture of tall, mid, and short grasses and woody shrubs and forbs. The composition by weight of the climax vegetation is 25 percent blue grama; 15 percent sideoats grama; 10 percent buffalograss; 5 percent little bluestem; 5 percent sand bluestem; 5 percent indiangrass; 5 percent silver bluestem; 20 percent other perennial grasses; 5 percent sand sagebrush; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 2,400 pounds per acre in favorable years and about 1,600 pounds in unfavorable years. Cattle graze most species of this herbage to some degree.

Continued heavy grazing by cattle on this site results in a decrease of sideoats grama, blue grama, little bluestem, sand bluestem, indiangrass, and switchgrass. Other species, including buffalograss, sand dropseed, silver bluestem, hairy grama, threeawn, catclaw, sand sagebrush, and annual forbs, increase under heavy grazing. Mesquite, catclaw, and some annuals invade the deteriorated site.

SHALLOW CLAY RANGE SITE

This site consists of rolling land or gently sloping gullied land in redbed formations. Permeability is very slow. The soils are clayey and are very shallow and shallow. The site is very slow to recover, even under the best of management.

The climax vegetation is dominantly mid and short grasses and a few tall grasses. The composition by weight of the climax vegetation is 20 percent sideoats grama; 15 percent blue grama; 10 percent hairy grama; 10 percent buffalograss; 5 percent black grama; 5 percent little bluestem; 5 percent silver bluestem; 15 percent other perennial grasses; 10 percent woody plants; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 1,600 pounds per acre in favorable years and about 900 pounds in unfavorable years. Cattle graze most species of this herbage to some degree.

Continued heavy grazing by cattle on this site results in a decrease of little bluestem, black grama, blue grama, and sideoats grama. Other species, including alkali sacaton, Wright threeawn, silver bluestem, and annual weeds, increase under heavy grazing. Redberry juniper, mesquite, and pricklypear invade the deteriorated site.

VERY SHALLOW RANGE SITE

This site consists of very shallow, gently sloping and rolling to moderately steep, loamy soils. The available water capacity is very low. The hazard of water erosion is severe.

The climax vegetation is a mixture of tall and mid grasses and woody vegetation (shrubs). The composition by weight of the climax vegetation is 25 percent sideoats grama; 10 percent little bluestem; 10 percent blue grama; 5 percent sand bluestem; 5 percent indiangrass; 5 percent switchgrass; 25 percent other perennial grasses; 10 percent woody plants; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 840 pounds per acre in favorable years and about 400 pounds in unfavorable years. Cattle graze most species of this herbage to some degree.

Continued heavy grazing by cattle on this site results in a decrease of sand bluestem, switchgrass, indiangrass, and sideoats grama. Hairy grama, Wright threeawn, sand dropseed, silver bluestem, and annual forbs

increase under heavy grazing. Hairy tridens, redberry juniper, and some annuals invade the deteriorated site.

WET BOTTOMLAND RANGE SITE

This site consists of nearly level, moderately rapidly permeable soils along streambeds. Some areas are subject to frequent flooding and deposition. A high water table is at a depth of 8 to 14 inches most of the time.

Excellent vegetation is common when the site is properly managed. The climax vegetation is dominantly tall grasses and a small percentage of mid grasses. The composition by weight of the climax vegetation is 15 percent switchgrass; 15 percent sedges and rushes; 10 percent indiangrass; 10 percent sand bluestem; 10 percent western wheatgrass; 5 percent little bluestem; 5 percent prairie cordgrass; 5 percent eastern gamagrass; 15 percent other perennial grasses; 5 percent woody plants; and 5 percent perennial forbs.

If this site is in excellent condition, the total annual yield of air dry herbage is about 9,000 pounds per acre in favorable years and about 5,000 pounds in unfavorable years. Cattle graze all species of this herbage to some degree.

Continued heavy grazing by cattle on this site results in a decrease of switchgrass, indiangrass, sand bluestem, prairie cordgrass, and eastern gamagrass. Other species, including alkali sacaton, vine-mesquite, sideoats grama, willows, and western ironweed, increase under heavy grazing. Annual forbs invade the deteriorated site.

Use of the Soils for Wildlife

Long, narrow areas of escarpment are on both sides of several canyons in Hartley County. These canyons are mainly in the central and southern parts of the county. The land associated with the escarpments provides some of the better wildlife habitat in the northern Texas Panhandle.

The escarpment, or "breaks country," provides good habitat for a variety of wildlife including mule deer, wild turkey, white-tailed deer, scaled (blue) quail, coyote, bobwhite quail, bobcat, opossum, swift fox, raccoon, ringtail, hawks, owls, and many species of smaller birds (fig. 16). Cottontail rabbits, jackrabbits, ground squirrels, and numerous other species of rodents are also present.

The High Plains part of Hartley County consists of nearly level to gently sloping rangeland and cropland. Herds of antelope range mostly in the southern and western parts of the county on vast acreages of rangeland. Golden eagles and curlews migrate into the county each year. Stubble fields provide cover for pheasant which were introduced into the county. The grain fields and intermittent playas attract ducks, geese, and sandhill crane during migration. Other wildlife species in the county are porcupine, skunks, prairie dogs, and badgers.

Native fish and amphibians are limited because of the seasonal shortage of water. Salamanders, commonly known as "waterdogs," are in many windmill ponds and playas. Several species of reptiles, including rattlesnakes, are common.

Production of fish is limited mainly to Rita Blanca Lake. Punta De Agua Creek and Rita Blanca Creek have several waterholes that contain various species of fish.

Soil ratings for wildlife habitat.—Soils directly influence kinds and amounts of vegetation and amounts of water available; and, in this way, they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are thickness of soil useful to crops, surface texture, available water capacity to a depth of 40 inches, wetness, surface stoniness or rockiness, flood hazard, slope, and permeability of the soil material to air and water.

In table 3 soils of this survey area are rated for producing six elements of wildlife habitat and for three groups, or kinds, of wildlife. The ratings indicate relative suitability for various elements.

A rating of *good* means the element of wildlife habitat and habitats generally are easily created, improved, and maintained. Few or no limitations affect management, and satisfactory results can be expected when the soil is used for the prescribed purpose.

A rating of *fair* means the element of wildlife habitat and habitats can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention may be required, however, for satisfactory results.

A rating of *poor* means the element of wildlife habitat and limitations for the designated use are rather severe. Habitats can be created, improved, or maintained in most places; but management is difficult and requires intensive effort.

A rating of *very poor* means the elements of wildlife habitat are very severe and unsatisfactory results are to be expected. It is either impossible or impractical to

Figure 16.—**Wild turkey in the breaks area of Hartley County.**

TABLE 3.—*Interpretations of the soils for elements of wildlife habitat and for kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Shrubs	Wetland food and cover plants	Shallow water developments	Openland	Rangeland	Wetland
Berda:									
BeC	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
BeD, BRD	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
BpG	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Poor	Poor	Very poor.
For Potter part of BpG, see Potter series. For Veal part of BRD, see Veal series.									
Bippus: BuA, Bub	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Colorado: Co	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Conlen: CoB	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Dallam: DaB, DfA, DfB, DfC.	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Dumas: DuA, DuB	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Glenrio: GkD	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
For Knoco part, see Knoco series.									
Gracemore: Gm	Fair	Good	Good	Fair	Good	Good	Good	Good	Good.
Gruver: GrA, GrB	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Fair	Very poor.
Guadalupe: Gu	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Karde:									
KaB	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
KaC	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Knoco	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Mapped only in complex with Glenrico soils.									
Likes: Lk	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Lincoln: Ln	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Mangum: Ma	Fair	Fair	Poor	Fair	Poor	Poor	Fair	Poor	Poor.
Mobeetie: MoB, MoC, MoD, MVD.	Fair	Fair	Good	Poor	Very poor	Very poor	Fair	Fair	Very poor.
For Veal part of MVD, see Veal series.									
Ness: Ne	Poor	Poor	Poor	Very poor	Poor	Fair	Poor	Very poor	Poor.
Perico: PcB, PeA, PeB, PeC.	Fair	Fair	Good	Poor	Poor	Poor	Fair	Fair	Very poor.
Potter: PoE	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor.
Rickmore: RcB, RkA	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
San Jon: SaB, SgD	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Fair	Very poor.
For Glenrio part of SgD, see Glenrio series.									
Sherm: ShA	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Fair	Very poor.
Spur: Sm	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Spurlock: SpB, SpC, SrB.	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Sunray: SuA, SuB	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Tascosa: TaE	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Poor	Very poor.

TABLE 3.—*Interpretations of the soils for elements of wildlife habitat and for kinds of wildlife*—Continued

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Shrubs	Wetland food and cover plants	Shallow water developments	Openland	Rangeland	Wetland
Valentine: Va, VcE—For Spurlock part of VcE, see Spurlock series.	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Poor	Very poor.
Veal—Mapped in association with Berda and Mobeetie soils.	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Vingo: VDD—For Dallam part, see Dallam series.	Good	Good	Good	Poor	Very poor	Very poor	Good	Fair	Very poor.

create, improve, or maintain habitats on soils in this category.

The significance of each subheading in table 3 under "Elements of wildlife habitat" and "Kinds of wildlife" is given in the following paragraphs.

Elements of wildlife habitat.—In table 3 each soil is rated according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of a site for development as a habitat for wildlife requires inspection at the site.

Grain and seed crops. These crops are annual grain-producing plants, such as corn, sorghum, and wheat.

Grasses and legumes. This group is made up of domestic grasses and legumes that are established by planting. These plants provide food and cover for wildlife. Grasses include switchgrass, ryegrass, and western wheatgrass. Legumes include wild alfalfa, Illinois bundleflower, and sweetclover.

Wild herbaceous upland plants. This group consists of native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Ragweed, Maximilian sunflower, wildbean, pokeweed, and bristlegrass are typical examples. Typical plants on rangeland are bluestem, grama perennial forbs, and legumes.

Shrubs. In this group are shrubby plants that produce twigs, buds, bark, or foliage used as food by wildlife, or that provide cover and shade for some wildlife species. Examples are plum, skunkbush, Russian-olive, mountainmahogany, shin oak, catclaw, and fourwing saltbush.

Wetland food and cover plants. This group consists of annual and perennial herbaceous plants that grow wild on moist and wet sites. These plants provide food and cover mostly for wetland wildlife. Typical examples are smartweed, wild millet, spikerush and other rushes, sedges, burreed, tearthumb, and aneilema. Submerged and floating aquatics are not included in this category.

Shallow water developments. These developments are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitats that are suitable for waterfowl. Some are designed to be drained, planted, and then flooded; other are permanent impoundments that grow submersed aquatics.

Kinds of wildlife.—In table 3 soils are rated according to their suitability as habitat for the three kinds of wildlife in the county—openland, rangeland, and wetland. These ratings are related to ratings made for the elements of habitat. For example, soils rated very poor for shallow water developments are rated very poor for wetland wildlife.

Openland wildlife consists of birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Quail, doves, meadowlarks, field sparrows, cottontail rabbits, and foxes are typical examples of open land wildlife.

Rangeland wildlife consists of birds and mammals of natural rangelands. Examples are antelope, white-tailed deer, mule deer, buffalo, scaled quail, bobwhite quail, meadowlark, lark bunting, coyote, and turkey.

Wetland wildlife consists of birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, herons, and some rats and mice are typical examples of wetland wildlife.

Use of the Soils for Recreational Development

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 4 the soils of Hartley County are rated according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. For all of the ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they can be overcome easily. A *moderate* limitation can be overcome or modified by planning, by design, or by spe-

TABLE 4.—*Limitations of the soils for recreational development*

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Berda:				
BeC, BeD, BRD	Slight	Slight	Moderate: slope	Slight.
BpG For Veal part of BRD, see Veal series. For Potter part of BpG, see Potter series.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Bippus: BuA, BuB	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
Colorado: Co	Severe: flooding	Moderate: flooding	Severe: flooding	Slight.
Conlen: CoB	Slight	Slight	Slight	Slight.
Dallam:				
DaB	Moderate: too sandy	Moderate: too sandy	Severe: too sandy	Moderate: too sandy.
DfA	Slight	Slight	Slight	Slight.
DfB, DfC	Slight	Slight	Moderate: slope	Slight.
Dumas:				
DuA	Slight	Slight	Slight	Slight.
DuB	Slight	Slight	Moderate: slope	Slight.
Glenrio: GkD For Knoco part, see Knoco series.	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Gracemore: Gm	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding.
Gruver: GrA, GrB	Moderate: percs slowly	Slight	Moderate: percs slowly	Slight.
Guadalupe: Gu	Severe: flooding	Moderate: flooding	Moderate: flooding	Slight.
Karde: KaB, KaC	Moderate: dusty	Moderate: dusty	Moderate: dusty, slope.	Moderate: dusty.
Knoco Mapped only in a complex with Glenrio soils.	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Likes: Lk	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy.
Lincoln: Ln	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding.
Mangum: Ma	Severe: flooding, too clayey.	Severe: too clayey	Severe: flooding, too clayey.	Severe: too clayey.
Mobeetie: MoB, MoC, MoD, MVD. For Veal part of MVD, see Veal series.	Slight	Slight	Moderate: slope	Slight.
Ness: Ne	Severe: wet, too clayey	Severe: wet, too clayey	Severe: wet, too clayey	Severe: wet, too clayey.
Perico:				
PcB	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy.
PeA	Slight	Slight	Slight	Slight.
PeB, PeC	Slight	Slight	Moderate: slope	Slight.
Potter:				
PoE	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope.
Potter part of BpG	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Rickmore:				
RcB	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy.
RkA	Slight	Slight	Slight	Slight.
San Jon: SaB, SgD For Glenrio part of SgD, see Glenrio series.	Moderate: too clayey	Moderate: too clayey	Moderate: slope, too clayey	Moderate: too clayey.
Sherm: ShA	Moderate: percs slowly, too clayey.	Moderate: too clayey	Moderate: percs slowly, too clayey.	Moderate: too clayey.
Spur: Sm	Severe: flooding	Moderate: flooding	Severe: flooding	Slight.
Spurlock: SpB, SpC, SrB	Slight	Slight	Moderate: slope	Slight.

TABLE 4.—*Limitations of the soils for recreational development*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Sunray: SuA, SuB	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
Tascosa: TaE	Moderate: small stones	Moderate: small stones	Severe: small stones	Moderate: small stones.
Valentine: Va, VcE. For Spurlock part of VcE, see Spurlock series.	Severe: too sandy	Severe: too sandy	Severe: too sandy	Severe: too sandy.
Veal. Mapped in association with Berda and Mobeetie soils.	Slight	Slight	Moderate: slope	Slight.
Vingo: VDD. For Dallam part, see Dallam series.	Moderate: too sandy	Moderate: too sandy	Severe: too sandy	Moderate: too sandy.

cial maintenance. A *severe* limitation means that costly soil reclamation, special design, intense maintenance, or a combination of these, is required.

Camp areas are those sites used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have gentle slopes, good drainage, a surface without rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Picnic areas are natural or landscaped tracts used primarily for eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The most suitable soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increases cost of leveling sites or of building access roads.

Playgrounds are those areas that are used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The most suitable soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, and freedom from flooding during periods of heavy use. Their surface is firm after rains but not dusty when dry. If grading and leveling are required, depth to bedrock is important.

Paths and trails are areas to be used for local and cross country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The most suitable soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Engineering Uses of the Soils [3]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built to predict performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, several estimated soil properties significant to engineering, interpretations for various engineering uses, and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make other useful maps.

[3] DAN C. HUCKABEE, engineer, Soil Conservation Service, assisted in the preparation of this section.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*2*) used by the Soil Conservation Service engineers, Department of Defense, and others, and the AASHTO system (*1*) adopted by the American Association of State Highway and Transportation Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7. The groups are established on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-b. A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 7; the estimated AASHTO classification, without group index numbers, is given in table 5 for all soils mapped in the survey area.

Soil properties significant to engineering

Table 5 provides estimates of soil properties significant to engineering. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for those and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer. In Hartley County the depth to bedrock for most soils is well beyond depths to which the soils were investigated in the field mapping. Soils in the Potter, Tascosa, and Knoco series have rock at relatively shallow depths. Since these are the only soils which have rock within the investigated depths, this column was omitted from table 5.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years. Only the Gracemore series in Hartley County has a seasonal high water table within the depth to which the soils were investigated; however, some of the soils are subject to flooding. These are the Colorado, Guadalupe, Lincoln, Mangum, and Ness soils. The column for seasonal high water table was omitted from table 5.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Hydrologic soil groups give the runoff potential from rainfall. Four major hydrologic groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling, and without the protective effects of vegetation.

The major soil groups are as follows:

Group A is made up of soils that have high infiltration rates even when thoroughly wetted. These soils consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission in that water readily passes through them, and they have a low runoff potential.

Group B is made up of soils that have moderate infiltration rates when thoroughly wetted. These are chiefly moderately deep to deep, moderately well drained soils that have moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C is made up of soils that have slow infiltration rates when thoroughly wetted. These are chiefly soils that have a layer that impedes downward movement of water or soils that have moderately fine to fine texture. These soils have a slow rate of water transmission.

Group D soils have very slow infiltration rates when thoroughly wetted. These are chiefly clay soils that have a high swelling potential; soils that have a permanent high water table; soils that have a claypan or clay layer at or near the surface; and shallow soils that

TABLE 5.—*Estimated soil properties*

[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 instructions for referring to other series that appear in the first column of this table. Absence of entry in

Soil series and map symbols	Hydrologic group	Depth from surface	USDA texture	Classification	
				Unified	AASHTO
		Inches			
*Berda: BeC, BeD, BpG, BRD	B	0–5	Loam, clay loam, and sandy clay loam.	SC or CL	A–4 or A–6
For properties of Potter part of BpG, see Potter series. For properties of Veal part of BRD, see Veal series.		5–60	Sandy clay loam	SC or CL	A–4 or A–6
Bippus: BuA, BuB	B	0–42	Clay loam	CL or SC	A–4 or A–6
		42–72	Sandy clay loam, clay loam	CL or SC	A–4 or A–6
Colorado: Co	B	0–8	Loam	CL	A–4 or A–6
		8–20	Clay loam	CL	A–4 or A–6
		20–36	Sandy clay loam	CL	A–4 or A–6
		36–60	Fine sandy loam	SM, SC, or SM–SC	A–2 or A–4
Conlen: CoB	B	0–10	Loam	CL–ML, CL, SC, or SM–SC	A–4 or A–6
		10–80	Clay loam	CL	A–4 or A–6
Dallam:					
DaB	B	0–16	Loamy fine sand	SM	A–2–4
		16–50	Sandy clay loam	CL or SC	A–4 or A–6
		50–65	Clay loam	CL or SC	A–6
		65–95	Sandy clay loam	CL or SC	A–4 or A–6
DfA, DfB, DfC	B	0–9	Fine sandy loam	SM or SM–SC	A–2–4 or A–4
		9–80	Sandy clay loam	CL or SC	A–4 or A–6
Dumas: DuA, DuB	B	0–10	Loam	CL or CL–ML	A–4 or A–6
		10–17	Sandy clay loam	CL or SC	A–6
		17–22	Clay loam	CL	A–6
		22–85	Sandy clay loam	CL or SC	A–6
*Glenrio: GkD	D	0–14	Clay	CL, CH	A–7–6
For properties of Knoco part of GkD, see Knoco series.		14–60	Shaly clay	CL, CH	A–7–6
Gracemore: Gm	C	0–3	Clay loam, sandy clay loam, fine sandy loam, loamy fine sand.	SM, ML, SC, CL, CL–ML or SM–SC	A–4 or A–6
		3–60	Fine sand	SM or SP–SM	A–2 or A–3
Gruver: GrA, GrB	C	0–8	Loam	CL	A–6
		8–98	Clay loam	CL	A–6 or A–7–6
Guadalupe: Gu	B	0–60	Fine sandy loam	SM, SC or SM–SC	A–2–4 or A–4
Karde: KaB, KaC	B	0–60	Loam, sandy clay loam, clay loam, fine sandy loam.	CL–ML, CL	A–4 or A–6
*Knoco:	D	0–8	Clay	CL, CH	A–7
Mapped in complex with the Glenrio series.		8–60	Clayey shale	CL, CH	A–7
Likes: Lk	A	0–60	Loamy fine sand	SM, SP–SM or SM–SC	A–2–4
Lincoln: Ln	A	0–60	Loamy fine sand, fine sand	SM or SP–SM	A–2 or A–3
Mangum: Ma	D	0–25	Clay	CL or CH	A–7–6
		25–60	Silty clay	CL or CH	A–7–6
*Mobeetie: MoB, MoC, MoD, MVD	B	0–60	Fine sandy loam	ML, CL–ML, SM or SM–SC	A–4
For properties of Veal part of MVD, see Veal series.					
Ness: Ne	D	0–60	Clay	CH	A–7–6

significant to engineering

The soils in such mapping units have different properties and limitations, and for this reason it is necessary to follow carefully a column indicates that characteristics are too variable for the material to be classified. < means less than]

Percentage passing seive—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
						Inches per hour	*In per in of soil*	*pH*		
90–100	85–100	80–95	36–70	20–35	8–20	0.6–2.0	0.14–0.17	7.9–8.4	Low	Moderate.
95–100	95–100	80–95	38–70	20–35	8–20	0.6–2.0	0.14–0.17	7.9–8.4	Low	Moderate.
100	95–100	85–98	40–80	22–40	8–20	0.6–2.0	0.15–0.20	7.9–8.4	Moderate	Moderate.
100	90–100	85–98	36–75	22–40	8–20	0.6–2.0	0.14–0.20	7.9–8.4	Moderate	Moderate.
75–100	75–100	60–100	55–95	29–40	10–21	0.6–2.0	0.16–0.20	7.9–8.4	Low	High.
75–100	75–100	60–100	55–95	29–40	10–21	0.6–2.0	0.16–0.20	7.9–8.4	Low	High.
75–100	75–100	60–100	55–95	29–40	10–21	0.6–2.0	0.16–0.20	7.9–8.4	Low	High.
95–100	95–100	75–99	25–50	18–30	2–10	2.0–6.0	0.10–0.15	7.9–8.4	Low	Moderate.
95–100	95–100	80–98	36–75	20–35	5–20	0.6–2.0	0.14–0.18	7.9–8.4	Low	Moderate.
95–100	95–100	90–98	51–80	30–40	10–25	0.6–2.0	0.14–0.18	7.9–8.4	Moderate	Moderate.
100	100	70–85	15–35	<20	[1]NP–3	2.0–6.0	0.06–0.10	6.6–7.3	Very low	Low.
100	98–100	85–100	45–70	20–35	8–20	0.6–2.0	0.14–0.18	7.4–8.4	Low	Moderate.
100	98–100	85–100	50–80	25–40	11–25	0.6–2.0	0.15–0.20	7.9–8.4	Low	Moderate.
100	98–100	85–100	45–70	20–35	8–20	0.6–2.0	0.14–0.18	7.4–8.4	Low	Moderate.
100	100	70–98	30–50	<25	NP–6	2.0–6.0	0.10–0.14	6.6–7.8	Low	Low.
100	98–100	85–100	45–80	20–37	10–25	0.6–2.0	0.14–0.18	7.4–8.4	Low	Moderate.
100	100	95–100	51–75	25–35	6–15	0.6–2.0	0.14–0.18	6.6–7.8	Low	Moderate.
100	98–100	85–100	45–75	20–35	10–25	0.6–2.0	0.14–0.18	7.4–8.4	Low	Moderate.
100	100	95–100	51–75	25–40	10–20	0.6–2.0	0.15–0.20	7.4–8.4	Low	Moderate.
97–100	95–100	85–100	45–75	20–35	10–25	0.6–2.0	0.14–0.18	7.4–8.4	Low	Moderate.
95–100	90–100	90–100	70–95	45–60	25–38	<.06	0.12–0.17	7.9–8.4	High	High.
90–100	85–100	80–90	55–80	40–55	22–35	<.06	0.03–0.08	7.9–8.4	High	High.
90–100	80–100	75–100	40–95	<40	NP–20	0.2–6.0	0.10–0.24	7.4–8.4	Low	Low.
90–100	80–100	75–100	10–35	.....	NP	2.0–6.0	0.05–0.10	7.9–8.4	Very low	Low.
100	95–100	85–100	55–75	25–40	10–20	0.6–2.0	0.15–0.20	7.4–8.4	Moderate	Moderate.
100	95–100	90–100	60–90	25–50	15–30	0.2–0.6	0.15–0.20	7.4–8.4	Moderate	Moderate.
95–100	95–100	75–99	17–50	18–30	2–10	2.0–6.0	0.10–0.15	7.9–8.4	Low	Low.
100	100	85–100	60–90	15–35	5–20	0.6–2.0	0.15–0.20	7.9–8.4	Low	Moderate.
90–100	90–100	90–100	80–98	45–60	20–35	<.06	0.12–0.17	7.9–8.4	High	High.
90–100	85–100	80–90	60–90	40–60	20–35	<.06	0.03–0.07	7.9–8.4	High	High.
90–98	90–98	75–95	10–30	<25	NP–6	2.0–6.0	0.06–0.10	7.4–8.4	Very low	Low.
90–100	85–100	75–100	8–35	.....	NP	6.0–20.0	0.05–0.10	7.4–8.4	Very low	Low.
100	100	100	95–100	48–70	25–40	<.06	0.14–0.18	7.9–8.4	High	High.
100	100	100	90–100	48–70	25–40	<.06	0.14–0.18	7.9–8.4	High	High.
95–98	90–95	80–95	40–65	18–25	2–7	2.0–6.0	0.10–0.14	7.9–8.4	Low	Low.
100	100	95–100	90–95	55–65	30–40	<.06	0.10–0.13	6.6–8.4	High	High.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Hydrologic group	Depth from surface	USDA texture	Classification	
				Unified	AASHTO
Perico:					
PcB	B	0–8	Loamy fine sand	SM, or SM–SC	A–2–4 or A–4
		8–28	Sandy clay loam	CL or SC	A–6
		28–80	Clay loam	CL or SC	A–6
PeA, PeB, PeC	B	0–8	Fine sandy loam	SM or SM–SC	A–2 or A–4
		8–16	Sandy clay loam	CL or SC	A–6
		16–84	Clay loam	CL or SC	A–6
Potter: PoE	C	0–8	Loam	ML or CL, CL–ML	A–4 or A–6
		8–60	Caliche	GM, GC, SM, SC, SM–SC, GM–GC	A–2, A–4 or A–6
Rickmore:					
RcB	C	0–8	Loamy fine sand	SM or SM–SC	A–2–4 or A–4
		8–18	Sandy clay loam	CL	A–6 or A–7–6
		18–80	Clay loam	CL	A–6 or A–7–6
RkA	C	0–8	Fine sandy loam	SM or SM–SC	A–2 or A–4
		8–16	Sandy clay loam	CL	A–6 or A–7–6
		16–48	Clay loam	CL	A–6 or A–7–6
		48–85	Sandy clay loam	CL	A–6 or A–7–6
*San Jon: SaB, SgD For Glenrio part of SgD, see Glenrio series.	B	0–60	Clay loam	CL, SC, CL–ML, or SM–SC	A–4 or A–6
Sherm: ShA	D	0–6	Clay loam	CL	A–6 or A–7–6
		6–36	Clay	CL or CH	A–7–6
		36–90	Clay loam	CL	A–6 or A–7–6
Spur: Sm	B	0–60	Loam	CL	A–6
Spurlock: SpB, SpC, SrB	B	0–10	Fine sandy loam	SM or SM–SC	A–2–4 or A–4
		10–16	Sandy clay loam	CL	A–4 or A–6
		16–88	Clay loam	CL	A–6
Sunray: SuA, SuB	B	0–18	Clay loam	CL	A–4 or A–6
		18–85	Clay loam	CL	A–6 or A–7–6
Tascosa: ToE	B	0–18	Gravelly loam, very gravelly loam.	SP–SM, SM, GM, GC, SC, GM–GC, SM–SC or GP–GC	A–1 or A–2
		18–80	Gravelly sandy loam	SC, GM–GC, SM–SC, GP–GM or SP–SM, GP–GC, SM, GM, GC, SP–GC	A–1 or A–2
Valentine: Va, VcE For properties of Spurlock part of VcE, see Spurlock series.	A	0–60	Fine sand	SM, SP or SP–SM	A–2 or A–3
*Veal Mapped in association with Berda and Mobeetie soils.	B	0–5	Fine sandy loam	SM, SC or SM–SC	A–2–4 or A–4
		5–60	Sandy clay loam	CL or SC	A–4 or A–6
*Vingo: VDD For properties of Dallam part of VDD, see Dallam series.	B	0–16	Loamy fine sand	SM	A–2–4
		16–46	Fine sandy loam	SM, SM–SC	A–2–4 or A–4
		46–85	Sandy clay loam	SC, ML, or SM–SC	A–4 or A–7–5

[1] NP = Nonplastic.

significant to engineering—Continued

Percentage passing seive—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
100	96–100	60–90	20–40	<20	NP–5	2.0–6.0	0.06–0.10	7.9–8.4	Very low	Moderate.
98–100	96–100	80–100	45–75	25–40	11–25	0.6–2.0	0.14–0.20	7.9–8.4	Moderate	Moderate.
98–100	96–100	80–100	45–75	25–40	11–25	0.6–2.0	0.14–0.20	7.9–8.4	Moderate	Moderate.
100	96–100	20–90	30–50	<25	NP–6	2.0–6.0	0.10–0.14	7.9–8.4	Low	Moderate.
98–100	96–100	80–100	45–75	25–40	11–25	0.6–2.0	0.14–0.20	7.9–8.4	Low	Moderate.
98–100	96–100	80–100	45–75	25–40	11–25	0.6–2.0	0.14–0.20	7.9–8.4	Low	Moderate.
80–95	70–90	60–85	51–70	25–40	5–15	0.6–2.0	0.12–0.16	7.9–8.4	Low	Moderate.
30–80	25–75	20–60	13–50	25–40	5–15	0.6–2.0	0.01–0.04	7.9–8.4	Low	Moderate.
100	98–100	60–90	20–40	<20	NP–5	2.0–6.0	0.06–0.10	6.6–7.8	Very low	Moderate.
100	100	80–100	51–80	35–50	20–30	0.2–0.6	0.15–0.19	7.4–8.4	Moderate	Moderate.
100	100	80–100	51–80	35–50	20–30	0.2–0.6	0.15–0.19	7.4–8.4	Moderate	Moderate.
100	98–100	80–95	30–50	<25	NP–6	2.0–6.0	0.08–0.12	6.6–7.8	Low	Moderate.
100	80–100	80–100	51–80	35–50	20–30	0.2–0.6	0.15–0.19	7.4–8.4	Moderate	Moderate.
100	100	80–100	51–80	31–50	20–30	0.2–0.6	0.15–0.19	7.4–8.4	Moderate	Moderate.
100	100	80–100	51–80	35–50	20–30	0.2–0.6	0.15–0.19	7.4–8.4	Moderate	Moderate.
60–100	55–95	50–90	40–70	25–40	5–20	0.2–0.6	0.14–0.18	7.9–8.4	Moderate	Moderate.
100	100	100	80–90	30–42	15–25	0.06–0.2	0.16–0.20	6.6–7.3	Moderate	High.
100	100	100	80–98	41–55	20–30	<.06	0.15–0.19	6.6–8.4	High	High.
97–100	95–100	94–99	75–92	31–42	15–26	0.2–0.6	0.13–0.17	7.9–8.4	Moderate	High.
100	95–100	90–100	60–93	25–40	10–25	0.6–2.0	0.15–0.20	7.9–8.4	Moderate	Moderate.
95–100	95–100	70–98	20–45	15–25	3–7	2.0–6.0	0.10–0.14	7.9–8.4	Low	Moderate.
94–100	85–100	80–98	51–75	20–35	8–20	0.6–2.0	0.10–0.16	7.9–8.4	Low	Moderate.
95–100	90–100	85–98	51–80	20–40	10–20	0.6–2.0	0.14–0.19	7.9–8.4	Low	Moderate.
98–100	98–100	95–100	51–85	24–40	9–25	0.6–2.0	0.14–0.18	7.9–8.4	Low	Moderate.
95–100	95–100	85–100	51–90	25–42	10–26	0.6–2.0	0.12–0.16	7.9–8.4	Low	Moderate.
40–65	35–60	25–50	10–26	25–42	5–14	0.6–2.0	0.06–0.12	7.9–8.4	Very low	Low.
30–60	20–60	15–45	5–15	<32	NP–14	2.0–6.0	0.03–0.07	7.9–8.4	Very low	Low.
100	100	95–100	4–20	.....	NP	6.0–20.0	0.08–0.11	6.1–7.3	Very low	Low.
90–100	85–100	70–95	30–50	15–25	3–10	2.0–6.0	0.10–0.14	7.9–8.4	Low	Moderate.
85–100	80–100	80–100	40–70	20–30	8–15	0.6–2.0	0.12–0.16	7.9–8.4	Low	Moderate.
100	100	70–90	15–35	.....	NP	6.0–20.0	0.06–0.10	6.6–7.8	Very low	Low.
100	100	80–95	30–45	<25	NP–5	2.0–6.0	0.10–0.14	6.6–7.8	Low	Low.
100	100	80–95	40–70	35–50	5–15	0.6–2.0	0.11–0.15	7.4–8.4	Low	Low.

TABLE 6.—*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. instructions for referring to other series that appear in the first column of this table. "Shrink-swell"

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfills	Local roads and streets
*Berda: BeC, BeD	Slight	Moderate: slope; seepage.	Slight	Slight	Slight	Slight: low strength.
BpG. For interpretations of Potter part of BpG, see Potter series.	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
BRD. For interpretations of Veal part of BRD, see Veal series.	Slight	Moderate: slope; seepage.	Slight	Slight	Slight	Slight
Bippus: BuA	Slight	Moderate: seepage.	Moderate: cutbanks cave.	Moderate: low strength.	Moderate: too clayey.	Moderate: low strength.
BuB	Slight	Moderate: seepage.	Moderate: cutbanks cave.	Moderate: low strength.	Moderate: too clayey.	Moderate: low strength.
Colorado: Co	Severe: floods	Moderate: seepage.	Severe: floods	Severe: floods	Severe: floods	Severe: floods
Conlen: CoB	Slight	Moderate: seepage.	Slight	Slight	Moderate: too clayey.	Moderate: low strength.
Dallam: DaB	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
DfA	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
DfB, DfC	Slight	Moderate: seepage; slope.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
Dumas: DuA	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
DuB	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
*Glenrio: GkD. For interpretations of Knoco part of GkD, see Knoco series.	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
Gracemore: Gm	Severe: floods	Severe: floods; seepage.	Severe: floods	Severe: floods	Severe: floods	Severe: floods
Gruver: GrA	Moderate: percs slowly.	Slight	Moderate: too clayey.	Moderate: low strength; shrink-swell.	Moderate: too clayey.	Severe: low strength.

properties of the soils

The soils in such mapping units have different properties and limitations and for this reason it is necessary to follow carefully the and some of the other terms that describe restrictive soil features are defined in the Glossary]

Degree and kind of limitations for—Continued		Suitability as source of—		Soil features affecting—		
Pond reservoir areas	Dikes, levees and other embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Good	Slope: erodes easily.	Favorable	Erodes easily.
Moderate: seepage.	Moderate: piping; erodes easily.	Poor: slope	Poor: slope	Slope: erodes easily.	Slope	Slope.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Good	Slope: erodes easily.	Favorable	Erodes easily.
Moderate: seepage.	Moderate: piping; seepage; erodes easily.	Fair: low strength.	Fair: too clayey.	Favorable	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; seepage; erodes easily.	Fair: low strength.	Fair: too clayey.	Slope	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Good	Floods	Not needed	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: excess lime; too clayey.	Slope	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Poor: too sandy.	Fast intake	Too sandy	Erodes easily.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: thin layer.	Favorable	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: thin layer.	Slope	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: thin layer.	Favorable	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: thin layer.	Slope	Favorable	Favorable.
Slight	Moderate: low strength.	Poor: shrink-swell; low strength.	Poor: too clayey.	Not suited	Not suited	Not suited.
Severe: seepage.	Moderate: low strength; unstable fill.	Fair: wet	Poor: too sandy.	Not suited	Not suited	Not needed.
Moderate: percs slowly.	Moderate: piping; erodes easily.	Poor: low strength.	Fair: too clayey.	Favorable	Favorable	Favorable.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfills	Local roads and streets
GrB	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Moderate: low strength; shrink-swell.	Moderate: too clayey.	Severe: low strength.
Guadalupe: Gu	Severe: floods.	Severe: floods; seepage.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Karde: KaB, KaC	Moderate: percs slowly.	Moderate: slope.	Slight	Moderate: shrink-swell.	Moderate: too clayey.	Moderate: shrink-swell.
*Knoco Mapped in complex with Glenrio soils.	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
Likes: Lk	Slight	Severe: seepage.	Severe: cutbanks cave.	Slight	Severe: too sandy; seepage.	Slight
Lincoln: Ln	Severe: floods.	Severe: floods; seepage.	Severe: floods; cutbanks cave.	Severe: floods.	Severe: floods; seepage.	Severe: floods.
Mangum: Ma	Severe: floods; percs slowly.	Severe: floods.	Severe: too clayey; floods.	Severe: floods; shrink-swell.	Severe: floods; too clayey.	Severe: floods; shrink-swell.
*Mobeetie:						
MoB, MoC	Slight	Severe: seepage.	Slight	Slight	Severe: seepage.	Moderate: low strength.
MoD, MVD For Veal part of MVD, see Veal soils.	Slight	Severe: seepage.	Slight	Slight	Severe: seepage.	Moderate: low strength.
Ness: Ne	Severe: floods; percs slowly.	Severe: floods.	Severe: floods; too clayey.	Severe: floods; shrink-swell.	Severe: too clayey; floods.	Severe: shrink-swell.
Perico:						
PcB	Slight	Moderate: seepage; slope.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
PeA	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
PeB, PeC	Slight	Moderate: seepage; slope.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
Potter:						
PoE	Moderate: slope.	Severe: seepage.	Severe: cemented pan.	Moderate: low strength.	Severe: cemented pan.	Moderate: cemented pan; seepage.
Potter part of BpG	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rickmore:						
RcB	Moderate: percs slowly.	Slight	Moderate: too clayey.	Moderate: low strength; shrink-swell.	Moderate: too clayey.	Moderate: low strength; shrink-swell.
RkA	Moderate: percs slowly.	Slight	Moderate: too clayey.	Moderate: low strength; shrink-swell.	Moderate: too clayey.	Moderate: low strength; shrink-swell.
*San Jon: SaB, SgD For interpretations of Glenrio part of SgD, see Glenrio series.	Moderate: percs slowly.	Moderate: seepage.	Slight	Moderate: shrink-swell.	Moderate: too clayey.	Moderate: shrink-swell.

properties of the soils—Continued

Degree and kind of limitations for—Continued		Suitability as source of—		Soil features affecting—		
Pond reservoir areas	Dikes, levees and other embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Moderate: percs slowly.	Moderate: piping; erodes easily.	Poor: low strength.	Fair: too clayey.	Slope	Favorable	Favorable.
Severe: seepage.	Moderate: erodes easily; low strength.	Good	Good	Fast intake; floods.	Not needed	Not needed.
Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Poor: excess lime.	Erodes easily; excess lime.	Erodes easily	Erodes easily.
Slight	Moderate: low strength.	Poor: low strength; shrink-swell.	Poor: too clayey.	Not suited	Not suited	Not suited.
Severe: seepage.	Moderate: piping; erodes easily.	Good	Poor: too sandy.	Not suited	Not suited	Not suited.
Severe: seepage.	Moderate: unstable fill; piping.	Good	Poor: too sandy.	Fast intake	Not needed	Favorable.
Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Slow intake; floods.	Not needed	Not needed.
Severe: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Good	Slope; fast intake.	Erodes easily	Erodes easily.
Severe: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Good	Slope; fast intake.	Erodes easily	Erodes easily.
Slight	Moderate: compressible; shrink-swell.	Poor: shrink-swell.	Poor: too clayey.	Slow intake; floods.	Not needed	Not needed.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Poor: too clayey.	Fast intake	Too clayey	Erodes easily.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: thin layer.	Fast intake	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: thin layer.	Slope: fast intake.	Favorable	Favorable.
Severe: cemented pan; seepage.	Severe: thin layer.	Fair: low strength.	Poor: thin layer.	Not suited	Not suited	Not suited.
Severe: seepage.	Severe: thin layer.	Severe: slope	Poor: thin layer; slope.	Not suited	Not suited	Not suited.
Moderate: seepage.	Moderate: low strength; erodes easily.	Fair: low strength; shrink-swell.	Poor: too sandy.	Slope	Favorable	Erodes easily.
Moderate: seepage.	Moderate: low strength; erodes easily.	Fair: low strength; shrink-swell.	Fair: thin layer.	Favorable	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: too clayey.	Slope	Favorable	Favorable.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitations for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfills	Local roads and streets
Sherm: ShA	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: shrink-swell.
Spur: Sm	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
Spurlock: SpB, SpC, SrB	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Slight	Moderate: low strength.
Sunray:						
SuA	Slight	Moderate: seepage.	Slight	Moderate: low strength.	Moderate: too clayey.	Moderate: low strength.
SuB	Slight	Moderate: seepage; slope.	Slight	Moderate: low strength.	Moderate: too clayey.	Moderate: low strength.
Tascosa: TaE	Moderate: slope.	Severe: seepage; slope.	Severe: small stones.	Moderate: slope.	Moderate: slope.	Moderate: slope.
*Valentine: Va, VcE. For interpretations of Spurlock part of VcE, see Spurlock series.	Moderate: slope.	Severe: seepage.	Moderate: slope.	Moderate: slope.	Moderate: slope.	Slight
*Veal. Mapped in association with Berda and Mobeetie soils.	Slight	Severe: seepage.	Slight	Slight	Slight	Moderate: low strength.
*Vingo: VDD. For interpretations of Dallam part of VDD, see Dallam series.	Slight	Severe: slope; seepage.	Slight	Slight	Severe: seepage.	Moderate: low strength.

overlie nearly impervious material. These soils have a very slow rate of water transmission and a high runoff potential.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semi-solid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semi-solid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 5, but in table 7 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in mmhos per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as construction material, and its corrosiveness to metals and concrete. Salinity is not a concern in any of the soils in Hartley County.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, or the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to main-

properties of the soils—Continued

Degree and kind of limitations for—Continued		Suitability as source of—		Soil features affecting—		
Pond reservoir areas	Dikes, levees and other embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Slight	Moderate: shrink-swell.	Poor: shrink-swell.	Fair: too clayey.	Slow intake	Favorable	Favorable.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Good	Floods	Not needed	Not needed.
Moderate: seepage.	Moderate: piping.	Fair: low strength.	Fair: excess lime.	Slope: excess lime.	Pipng; erodes easily.	Slope; erodes easily.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: too clayey.	Favorable	Erodes easily	Erodes easily.
Moderate: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Fair: too clayey.	Slope	Erodes easily	Erodes easily.
Severe: seepage.	Moderate: piping.	Good	Poor: small stones.	Not suited	Not suited	Not suited.
Severe: seepage.	Severe: erodes easily; unstable fill.	Good	Poor: too sandy.	Fast intake	Not suited	Not suited.
Severe: seepage.	Moderate: piping; erodes easily.	Fair: low strength.	Poor: excess lime; thin layer.	Not suited	Not suited	Not suited.
Severe: seepage.	Moderate: piping; erodes easily.	Good	Poor: too sandy.	Complex slope; fast intake.	Not needed	Not needed.

tenance of structures built in, on, or with material that has this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means there is a low probability of soil-induced corrosion damage. A rating of *high* means there is a high probability of damage, so that protective measures for steel should be used to avoid or minimize damage.

Engineering interpretations of the soils

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and other areas nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Hartley County. In table 6, ratings are used to summarize limitation or suitability of the soils for all listed purposes except for irrigation, waterways, and terraces and diversions. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties generally are favorable for the rated use or, in other words, limitations are minor and easily overcome. *Moderate* means some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings almost synonymous with the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 6.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability,

TABLE 7.—*Engineering*

[Tests performed by Texas Highway Department in accordance with standard procedures of the American Association of State

Soil name and location	Parent material	Texas report no.	Depth from surface	Shrinkage			Mechanical analysis[1] Percentage passing sieve—				
				Limit	Linear	Ratio	2 in.	1¼ in.	⅞ in.	⅝ in.	⅜ in.
			Inches	*Percent*	*Percent*						
Berda loam:											
2 miles south of Dalhart; 800 feet southeast of Rita Blanca Lake Dam. (Modal)	Calcareous loamy materials.	72–52–R	10–25	15	5.5	1.90	------	------	------	------	100
Conlen loam:											
12 miles east of Dalhart; from intersection of Farm Road 281 and U.S. Highway 87; 12 miles east on Farm Road 281; 1 mile south and 0.25 mile west; then 100 feet north of railroad. (Modal)	Calcareous loamy materials.	72–53–R	0–10	15	8.8	1.85	------	------	------	------	------
		72–54–R	15–30	20	6.1	1.73	------	------	------	100	99
		72–55–R	30–80	13	10.2	1.95	------	------	------	------	------
Dallam fine sandy loam:											
In Dalhart from intersection of Farm Road 281 and U.S. Highway 87; 8.5 miles southeast on U.S. Highway 87; then 0.25 mile east on dirt road and 200 feet south of road. (Modal)	Calcareous loamy materials.	72–56–R	0–9	15	2.7	1.87	------	------	------	------	------
		72–57–R	9–28	15	7.6	1.89	------	------	------	------	------
		72–58–R	48–80	14	11.4	1.92	------	------	------	------	------
Dumas loam:											
15 miles southwest and 4 miles west of Dalhart; from intersection of Farm Road 694 and U.S. Highway 54; 11 miles southwest on U.S. Highway 54; 4 miles west on county road and 100 feet north of road. (Modal)	Calcareous loamy materials.	72–62–R	0–10	15	6.0	1.85	------	------	------	------	------
		72–63–R	10–17	14	8.8	1.90	------	------	------	------	------
		72–64–R	22–36	14	7.4	1.93	------	------	------	------	------
		72–65–R	36–65	14	8.2	1.02	------	------	------	100	99
		72–66–R	65–85	13	7.3	1.95	------	------	------	------	100
Gruver loam:											
4 miles west of Dalhart; from intersection of Farm Road 998 and U.S. Highway 54; 2.9 miles south on Farm Road 998 and 100 feet west of highway. (Modal)	Calcareous loamy and clayey materials.	72–67–R	0–8	15	7.9	1.87	------	------	------	------	------
		72–68–R	8–19	14	10.7	1.93	------	------	------	------	------
		72–69–R	60–78	15	7.7	1.86	------	------	------	------	------
		72–70–R	78–98	12	8.7	2.01	------	------	------	------	------

test data

Highway and Transportation Officials (AASHTO) (*1*). Absence of an entry indicates that no determination was made]

Mechanical analysis—Continued									Liquid limit [2]	Plasticity index [2]	Classification	
Percentage passing sieve—Continued					Percentage smaller than—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (.42 mm.)	No. 60 (.25 mm.)	No. 200 (.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHTO [3]	Unified [4]
98	96	90	80	39	31	.....	21	15	24	11	A–6(1)	SC
.....	100	98	94	75	64	.....	28	18	33	17	A–6(11)	CL
97	95	93	90	75	70	.....	54	40	32	12	A–6(9)	CL
.....	100	98	92	57	48	.....	34	26	32	20	A–6(8)	CL
.....	100	96	80	34	25	.....	8	5	19	4	A–2–4(0)	SM–SC
.....	100	98	88	49	48	.....	30	27	29	16	A–6(5)	SC
.....	100	98	93	77	69	.....	44	38	37	23	A–6(13)	CL
.....	100	98	93	65	48	.....	13	8	26	10	A–4(6)	CL
.....	100	97	89	58	49	.....	25	20	31	17	A–6(7)	CL
.....	100	98	90	53	46	.....	23	18	27	14	A–6(5)	CL
97	95	91	81	53	47	.....	32	24	29	17	A–6(6)	CL
99	98	95	88	54	46	.....	30	23	26	15	A–6(6)	CL
.....	100	98	93	67	55	.....	26	18	30	15	A–6(8)	CL
.....	100	98	92	71	61	.....	34	26	35	21	A–6(11)	CL
.....	100	97	92	71	66	.....	51	42	30	15	A–6(9)	CL
.....	100	97	89	60	54	.....	39	81	27	17	A–6(8)	CL

TABLE 7.—*Engineering*

Soil name and location	Parent material	Texas report no.	Depth from surface	Shrinkage			Mechanical analysis [1]				
							Percentage passing sieve—				
				Limit	Linear	Ratio	2 in.	1¼ in.	⅞ in.	⅝ in.	⅜ in.
			Inches	*Percent*	*Percent*						
Guadalupe fine sandy loam:											
13 miles south of Dalhart; from the intersection of Farm Road 998 and U.S. Highway 54; 13 miles south and 2.5 miles east on Farm Road 998 50 feet south of highway, 50 feet east of Rita Blanca Creek Channel. (Modal)	Calcareous loamy alluvium.	72–59–R 72–60–R 72–61–R	0–10 10–21 21–36	18 16 16	2.2 5.3 3.2	1.74 1.85 1.82	------ ------ ------	------ ------ ------	------ ------ ------	------ ------ ------	------ ------ ------
Spurlock fine sandy loam:											
6.5 miles northeast of Channing; from intersection of U.S. Highway 385 and Farm Road 722; 0.8 mile east on Farm Road 722 and 100 feet north of road. (Modal)	Calcareous loamy materials.	72–79–R 72–80–R 72–81–R	0–8 18–36 54–88	15 14 12	3.8 8.7 9.0	1.85 1.92 1.98	------ ----- ------	------ ------ ------	------ ------ ------	------ ------ ------	------ 100 ------
Sunray clay loam:											
1.5 miles west of Exum; from intersection of Farm Road 281 and Farm Road 2577; 4.5 miles east on Farm Road 281 and 100 feet south of road. (Modal)	Calcareous loamy materials.	72–71–R 72–72–R 72–73–R 72–74–R 72–75–R	0–8 18–30 30–43 43–52 52–85	15 16 13 13 12	5.5 8.7 7.5 13.0 7.4	1.90 1.86 1.96 1.96 2.00	------ ------ ------ ------ ------	------ ------ ------ ------ ------	------ ------ ------ ------ ------	------ ------ ------ ------ ------	------ ------ 100 100 ------
Tascosa gravelly loam:											
13 miles west and 4.5 miles south of Channing; from intersection of Farm Road 767 and Farm Road 2357; 9 miles west on Farm Road 767, then 4.5 miles south on ranch road and 0.5 mile west on ridge. (Modal)	Gravelly outwash materials.	72–76–R 72–77–R 72–78–R	0–6 18–50 50–80	25 22 19	7.7 6.2 5.5	1.56 1.66 1.75	100 100 100	80 83 93	68 65 87	64 57 76	56 50 60

[1] Mechanical analysis according to the AASHTO Designation T88 (*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 AASHTO 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

test data—Continued

Mechanical analysis—Continued									Liquid limit [2]	Plasticity index [2]	Classification	
Percentage passing sieve—Continued					Percentage smaller than—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (.42 mm.)	No. 60 (.25 mm.)	No. 200 (.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHTO [3]	Unified [4]
------	100	99	85	17	11	------	6	4	21	4	A–2–4(0)	SM–SC
------	100	98	86	40	32	------	20	14	25	10	A–4(1)	SC
------	100	97	82	28	22	------	13	9	22	5	A–2–4(0)	SM–SC
------	100	98	------	24	------	------	------	------	21	5	A–2–4(0)	SM–SC
99	97	95	------	72	------	------	------	------	31	17	A–6(10)	CL
100	99	98	------	72	------	------	------	------	29	17	A–6(10)	CL
------	100	97	------	52	------	------	------	------	24	9	A–4(3)	CL
100	99	96	------	63	------	------	------	------	32	17	A–6(8)	CL
99	98	93	------	54	------	------	------	------	26	14	A–6(5)	CL
98	98	97	------	77	------	------	------	------	40	26	A–6(14)	CL
------	100	98	------	51	------	------	------	------	25	14	A–6(5)	CL
46	39	30	------	18	------	------	------	------	42	13	A–2–7(0)	GM
41	35	24	------	12	------	------	------	------	35	13	A–2–6(0)	GP–GC
48	41	18	------	6	------	------	------	------	30	12	A–2–6(0)	GP–GC

fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

[2] Laboratory test procedures may cause minor discrepancies in shrinkage limit, liquid limit, and the computed plasticity index.

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHTO designation M 145–49.

[4] Based on the Unified Soil Classification System (*2*).

depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow on effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor; and it has sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties that affect the pond floor and the embankment are considered. Those that affect the pond floor are permeability, organic matter, and slope; and if the floor needs to be leveled, depth to bedrock becomes important. Soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amount of stones, if any, that influence excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmissions lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings without basements, as rated in table 6, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 6 apply only to a depth of about 6 feet. Therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils, reliable predictions can be made to a depth of 10 to 15 feet; but every site should be investigated before it is selected.

Local roads and streets, as rated in table 6, have an all-weather surface that is expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones and content of organic material in a soil are among factors that are unfavorable.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. Limited amounts of sand and gravel are in Hartley County. The only deposits of commercial value are in the Tascosa series. The column for suitability as a source of sand and gravel was omitted from table 5.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is effected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil that is suitable

for these structures provides outlets for runoff and is not difficult to vegetate.

Waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Soil test data

Table 7 contains engineering test data for some of the major soil series in Hartley County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 5.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when oven dry.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

Formation and Classification of the Soils

This section discusses the five factors of soil formation and the process of horizon differentiation. It also classifies the soils by higher categories.

Formation of the Soils

The five major factors of soil formation are climate, living organisms (especially vegetation), parent material, relief, and time. The kind of soil that forms in one area differs from the kind of soil that forms in another area if there has been a difference between the two areas in one or more of the major factors.

Climate

The climate of Hartley County is a dry steppe type, characterized by mild winters. It is uniform, but its effects have been modified locally by relief and runoff. Because of low rainfall and long, dry periods, soil development is slow. The soils are seldom wet below the root zone; and, as a result, many have a horizon of soft powdery lime accumulation. Leaching has not removed free lime from the upper layers of such soils as Conlen, Sunray, and Berda.

Living organisms

Plants, micro-organisms, earthworms, and other forms of animal life are important in the formation of soils. The kinds and amounts of plants are determined partly by the climate and parent material. The vegetation in this county is mostly grass, but there are some brushy plants. The grasses are tall or short, depending on the kind of parent material. Vingo soils, which have sandy parent material, support tall grasses; and Sherm clay loam, which has a parent material much higher in clay content, supports short grasses.

The prairie type of vegetation contributes large amounts of organic matter to the soil. Grass, leaves, and stems fall on the surface, decay, and darken the surface soil. Roots decompose and distribute organic matter throughout the solum and provide food for earthworms and micro-organisms. Prairie dogs and other rodents offset the leaching of soluble minerals and destroy soil structure.

Man also has influenced soil formation by fencing the range and allowing it to be overgrazed, changing the vegetation, and plowing the soils for crops. He has clean harvested the crops and has not controlled runoff and soil blowing. Because of these practices, organic matter has been depleted and silt and clay particles have been blown from the plow layer. Heavy machinery and untimely tillage have compacted the soils and have slowed the infiltration of water and air. Irrigation has drastically changed the natural moisture regime in some areas.

Parent material

The soils of Hartley County formed in sandy, loamy, and clayey, calcareous, moderately alkaline sediment. This sediment was derived mostly from alluvial outwash from the Rocky Mountains and has been partially reworked by wind.

Dallam and Perico soils are among those that formed in a fairly thick mantle of ancient alluvial outwash. Guadalupe and Lincoln soils are examples of soils that formed in recent alluvium. Valentine and Vingo soils are examples of those formed in wind-laid sandy material.

Relief

Relief influences soil formation through its effects on drainage and runoff. If other factors of soil development are equal, the degree of profile development depends on the amount of water that enters a soil. For example, Potter and Sherm soils are on uplands. Potter soils are more sloping, have more runoff, absorb less moisture, and have a less well-developed profile than Sherm soils. In addition, the formation of steep soils is retarded by continuous erosion.

Relief also affects the kind and amount of vegetation on a soil. Soils on north-facing slopes receive less sunlight than those on southfacing slopes and consequently lose less moisture through evaporation. As a result, those on north slopes have the densest vegetation and generally are more strongly developed. For the same reason, soils that face east are better developed than those that face west.

Time

The characteristics of a soil are determined mainly by the length of time that the soil-forming factors have been active. A long time generally is required for the formation of well-defined, genetically related horizons. Gruver and Dumas soils are examples of those soils that have been in place a long time and have approached equilibrium with their environment. They are mature soils and show marked horizon differentiation. Examples of young soils that have a weakly developed profile are Colorado soils on bottom lands and Berda soils on slopes below the caprock escarpment.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationship to one another and to the whole environment, and develop principles that help us to 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 (*14*).

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and range; 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 of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search for the latest literature available.

The current system of classification has six categories (*16*). Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties (*15*) that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. In table 8, the soil series of Hartley County are placed in four categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates.

The six orders to which the soils of Hartley County belong are Alfisols, Aridisols, Entisols, Inceptisols, Mollisols, and Vertisols.

Alfisols have a light-colored surface layer low in organic matter, a clay-enriched B horizon, an accumulation of aluminum and iron, and a base saturation of more than 35 percent.

Aridisols have a light-colored surface layer low in organic matter, and have inadequate moisture to mature a crop without irrigation in most years.

Entisols have little or no evidence of development of pedogenic horizons.

Inceptisols have a light-colored surface layer low in organic matter, but lack a clay-enriched B horizon.

Mollisols have a dark-colored surface layer high in

TABLE 8.—*Classification of soil series*

Series	Family	Subgroup	Order
Berda	Fine-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Bippus	Fine-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols.
Colorado	Fine-loamy, mixed (calcareous), thermic	Typic Ustifluvents	Entisols.
Conlen	Fine-loamy, carbonatic, mesic	Calciorthidic Paleustolls	Mollisols.
Dallam	Fine-loamy, mixed, mesic	Aridic Paleustalfs	Alfisols.
Dumas	Fine-loamy, mixed, mesic	Aridic Paleustolls	Mollisols.
Glenrio	Clayey, mixed, thermic, shallow	Ustochreptic Camborthids	Aridisols.
Gracemore	Sandy, mixed, thermic	Aquic Udifluvents	Entisols.
Gruver	Fine, mixed, mesic	Aridic Paleustolls	Mollisols.
Guadalupe	Coarse-loamy, mixed, thermic	Fluventic Ustochrepts	Inceptisols.
Karde	Fine-silty, carbonatic, mesic	Ustic Torriorthents	Entisols.
Knoco	Clayey, mixed (calcareous), thermic, shallow	Ustic Torriorthents	Entisols.
Likes	Mixed, thermic	Typic Ustipsamments	Entisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Mangum	Fine, mixed (calcareous), thermic	Vertic Ustifluvents	Entisols.
Mobeetie	Coarse-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Ness	Fine, montmorillonitic, mesic	Udic Pellusterts	Vertisols.
Perico	Fine-loamy, mixed, mesic	Aridic Paleustalfs	Alfisols.
Potter	Loamy, carbonatic, thermic, shallow	Ustollic Calciorthids	Aridisols.
Rickmore	Fine-loamy, mixed, mesic	Aridic Paleustalfs	Alfisols.
San Jon	Fine-loamy, mixed, thermic	Ustochreptic Calciorthids	Aridisols.
Sherm	Fine, mixed, mesic	Torrertic Paleustolls	Mollisols.
Spur	Fine-loamy, mixed, thermic	Fluventic Haplustolls	Mollisols.
Spurlock	Coarse-loamy, carbonatic, mesic	Calciorthidic Paleustalfs	Alfisols.
Sunray	Fine-loamy, mixed, mesic	Calciorthidic Paleustolls	Mollisols.
Tascosa	Loamy-skeletal, mixed, thermic	Aridic Calciustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.
Veal	Fine-loamy, carbonatic, thermic	Aridic Ustochrepts	Inceptisols.
Vingo	Coarse-loamy, mixed, mesic	Aridic Paleustalfs	Alfisols.

organic matter, and have a base saturation of more than 50 percent.

Vertisols are clayey soils that have deep, wide cracks part of each year in most years.

SUBORDER. Each order is subdivided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation.

GREAT GROUP. Soil 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; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark red and dark brown colors associated with basic rocks, and the like.

SUBGROUP. Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other subgroups, called intergrades, made up of soils that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to plant growth or on the behavior of soils when used for engineering. Some of these properties are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

Environmental Features That Affect Soil Use in the County

This section provides information of general interest about Hartley County. It describes briefly facts about the climate, geology, history, irrigation, and livestock.

Climate [4]

Hartley County is in a cool temperate climatic zone. It has a dry steppe type of climate characterized by mild winters. Temperature and precipitation data for Hartley County are given in table 9.

Precipitation averages 16.25 inches annually. Approximately 85 percent of this amount falls during the warm season, April through October. Rainfall varies considerably from month to month and from year to year. Since 1949, the wettest year on record was 1960, when 24.55 inches fell. In 1955, the driest year, only 8.37 inches fell. Warm-season rainfall occurs most frequently as a result of thunderstorms. In exceptionally wet years, a significant proportion of the total rainfall may be in the form of excessive downpours that run off rapidly and erode the soil. In an average year, thunderstorms occur on 50 days.

Winds are south to southwesterly throughout the year, but in winter northerly winds predominate. The mean relative humidity at noon is estimated at 45 percent in January, 35 percent in April, 42 percent in July, and 37 percent in October. The mean percentage of total possible sunshine is estimated at 69 percent in winter, 71 percent in spring, 77 percent in summer, and 74 percent in fall. In an average year, free water evaporation exceeds precipitation by 44 inches.

In winter Hartley County is subject to sharp drops in temperature when cold polar Canadian air masses sweep southward across the level plains. Sometimes these air mass changes are accompanied by strong northerly winds. Although temperatures are low occasionally, the winters in this area are mild compared with those of the northern Great Plains. Cold spells rarely last longer than 48 hours before sunshine and southwesterly winds cause rapid warming. Nights are usually clear and cold. Freezes occur almost every night, but most days are sunny and mild. The lowest temperature of record at Dalhart is —21° F. It occurred on January 4, 1959.

Winter is a dry season, since frequent cold air masses ("northers") cut off the supply of moisture from the Gulf of Mexico. Winter precipitation often is in the form of light snow which piles up in drifts, so that the snowmelt is not distributed uniformly. The arithmetic mean often overestimates snowfall in a given year. A few exceptionally heavy snows cause the frequency distribution of snowfall amounts to be skewed.

Spring provides the greatest variety in weather. Throughout March and April, warm and cool periods follow each other in rapid succession. Trees and shrubs may bloom too early and be nipped by a late freeze. Occasionally, late in winter and in spring, strong northwesterly to southwesterly winds cause flowing dust in the area. Thunderstorms, which rarely occur in winter, are frequent late in spring.

Summer is one of the most pleasant seasons at Dalhart. Afternoon temperatures are sometimes hot, but most nights are pleasantly cool. Thundershowers are frequent, and cloudiness and precipitation which occur during the day cause significant cooling. Evaporative type air-conditioners operate efficiently in this relatively dry climate. The highest temperature on record at Dalhart is 107° F. It occurred on June 28, 1968.

Fall also is a pleasant season at Dalhart. Weather varies to a greater extent in fall than in summer, but temperatures are moderate. Rainfall decreases. Days are sunny and mild, and nights are clear and cool. Winds are not so strong as in spring.

The warm season, or freeze free period, at Dalhart averages 178 days. The mean dates of the last occurrence of a temperature 32° F or below in spring and the first in fall are April 23 and October 18, respectively.

[4] By ROBERT B. ORTON, State climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 9.—*Temperature and*

[Data from Dalhart, Texas; elevation

Month	Temperature					Precipitation			
						Probability, in percent, of receiving selected amounts during month			
	Mean daily maximum [1]	Mean monthly highest maximum [1]	Mean daily minimum [1]	Mean monthly lowest minimum [1]	Mean total [1]	0 inches or trace	0.50 inch or more	1.00 inch or more	2.00 inches or more
	°F	°F	°F	°F	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
January	50.1	71.9	18.7	1.6	0.38	10	30	10	5
February	53.3	74.1	22.8	7.0	0.51	1	30	10	1
March	59.6	80.9	27.5	10.4	0.74	5	45	25	8
April	70.1	88.1	38.1	24.5	0.89	5	70	45	23
May	79.0	89.4	49.1	35.6	2.69	([3])	94	80	58
June	88.1	99.6	59.2	47.6	2.27	([3])	89	70	40
July	91.5	101.0	63.8	56.9	3.32	([3])	91	80	50
August	89.8	99.5	62.2	54.0	2.19	([3])	90	78	48
September	82.5	95.1	53.8	41.2	1.35	3	69	50	29
October	73.2	89.8	41.6	28.3	1.14	5	69	69	25
November	59.6	79.0	28.2	11.9	0.35	18	39	19	4
December	51.5	71.6	21.1	3.8	0.42	10	38	18	4
Year	70.7	----	40.5	----	16.25	----	----	----	----

[1] Average length of record, 21 years.
[2] Average length of record, 14 years.
[3] Less than 1 percent.

Geology [5]

Rocks of two geologic eras are exposed in Hartley County. They belong to the Triassic System of the early Mesozoic Era and the late Tertiary and Quaternary systems of the Cenozoic Era (*12*). Earth movements in latest Paleozoic and earliest Mesozoic time (*12*) resulted in major uplift of Permian and older rocks above sea level. The formations of the Triassic Dockum Group (*12, 13*) are composed of "red bed" materials deposited by streams. The streams headed in uplands adjacent to the Panhandle region and eroded the exposed rocks. These rocks, probably the Trujillo Formation (*6*), are exposed along Canadian River tributaries in the southern part of the county where younger (Cenozoic) deposits have been eroded away. Typical lithologies include red to gray, cross-bedded sandstone and conglomerate with interbedded claystones and mudstones (*6, 13*).

The present soil landscapes of Hartley County are the result of the construction and partial dissection of the High Plains landscape. Streams flowing eastward from the rising Rocky Mountain mass deeply eroded older bedrock terrains, primarily of Mesozoic age, and locally cut into late Paleozoic-Permian red bed units. Early Pliocene streams deposited the gravelly to sandy alluvial outwash that comprises the basal strata of the Ogallala Formation in valley areas. Deposition of finer textured sediment followed and valley systems were completely backfilled. Ancient interfluve areas were buried by an extensive blanket of alluvium and some eolian deposits that make up the upper part of the Ogallala unit. Aggradation continued through middle Pliocene time until a vast piedmont plain was formed. The plain extended several hundred miles east of the Rocky Mountains (*5*). In much of the region, a strong indurated caliche zone formed in the uppermost beds of the formation during late Pliocene time (*5*). The Ogallala Formation, which ranges from 200 to 700 feet in thickness, once covered the entire panhandle region. It has been eroded away, however, in parts of the Canadian River Valley near the south edge of the county and has been partly dissected by larger streams such as Punta de Agua and Rita Blanca Creeks (*12*).

With regards to basic soil-landscape relationships, the most important events of geologic history occurred during the Quaternary Period and include (a) the deposition of the mantle of eolian (windblown) sediments that blanket the Ogallala Formation and older lake basin units on the Panhandle High Plains, (b) the episodic development and partial filling of playa lake basins, and (c) the cutting of stream valleys below the plains surface (*4, 8, 11*).

The bulk of eolian deposits was laid down during the middle to late part of the Pleistocene Epoch of the Quaternary Period, and is informally designated "windblown cover sands" by geologists (*5, 12*). The climate during intervals of major eolian activity was presumed to have been relatively dry, windy, and desiccating. Prevailing winds were generally from the southwest to the west (*8, 9, 10*). Throughout this period the entrenched Canadian and Pecos valley systems were forming to the west and south. Medium- to fine-textured sediments deflated from these valley areas, as well as from existing playa basins, comprise the bulk of the "cover" sediments; but there is also thought to

[5] DR. JOHN HAWLEY, soil scientist, Soil Conservation Service, assisted in the preparation of this section.

precipitation data

3,989 feet. Period of record 1949–69]

Precipitation—Continued									
Probability, in percent, of receiving selected amounts during month—Continued				Mean number of days				Snow, sleet	
3.00 inches or more	4.00 inches or more	5.00 inches or more	6.00 inches or more	0.10 inch or more [2]	0.50 inch or more [2]	1.00 inch or more [2]	Mean total [1]	Maximum monthly [1]	Greatest depth [2]
Percent	*Percent*	*Percent*	*Percent*				*Inches*	*Inches*	*Inches*
([3])	([3])	([3])	([3])	1	([4])	0	2.7	8.8	7
([3])	([3])	([3])	([3])	1	([4])	([4])	3.0	16.9	12
3	([3])	([3])	([3])	2	([4])	([4])	2.7	12.3	7
7	3	([3])	([3])	2	([4])	([4])	0.7	5.0	1
39	20	10	5	5	2	1	([5])	([5])	0
25	18	8	4	5	2	1	0	----	0
29	20	10	6	6	2	1	0	------	0
28	15	9	5	5	2	1	0	------	0
18	9	4	3	3	1	([4])	0	----	0
15	8	4	3	2	1	([4])	([5])	([5])	0
1	([3])	([3])	([3])	1	([4])	0	1.4	10.0	8
([3])	([3])	([3])	([3])	2	([4])	0	2.9	8.1	7
----	----	----	----	35	10	4	13.4	16.9	12

[4] Less than one-half day.
[5] Trace.

be a component of fine-grained (loessial) material that thickens northward, derived from river valley systems crossing the Great Plains north of the Panhandle (*8, 11*). There is good evidence that emplacement of windblown sediments was episodic and that periods of relative surface stability and soil formation occurred at intervals in the aggradational sequence (*8*). The thickness of the resultant mantle of eolian deposits ranges from 30 to 100 feet. Sherm, Gruver, Dumas, Dallam, Sunray, Conlen, and Ness soils formed in this material. Coarser (sandy) windblown materials deposited in the western part of the county, and derived from deflation areas a short distance to the west, form the parent materials of Vingo, Dallam, Perico, and Spurlock soils.

Closed playa-lake depressions receive much of the runoff in areas between stream valleys in northern and eastern parts of the county. These shallow basins are primarily of deflation origin (*3, 4, 11*) and often contain several ages of late Quaternary lake sediments. Locally, eolian materials have been deposited on the leeward slopes of basins. Soils associated with playa depressions include Conlen, Karde, Ness, Gruver, and Sunray. Erosion by Rita Blanca Creek and its tributaries about 6 miles west of Channing has exposed extensive ancient lake deposits of early Pleistocene age (*3, 4, 7*) that are similar to the Blanco and Tule Formations associated with large pluvial lake basins of the Llano Estacado (*4, 5, 8, 11*). Exposed materials are dominantly light colored sand, sandstone, calcareous claystone, and argillaceous limestone (*3*).

Slopes graded towards the valleys of the Canadian River and its major tributaries are characterized by relatively thin and discontinuous alluvial and colluvial fills of late Quaternary age. The fills overlie erosion surfaces cut on (a) older Pleistocene eolian and lacustrine units (b) the Ogallala Formation, and (c) Triassic red beds. Soils associated with eroded red-bed terrains include the San Jon, Knoco, and Glenrio. Soils of valley slopes graded across late Cenozoic alluvial, eolian, and lacustrine units include the Berda, Mobeetie, and Veal series.

The source of the underground water for irrigation is the saturated sand and gravel at the base of the Ogallala Formation. The water probably accumulated during the wet, humid intervals during and subsequent to deposition of the formation. The almost impervious underlying red beds kept the water from percolating deeper. At present, there seems to be little recharge from rainfall, and water is being pumped out faster than it is restored.

Throughout Quaternary time, tributary valleys of the Canadian River System have gradually encroached on the High Plains. However, wind activity has resulted in sizable contribution of eolian sediment to extensive plains areas during the same period.

History, Development, and Settlement

The area that is now Hartley County was originally inhabited by the Comanches, Kiowas, Apaches, and other Indian tribes that hunted buffalo, deer, and antelope. Settlers came to the area in the 1800's.

Hartley County was created from the Bexar and Young Territories in 1876. The county was organized in 1891 and was named after pioneer Texas attorneys Oliver C. and Rufus K. Hartley.

The early history of the county was largely dominated by the vast XIT Ranch. This ranch covered 3

million acres, from the Oklahoma State line to near what is now Lubbock, Texas. The land was payment to a Chicago syndicate for construction of the state capitol building in Austin, Texas. In most places, the western boundary of the XIT was the New Mexico state line. The eastern boundary was somewhat irregular.

Blizzards, drouths, and rustlers were great enemies of the XIT, which at one time had over 150,000 head of cattle. In the 1880's the ranch was the world's largest, but since then it has been divided into smaller ranches and farms. A large tract of land near Channing became the famous Matador Ranch, which operated the land until the 1950's.

Farming began to be extensive in the 1920's with the advent of the tractor. Large tracts of grassland were cultivated. Farming intensified rapidly during the next few years, and the county became an area of extensive dryland farming and ranching. Wheat and grain sorghum were grown in large acreages. Then, in the early thirties drought struck the Great Plains. Dust storms, lack of rainfall, and low market prices forced many farmers to leave the area. The area became known as the "Dust Bowl", and the era was known as the "Dirty Thirties" or "Dust Bowl Days". Only the better farmers or the farmers with adequate financial backing remained.

The early forties brought a series of wet years. Irrigation from deep wells was started about this time. Also, much was learned about how to farm the soils to control erosion. At present, as in earlier times, wheat and grain sorghum are the main crops; but ensilage, corn, sugar beets, alfalfa, and irrigated pasture are becoming important secondary crops. Raising of cattle is still the most important phase of agriculture in the county. Several large ranches still exist.

In the early 1960's, important advances in the development of irrigation were made in the county. At the present time there is a large expansion in the cattle-feeding industry.

Irrigation, improved farming and ranching practices, and better outlets for farm products are the main factors that have helped to produce a stable agriculture.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvial fan. A fan-shaped deposit of sand, gravel, and fine material dropped by a stream where its gradient lessens abruptly.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Aquifer. A porous soil or geological formation that yields ground water to wells and springs.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Buried soil. A developed soil, once exposed but now overlain by more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conglomerate. Rock composed of gravel and rounded stones cemented together by hardened clay, lime, iron oxide, or silica.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour. An imaginary line connecting points of equal elevation on the surface of the soil.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by lakes and streams associated with them.

Drill seeding. Planting seeds with a drill, generally in rows less than a foot apart.

Dryfarming. Production of crops that require some tillage in a subhumid region, without irrigation. Usually involves use of periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes, or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope.

Granule. A single mass, or cluster, of many individual soil particles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Grazing capacity. The maximum number of animals or animal units per acre or acres per animal unit, that a grazing area can support adequately without deterioration; sometimes called carrying capacity.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hue. One of the three variables of color. The dominant spectral (rainbow) color; it is related to the dominant wavelength of the light. See Munsell notation.

Humidity, relative. The ratio of the actual amount of water vapor in the air to the quantity that would be there if it were saturated.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic cycle. Groups of soils having similar rates of infiltration by water, even when wetted, and similar rates of water transmission within the soil. There are four such groups of soils currently recognized by the Soil Conservation Service.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Indicator plants (ecology). Plants that give reliable information concerning present condition and past history of an area as to soil, alkalinity, salinity, climate, depth to water table, overgrazing, fire, and the use to which the area is best adapted.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Inherited soil characteristic. Any characteristic of a soil that results directly from the nature of the soil material from which it formed, as contrasted to characteristics that are wholly or partly the result of soil-forming processes acting on parent material. For example, some soils are red because the parent material was red, but the color of most red soils is the result of the soil-forming processes.

Intensive cropping. Maximum use of the land through the frequent growing of harvested crops.

Intermittent stream. A stream or part of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Invasion (ecology). The movement of a plant or group of plants from one area into another and their establishment in the new area. The process involves migration, establishment, and finally, competition.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Land leveling. The reshaping of the ground surface to make for a more uniform application of irrigation water.

Landscape. All the characteristics that distinguish a certain kind of area on the earth's surface and give it a distinguishing pattern, in contrast to other kinds of areas. Any one kind of soil is said to have a characteristic natural landscape, and under different use it has one or more characteristic cultural landscapes.

Length-of-run (irrigation). The distance water is carried in furrows or by flooding from the head ditch to the lower end of the field.

Lime concretion. An aggregate cemented by the precipitation of calcium carbonate ($CaCO_3$).

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Marine deposit. Material deposited in the waters of oceans and seas and exposed by the elevation of the land or the lowering of the water level.

Marl. An earthy, unconsolidated deposit formed in fresh-water lakes that consists chiefly of calcium mixed with various amounts of clay or other impurities.

Mature soil. Any soil with well-developed soil horizons having characteristics produced by the natural processes of soil formation and in near equilibrium with its present environment.

Mechanical analysis (soils). The percentage of the various sizes of individual mineral particles, or separates, in the soil. Also, a laboratory method of determining soil texture.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Micro-organisms. Forms of life that are either too small to be seen with the unaided eye or are barely discernible.

Microrelief. Minor surface configurations of the land.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Montmorillonite. A fine, platy, alumino-silicate clay mineral that expands and contracts with the absorption and loss of water. It has a high cation-exchange capacity and is plastic and sticky when wet.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Normal soil. A soil having a profile near equilibrium with its environment; developed under good but not excessive drainage from parent material of mixed mineral, physical, and chemical composition. Its characteristics show the full effects of the forces of climate and living matter.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium. calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Organic matter. A general term for plant and animal material, in or on the soil in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of decomposition.

Overgrazing. Grazing so heavy as to impair future forage production and to deteriorate plants or soil, or both. Contrasts with undergrazing.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permanent pasture. Pasture that is on the soil for a long time, in contrast to rotation pasture, which is on the soil only a year or two because it is grown in rotation with other crops.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid. (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Plastic (soil consistence). Capable of being deformed without being broken.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plow layer. The soil ordinarily moved in tillage; equivalent to surface soil.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Pore space. That fraction of the total space in a soil that is not occupied by solid particles.

Porosity, soil. The degree to which the soil mass is permeated with pores or cavities.

Precipitation-effectiveness (P-E) index. The sum of the 12 monthly quotients of precipitation divided by the evaporation during the 12 months.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—excellent, good, fair, and poor. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range plant cover. All the herbaceous and shrubby plants on a range that livestock can reach, regardless of whether these plants constitute forage.

Range seeding. Establishing perennial grass or improved reseeding of grasses or legumes on rangeland to prevent the loss of soil and water and to restore the productivity of natural grassland.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Range survey. A systematic, comprehensive inventory and analysis of the range resources and the related problems of management in a range area, and the development of plans for its management.

Range type. An area of range differentiated from other range areas primarily by its kind of plant cover, such as grass, browse, or conifer.

Reaction, soil. The degree of acidity of alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Retention, moisture. The difference between the total precipitation and total runoff; the precipitation falling in a drainage area that does not escape as runoff.

Rolling. Having moderately steep, complex slopes; intermediate between undulating and hilly.

Root zone. The part of the soil that can be penetrated by plant roots.

Rotation grazing. Grazing two or more pastures, or parts of a range, in regular order, with definite recovery periods between grazing periods. Contrasts with continuous grazing.

Row crop. A crop planted in rows, generally 2 to 4 feet apart, so as to allow cultivation between rows during the growing season.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Salting (range). Leaving stock salt on the range or pasture in different places so that the vegetation will not be depleted in any one area. Livestock can thus be drawn to places not frequently grazed because of unfavorable topography, lack of water, or odd shape.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandy soils. A broad term for soils of the sand and loamy sand classes; soil material with more than 70 percent sand and less than 15 percent clay.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, ten multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.005 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum

in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subgrade (engineering). The substratum, consisting of in-place material or fill material, that is prepared for highway construction; does not include stabilized base course or actual paving material.

Subgrade modulus (engineering). The resistance of soil material to unit area displacement under load, expressed in pounds per square inch. Hence, if a load of 1,000 pounds, on 100 square inches of surface, penetrates 1 inch, the modulus is 10.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface tillage. Tillage with a sweeplike plow or blade that does not turn over the surface cover or incorporate it into the lower part of the surface soil.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging n depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Value (color). One of the three variables of color. Value increases as the relative intensity of reflected light increases. See Munsell notation.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windbreak. Any shelter that protects from the wind. A vegetative windbreak is a strip of closely spaced trees that is planted primarily to deflect wind currents and thereby reduce soil blowing, control snow drifting, conserve moisture, and protect crops, orchards, livestock, and buildings.

Wind stripcropping. Growing crops in strips that run crosswise to the general direction of prevailing wind and without adherence to the contour of the land.

Yield, sustained. The yield obtained when the productive capacity of soils is maintained through management.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, read the description then check its mapping unit for recommendations on use and management. For information about a range site, read the range site description and the introduction to the range section on pages 33 to 38. For facts about wildlife and recreation, turn to the sections beginning on pages 38 and 40, respectively. Absence of data in the column on irrigated capability units means the soil is not suited to irrigation.

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Capability unit Irrigated Symbol	Range site Name
BeC	Berda loam, 3 to 5 percent slopes	8	IVe-4	IVe-2	Hardland Slopes
BeD	Berda loam, 5 to 8 percent slopes	9	VIe-4	------	Hardland Slopes
BpG	Berda-Potter complex, 15 to 50 percent slopes	9	VIIe-1	------	Rough Breaks
BRD	Berda-Veal association, undulating	9	VIe-4	------	----------
	Berda part	--	------	------	Hardland Slopes
	Veal part	--	------	------	Mixedland Slopes
BuA	Bippus clay loam, 0 to 1 percent slopes	11	IIe-1	IIe-1	Draw
BuB	Bippus clay loam, 1 to 3 percent slopes	11	IIIe-6	IIIe-1	Draw
Ca	Colorado loam	11	IIe-1	IIe-1	Loamy Bottomland
CoB	Conlen loam, 0 to 3 percent slopes	12	IVe-2	IIIe-4	Hardland Slopes
DaB	Dallam loamy fine sand, 0 to 3 percent slopes	13	IVe-1	IIIe-3	Loamy Sand
DfA	Dallam fine sandy loam, 0 to 1 percent slopes	13	IIIe-1	IIe-3	Sandy Loam
DfB	Dallam fine sandy loam, 1 to 3 percent slopes	13	IIIe-5	IIIe-2	Sandy Loam
DfC	Dallam fine sandy loam, 3 to 5 percent slopes	13	IVe-3	IVe-2	Sandy Loam
DuA	Dumas loam, 0 to 1 percent slopes	14	IIIe-3	IIe-2	Clay Loam
DuB	Dumas loam, 1 to 3 percent slopes	15	IIIe-6	IIIe-1	Clay Loam
GkD	Glenrio-Knoco complex, 3 to 12 percent slopes	15	VIIs-1	------	Shallow Clay
Gm	Gracemore soils	16	Vw-1	------	Wet Bottomland
GrA	Gruver loam, 0 to 1 percent slopes	16	IIIe-3	IIe-2	Clay Loam
GrB	Gruver loam, 1 to 3 percent slopes	17	IIIe-6	IIIe-1	Clay Loam
Gu	Guadalupe fine sandy loam	17	IIIe-2	IIe-4	Loamy Bottomland
KaB	Karde soils, 1 to 3 percent slopes	18	IVe-5	IIIe-5	High Lime
KaC	Karde soils, 3 to 5 percent slopes	18	VIe-3	IIIe-5	High Lime
Lk	Likes loamy fine sand	19	VIe-1	------	Loamy Sand
Ln	Lincoln soils	19	Vw-1	------	Sandy Bottomland
Ma	Mangum clay	19	IIIw-1	IIIw-1	Clay Flat
MoB	Mobeetie fine sandy loam, 1 to 3 percent slopes	20	IIIe-5	IIIe-2	Mixedland Slopes
MoC	Mobeetie fine sandy loam, 3 to 5 percent slopes	20	IVe-3	IVe-2	Mixedland Slopes
MoD	Mobeetie fine sandy loam, 5 to 8 percent slopes	20	VIe-2	------	Mixedland Slopes
MVD	Mobeetie-Veal association, undulating	20	VIe-2	------	Mixedland Slopes
Ne	Ness clay	21	VIw-1	------	(1/)
PcB	Perico loamy fine sand, 0 to 3 percent slopes	21	IVe-1	IIIe-3	Loamy Sand
PeA	Perico fine sandy loam, 0 to 1 percent slopes	22	IIIe-1	IIe-3	Mixedland Slopes
PeB	Perico fine sandy loam, 1 to 3 percent slopes	22	IIIe-5	IIIe-2	Mixedland Slopes
PeC	Perico fine sandy loam, 3 to 5 percent slopes	22	IVe-3	IVe-2	Mixedland Slopes
PoE	Potter soils, 3 to 15 percent slopes	23	VIIs-1	------	Very Shallow
RcB	Rickmore loamy fine sand, 0 to 3 percent slopes	23	IVe-1	IIIe-3	Loamy Sand
RkA	Rickmore fine sandy loam, 0 to 1 percent slopes	23	IIIe-1	IIe-3	Sandy Loam
SaB	San Jon clay loam, 1 to 3 percent slopes	24	VIe-5	IIIe-1	Clay Loam
SgD	San Jon-Glenrio complex, 3 to 8 percent slopes	24	VIe-5	------	----------
	San Jon part	--	------	------	Clay Loam
	Glenrio part	--	------	------	Shallow Clay
ShA	Sherm clay loam, 0 to 1 percent slopes	25	IIIe-4	IIs-1	Clay Loam
Sm	Spur loam	26	IIe-1	IIe-1	Draw
SpB	Spurlock fine sandy loam, 0 to 3 percent slopes	26	IVe-2	IIIe-4	Mixedland Slopes
SpC	Spurlock fine sandy loam, 3 to 5 percent slopes	26	IVe-4	IVe-3	Mixedland Slopes
SrB	Spurlock soils, undulating	27	IVe-2	IIIe-4	Mixedland Slopes
SuA	Sunray clay loam, 0 to 1 percent slopes	27	IIIe-3	IIe-2	Clay Loam
SuB	Sunray clay loam, 1 to 3 percent slopes	28	IIIe-6	IIIe-1	Clay Loam

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Capability unit Irrigated Symbol	Range site Name
TaE	Tascosa gravelly loam, 3 to 15 percent slopes	28	VIs-1	------	Gravelly
Va	Valentine fine sand	28	VIIe-2	------	Sand Hills
VcE	Valentine-Spurlock complex, hummocky	29	VIIe-2	------	Sand Hills
VDD	Vingo-Dallam association, undulating	30	VIe-1	IVe-1	Loamy Sand

1/ Included with the surrounding range site.

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