Series 1959, No. 21 Issued April 1963

SOIL SURVEY

Bailey County, Texas

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with the
TEXAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; serve as a reference for students and teachers; and add to the knowledge of soil scientists.

In making this survey, soil scientists checked the fields and native grasslands in all parts of the county. They dug holes and examined surface soils and subsoils; measured slopes with a hand level; noted differences in growth of crops, weeds, and grasses; and recorded observations about the soils that they believed might affect their suitability for farming, engineering, and other uses.

The scientists plotted the boundaries of the soils on aerial photographs. Then, cartographers prepared from the photographs the detailed soil map in the back of this report. Fields, roads, and many other landmarks can be seen on the map.

Locating the Soils

Use the index for the map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. The boundaries of the soils are outlined on each sheet of the soil map, and there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. The symbol will be inside the area if there is enough space; otherwise, it will be outside the area and a pointer will show where it belongs.

Suppose, for example, an area located on the map has the symbol AfA. The legend for the detailed map shows that this symbol identifies Amarillo fine sandy loam, 0 to 1 percent slopes. This soil and all others mapped in the county are described in the section "Descriptions of the Soils."

Finding Information

The soil survey report has special sections for different groups of readers, as well as sections that may be of value to all.

Farmers and ranchers can learn about the soils in the section "Descriptions of the Soils" and then identify them on their land. They can learn how these soils can be managed by reading the section "Use and Management of the Soils."

The soils are placed in capability units; that is, groups of soils that need similar management and respond in about the same way. For example, in the section "Descriptions of the Soils," Amarillo fine sandy loam, 0 to 1 percent slopes, is shown to be in capability unit IIIe-2 (dryland) and capability unit IIe-2 (irrigated). These capability units are discussed in the section "Use and Management of the Soils."

The soils are placed in range sites, which are kinds of rangeland. Each range site has its own potential for production of grasses and other vegetation. For example, Amarillo fine sandy loam, 0 to 1 percent slopes, is placed in the Mixed Land range site. A description of each range site is given in the section "Range Management."

The "Guide to Mapping Units, Capability Units, and Range Sites" at the back of the report will simplify the use of the map and the report. The guide gives the name and map symbol for each soil and the page on which the soil is described, and the capability units and range site in which the soil has been placed and the pages on which the units are described.

Help in making plans for farms or ranches can be obtained through a local representative of the Soil Conservation Service or the county agricultural agent. Members of the staff of the Texas Agricultural Experiment Station and others familiar with farming in Bailey County will also be glad to help.

Engineers will want to refer to the section "Engineering Applications." Tables in that section show characteristics of the soils that affect engineering.

Soil scientists and others interested in the scientific aspects of the soil survey will find information about how the soils were formed and how they are classified in the section "Genesis, Classification, and Morphology of the Soils."

Students, teachers, and other users will find information about the soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Bailey County will be especially interested in the section "General Soil Map," which describes the broad pattern of the soils. They may also wish to read the section "Additional Facts About the County."

* * * * *

The Blackwater Valley Soil Conservation District was organized by farmers and ranchers in the county in 1941. The district helps farmers and ranchers get technical assistance from the United States Department of Agriculture on soil and water conservation. The survey of the soils of this county is part of this technical assistance.

This cooperative soil survey was made by the United States Department of Agriculture and the Texas Agricultural Experiment Station to provide a basis for determining the best agricultural uses of the soils. The Soil Conservation Service completed the fieldwork in 1959, and unless otherwise specified, all statements in this report refer to conditions at that time.

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SOIL SURVEY OF BAILEY COUNTY, TEXAS

BY CHARLES L. GIRDNER, JR., WAYNE E. RICHARDSON, ERNEST D. RIVERS, GARY L. REED, JAMES W. GREEN, DOUGLAS R. LOWE, AND SAMUEL B. NIX, SOIL CONSERVATION SERVICE

REPORT BY CHARLES L. GIRDNER, JR., SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

BAILEY COUNTY is in the southwestern part of the Panhandle of Texas. It is in the High Plains section of the Southern Great Plains. The total land area is 536,960 acres, or 839 square miles. The county is rectangular and extends about 25 miles from east to west, and about 33 miles from north to south. The location of Bailey County in Texas is shown in figure 1.

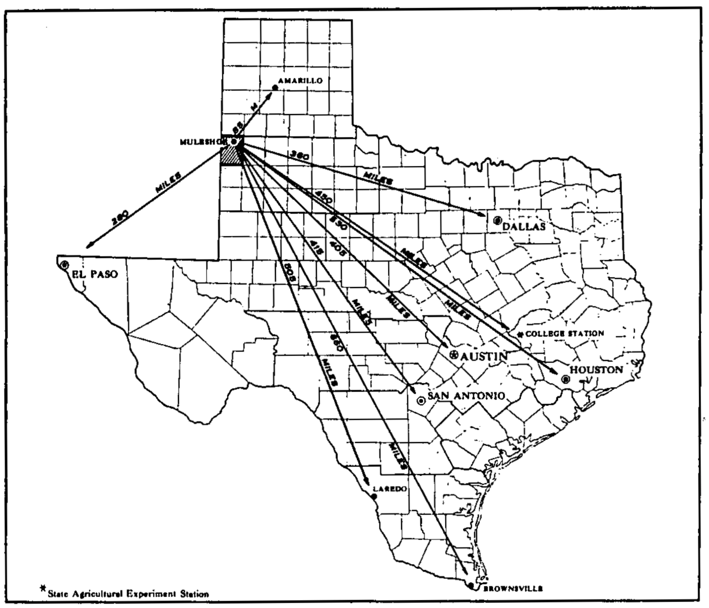

Figure 1.—Location of Bailey County in Texas.

This county is bordered on the west by Roosevelt County, N. Mex., on the south by Cochran County, Tex., on the east by Lamb County, Tex., and on the north by Parmer County, Tex.

The area is generally a nearly level to gently undulating plain that slopes upward from southeast to northwest. The elevation rises from about 3,600 to about 4,100 feet above sea level. The highest elevation in the county is northwest of Stegall. It is about 4,150 feet above sea level.

This is an agricultural county. About 370,797 acres are cultivated; of this area 221,321 acres are dry-farmed, and 149,476 acres are irrigated. Cotton and grain sorghum are the main crops. Other crops grown are alfalfa, corn, sesame, small grains, and vegetables. Much of the cropland is subject to wind and water erosion. There are periods of drought similar to those in other areas in the Southern Great Plains. Some years have ample moisture, when crops may be above average. Some are dry years, when crops not irrigated are below average.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Bailey County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored 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 to the rock material that has not been changed much by leaching or by roots of plants.

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 uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

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. Amarillo and Arvana, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Amarillo fine sandy loam and Amarillo loam are two soil types in the Amarillo series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Amarillo fine sandy loam, 3 to 5 percent slopes, is one of three phases of Amarillo fine sandy loam, a soil type that ranges from nearly level to gently sloping.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because they show woodlands, buildings, field borders, trees, and similar detail that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. 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 type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, he shows this mixture of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Arvana-Amarillo loams. Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Active dunes, and are called land types rather than soils.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units, and had shown the location of the mapping units on the soil map. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, managers of rangelands, and engineers.

To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; range sites, for those using large tracts of native grass; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After studying the soils in a locality and the way they are arranged, it is possible to make a general map that shows the main patterns of soils. Such a map is the colored general soil map in the back of this report. The patterns are called soil associations. Each kind of association, as a rule, contains a few major soils and several minor soils in a pattern that is characteristic, although not strictly uniform.

The soils within any one association are likely to differ greatly among themselves in some properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general map does not show the kind of soil at any particular place, but main patterns of soils. Each pattern may contain several kinds of different soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soil series of one association may also be present in other areas, but in a different pattern.

The general map that shows patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

1. Amarillo fine sandy loam association: Level to gently sloping, deep, moderately coarse textured, moderately permeable soils

The soils in this association occupy a nearly level to gently sloping plain that has a gradual slope to the southeast. This plain is dotted with basins, 10 to 100 acres in size. Intermittent lakes occur in the lowest part of the basins. This soil association contains about 156,000 acres.

Amarillo fine sandy loam, a deep, reddish-brown soil, is the most extensive soil in the area (fig. 2). The soils of other series that are within the lake basins are the Portales soils, which are darker than the Amarillo and limy to the surface; the Zita soils, which are darker; the Mansker soils, which are shallow; and the Randall soils, which consist of a dark clay in lakebeds. Other soils on the plain are the Arvana soils, which are underlain by rocklike caliche, and the Lubbock soils, which are darker and occupy slight depressions.

Most of this association is used for the production of crops. About one-half of the area is irrigated. Cotton and grain sorghum are the main irrigated crops. About 10 percent of the irrigated acreage is in alfalfa, corn, sesame, vegetables, and grass for seed.

These soils are productive, but they must be protected to control damage from wind erosion.

2. Amarillo-Arvana association: Level to gently sloping, moderately deep to deep, moderately coarse textured, moderately permeable soils

The soils of this association occupy a nearly level to gently sloping plain that has a gradual slope to the southeast. This plain is dotted with intermittent lakes, 10 to 30 acres in size. This soil association contains about 160,960 acres.

Amarillo and Arvana soils are the most extensive soils in the area. The Arvana soils are underlain by rocklike caliche that occurs at a depth of 36 inches. There are some rock outcrops in places. Other soils that occur on the plain are the Portales, Mansker, and Kimbrough soils. The soils that occur within the lake basins are the Zita, Portales, Mansker, and Randall soils.

About three-fourths of the association is cultivated; about 30 percent of the cultivated area is irrigated. Cotton and grain sorghum are the main crops. Most of the native range is in small pastures on shallow soils.

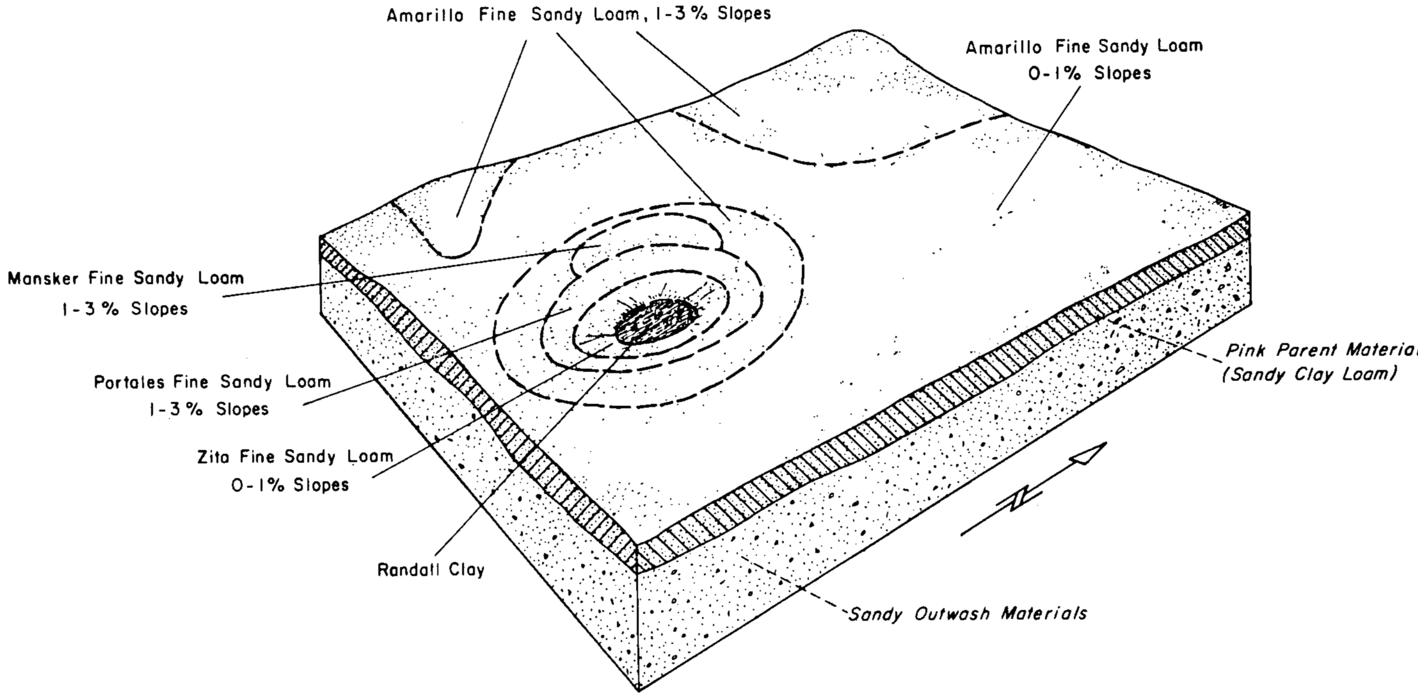

Figure 2.—**Amarillo fine sandy loam association.**

These soils are moderately productive but must be protected to control damage from wind erosion.

3. *Tivoli-Brownfield association: Duned and undulating, deep, coarse-textured soils*

The soils of this association occupy duned and gently undulating areas. The Tivoli fine sand is in the duned areas, and Brownfield fine sand is in the undulating areas (fig. 3). This association covers about 95,000 acres.

About 90 percent of this association is rangeland. If properly managed, it produces good yields of tall grasses. The 10 percent under cultivation is irrigated. The high hazard of wind erosion makes these soils poorly suited to cultivation.

4. *Amarillo loamy fine sand association: Gently undulating, deep, coarse-textured, moderately permeable soils with thin surfaces*

The soils of this association occupy a gently undulating area. Amarillo soils make up most of the area, but some Brownfield and Springer soils occur in scattered areas. Brownfield soils have thicker and sandier surface soils than the Amarillo, and the Springer soils have sandier subsoils.

This association occupies about 38,000 acres. About half of this acreage is irrigated cropland, and a fourth is rangeland. The main crops are cotton and grain sorghum.

These sandy soils need intensive management that will protect them from wind erosion.

5. *Arch-Drake association: Level to sloping, moderately deep, medium-textured, high-lime soils*

The soils of this association occupy nearly level to sloping areas surrounding saline lake basins or along Blackwater Draw. The association occupies about 35,000 acres. The Arch soils surround the lakebeds. The high dunes to the southeast of the saline lakes are Drake soils (fig. 4). Slowly permeable Church soils and less limy Portales soils make up about 25 percent of the soil area.

About 60 percent of this area is rangeland. In grazed areas, the present vegetation consists of alkali sacaton, inland saltgrass, buffalograss, bluegrass, and other short and mid grasses.

About 70 percent of the cultivated land is in dryland farms. Most of this area is poorly suited to cultivation because of the high content of lime.

Intensive management is needed to protect these soils from wind erosion.

6. *Portales association: Nearly level, deep, medium-textured, moderately to moderately rapidly permeable soils*

The soils of this association occupy a nearly level, broad, shallow valley with only a slight slope to the southeast. The association contains about 22,000 acres.

Portales loam is the main soil. Some Zita, Arch, Church, and Drake soils are around the edge of the area. Most of the area is irrigated farmland. Water is available at a depth of 30 to 70 feet.

Cotton and grain sorghum are the main crops; however, this general area produces higher yields of alfalfa hay than any other area on the High Plains. Other important crops are vegetables, sesame, corn, and small grain.

Good yields are obtained from these calcareous soils because of their native fertility, the good farming methods used, and the abundance of irrigation water.

7. *Stegall association: Nearly level, moderately shallow to deep, medium-textured, slowly permeable soils*

The soils of this association occupy a nearly level plain that has a gradual slope to the southeast. The plain is

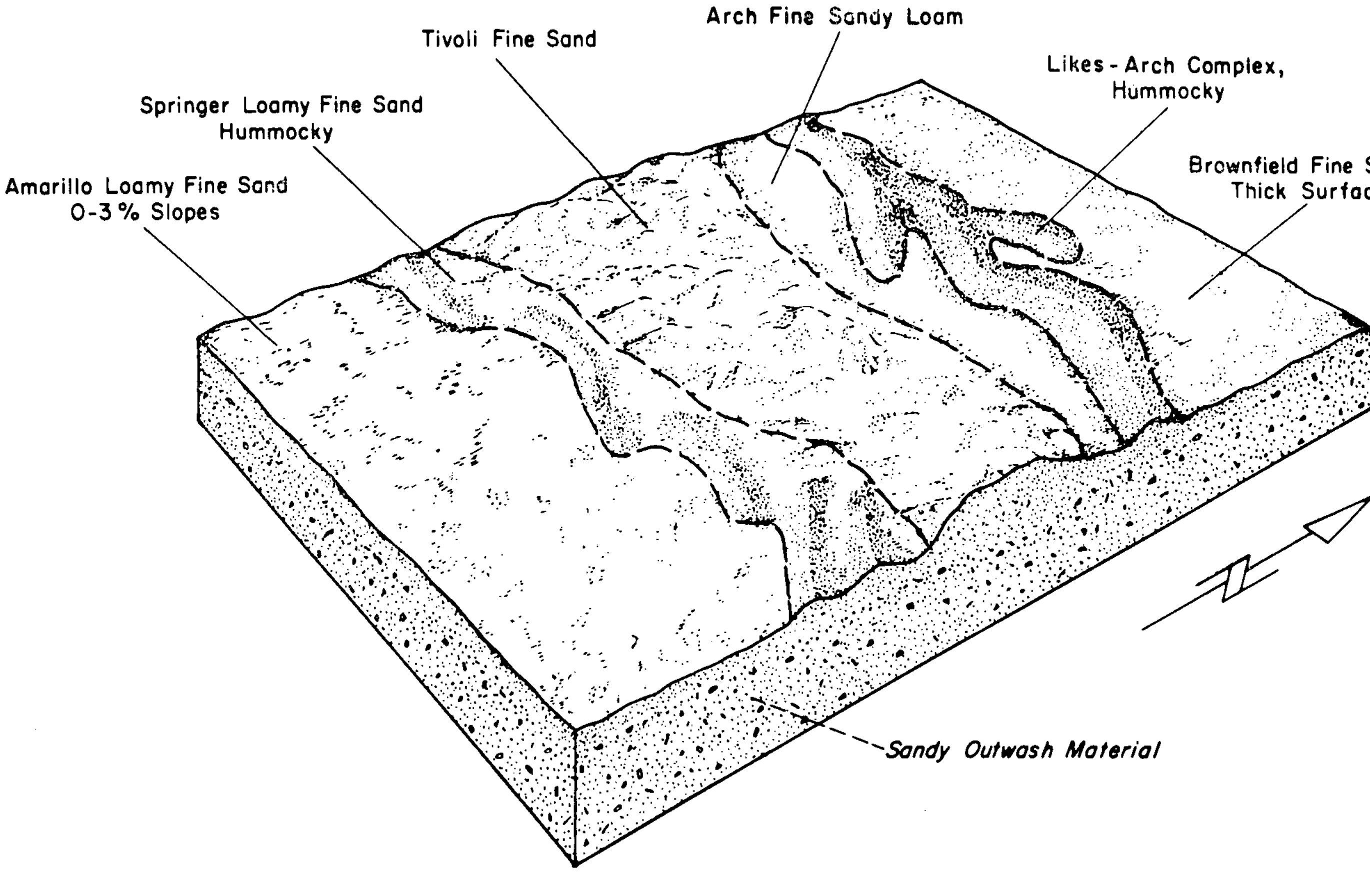

Figure 3.—**Typical patterns of soils in the Tivoli-Brownfield association and the Amarillo loamy fine sand association.**

dotted with intermittent lakes from 10 to 60 acres in size. The association contains about 23,000 acres.

Stegall loam is the principal soil in this association (fig. 5). It is underlain by rocklike caliche within 36 inches of the surface. Other soils within the basins are the Arvana soils, which are moderately permeable; the Portales soils, which are limy to the surface; the Mansker soils, which are shallow; the Kimbrough and Potter soils, which are very shallow; and the Randall soils, which are in the lakebeds.

Most of the area is farmed as dryland. Grain sorghum, wheat, and cotton are the main crops. Under dryland farming, this area has the best yields of wheat in the county. Yields of cotton and grain sorghum are low because the soils are droughty during summer.

8. *Berthoud-Mansker association: Sloping, shallow to deep, medium-textured, moderately rapidly permeable soils*

The soils of this association occupy the slopes to the west of some of the saline lakes. This association contains about 7,000 acres.

The Berthoud are the deeper soils and occur below the breaks. The Mansker are the shallow soils and occur on the breaks. The Potter and Kimbrough are very shallow soils included in this area.

Most of this area is rangeland that produces buffalograss, blue grama, side-oats grama, hairy grama, and other short and mid grasses.

Descriptions of the Soils

In this section, the soil series in Bailey County are described in alphabetic order. After each series, the soils of that series that were mapped in the county are described. The acreage and proportionate extent of the soils are shown in table 1. The use of the soils at the time of the survey is shown in table 2. Their location can be seen on the detailed map at the back of this report. The symbol in parentheses after the name of each soil identifies the soil on the detailed map. The capability group and range site are given for each soil.

The soil profile is an important part of each soil description. We can learn about soil characteristics by examining a soil profile to a depth of several feet.

Since all the soils in one series have essentially the same profile, except for possible differences in texture of the surface layer, it is not necessary to describe the profile of every soil. The profile is therefore described for each soil type in a series. Unless differences are pointed out, the reader can assume that all the other soils of one type have essentially the same kind of profile.

In describing the soils, the scientist frequently assigns a letter symbol, for example, "A_1," to the various layers. These letter symbols have special meanings that concern scientists and others who desire to make a special study of soils. Most readers need to remember only that all letter symbols beginning with "A" are surface soil and

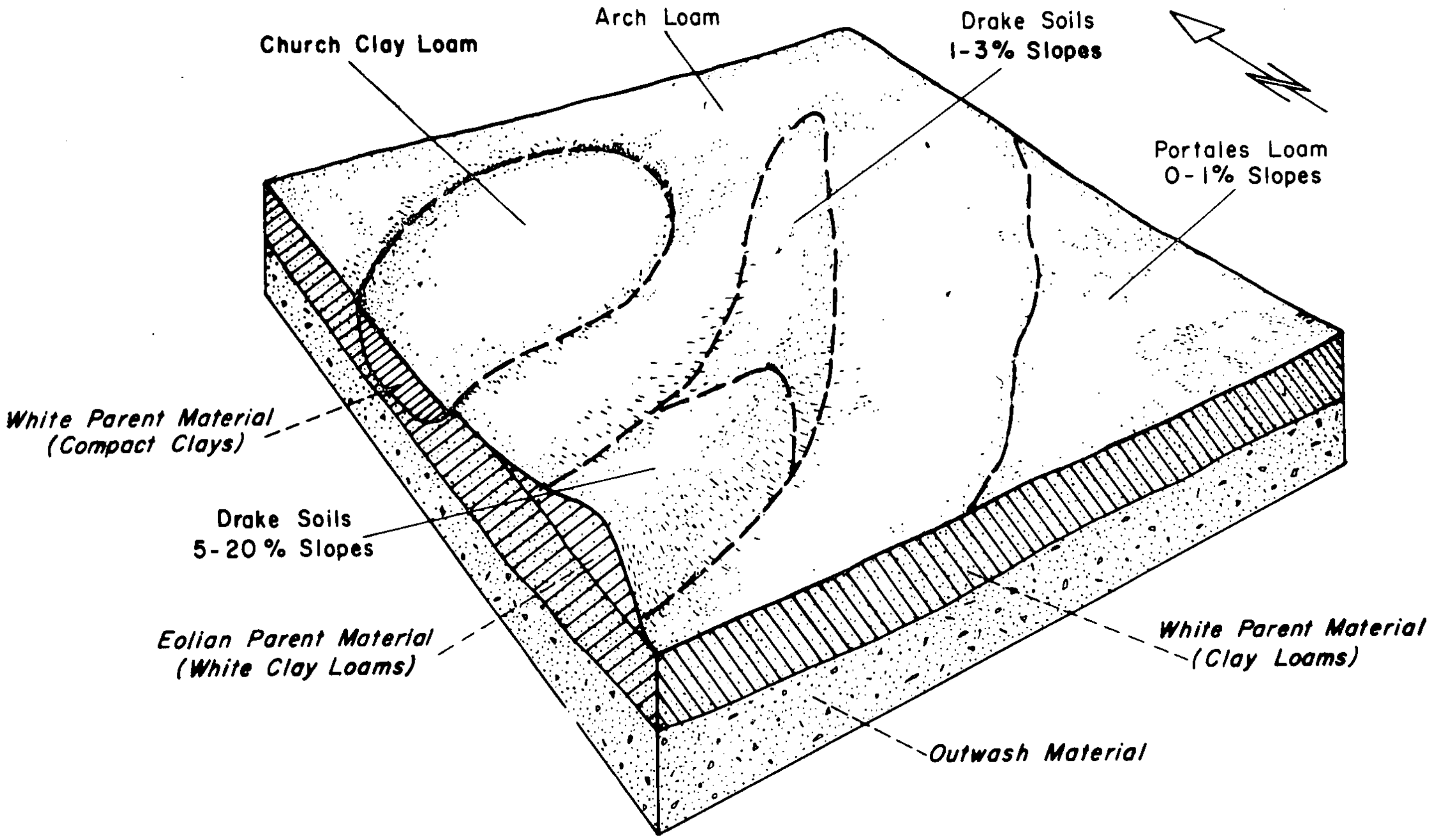

Figure 4.—Arch-Drake association.

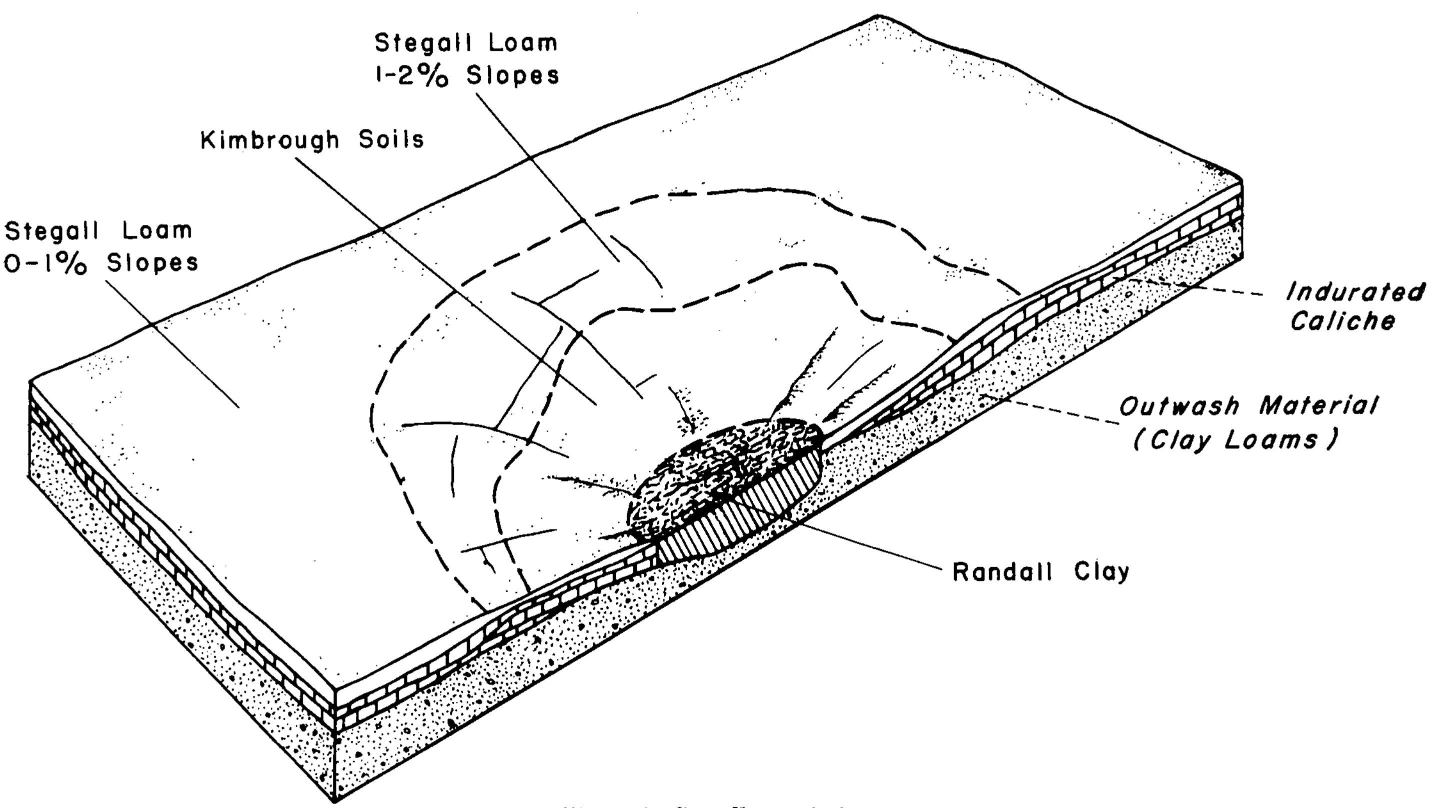

Figure 5.—Stegall association.

TABLE 1.—*Acreage and proportionate extent of the soils*

Soil	Area	Extent
	Acres	*Percent*
Active dunes	881	0. 2
Amarillo fine sandy loam, 0 to 1 percent slopes	66, 980	12. 5
Amarillo fine sandy loam, 1 to 3 percent slopes	30, 286	5. 6
Amarillo fine sandy loam, 3 to 5 percent slopes	1, 760	. 3
Amarillo loam, 0 to 1 percent slopes	6, 150	1. 1
Amarillo loam, 1 to 2 percent slopes	1, 542	. 3
Amarillo loamy fine sand, 0 to 3 percent slopes	46, 705	8. 7
Arch fine sandy loam	13, 628	2. 5
Arch loam	8, 063	1. 5
Arvana fine sandy loam, 0 to 1 percent slopes	48, 282	9. 0
Arvana fine sandy loam, 1 to 3 percent slopes	7, 858	1. 5
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	3, 001	. 6
Arvana fine sandy loam, shallow, 1 to 3 percent slopes	1, 628	. 3
Arvana-Amarillo loams, 0 to 1 percent slopes	6, 817	1. 3
Arvana-Amarillo loams, 1 to 2 percent slopes	1, 175	. 2
Berthoud fine sandy loam, 3 to 5 percent slopes	1, 623	. 3
Berthoud loam, 1 to 3 percent slopes	610	. 1
Berthoud loam, 3 to 8 percent slopes	987	. 2
Berthoud-Mansker fine sandy loams, 5 to 8 percent slopes	719	. 1
Brownfield fine sand, thick surface	37, 297	6. 9
Brownfield soils, severely eroded	2, 031	. 4
Church clay loam	3, 985	. 7
Drake soils, 1 to 3 percent slopes	3, 418	. 6
Drake soils, 3 to 5 percent slopes	3, 424	. 6
Drake soils, 5 to 20 percent slopes	3, 067	. 6
Gomez-Arch complex	6, 831	1. 3
Gomez-Arch complex, severely eroded	487	. 1
Kimbrough soils	10, 492	2. 0
Likes-Arch complex, hummocky	4, 495	. 8
Loamy alluvial land	1, 754	. 3
Lubbock loamy fine sand	508	. 1
Lubbock fine sandy loam	1, 712	. 3
Mansker fine sandy loam, 0 to 1 percent slopes	2, 202	. 4
Mansker fine sandy loam, 1 to 3 percent slopes	5, 050	. 9
Mansker fine sandy loam, 3 to 5 percent slopes	2, 060	. 4
Mansker loam, 0 to 1 percent slopes	565	. 1
Mansker loam, 1 to 3 percent slopes	219	(1)
Olton loam, 0 to 1 percent slopes	6, 308	1. 2
Portales fine sandy loam, 0 to 1 percent slopes	52, 149	9. 7
Portales fine sandy loam, 1 to 3 percent slopes	19, 419	3. 6
Portales loam, 0 to 1 percent slopes	28, 430	5. 3
Portales loam, 1 to 3 percent slopes	2, 340	. 4
Potter soils	3, 673	. 7
Randall clay	4, 333	. 8
Randall fine sandy loam	888	. 2
Springer loamy fine sand, undulating	1, 340	. 3
Springer loamy fine sand, hummocky	3, 886	. 7
Stegall loam, 0 to 1 percent slopes	13, 169	2. 5
Stegall loam, 1 to 2 percent slopes	899	. 2
Stegall loam, shallow, 0 to 1 percent slopes	1, 079	. 2
Tivoli fine sand	36, 377	6. 8
Zita fine sandy loam, 0 to 1 percent slopes	9, 989	1. 9
Zita fine sandy loam, 1 to 3 percent slopes	1, 785	. 3
Zita loam, 0 to 1 percent slopes	8, 795	1. 6
Zita loamy fine sand, 0 to 3 percent slopes	1, 893	. 4
Saline lakes	1, 916	. 4
Total	536, 960	100. 0

[1] Less than 0.1 percent.

TABLE 2.—*Use of soils at the time of the survey*

Soil	Cropland		Range	Other	Total
	Dry-land	Irri-gated			
	Acres	*Acres*	*Acres*	*Acres*	*Acres*
Active dunes				881	881
Amarillo fine sandy loam	56, 765	31, 331	8, 415	2, 515	99, 026
Amarillo loam	4, 016	2, 202	1, 273	201	7, 692
Amarillo loamy fine sand	24, 025	10, 539	10, 921	1, 220	46, 705
Arch fine sandy loam	1, 904	6, 089	5, 287	348	13, 628
Arch loam	2, 322	4, 362	1, 174	205	8, 063
Arvana fine sandy loam	38, 743	14, 200	1, 723	1, 474	56, 140
Arvana fine sandy loam, shallow	3, 309	169	1, 030	121	4, 629
Arvana-Amarillo loams	6, 426	872	490	204	7, 992
Berthoud fine sandy loam	104	295	1, 179	45	1, 623
Berthoud loam	22		1, 533	42	1, 597
Berthoud-Mansker fine sandy loams	62	79	552	26	719
Brownfield fine sand	959	5, 040	30, 430	868	37, 297
Brownfield soils	242	1, 543	122	124	2, 031
Church clay loam	909	984	1, 990	102	3, 985
Drake soils	2, 087	1, 161	6, 402	259	9, 909
Gomez-Arch complex	1, 140	1, 725	3, 802	164	6, 831
Gomez-Arch complex, severely eroded	87	100	273	27	487
Kimbrough soils	521	15	9, 682	274	10, 492
Likes-Arch complex, hummocky	521	988	2, 871	115	4, 495
Loamy alluvial land	501	729	478	46	1, 754
Lubbock loamy fine sand	365	27	103	13	508
Lubbock fine sandy loam	679	930	58	45	1, 712
Mansker fine sandy loam	4, 638	1, 534	2, 893	247	9, 312
Mansker loam	478	208	76	22	784
Olton loam	4, 957	712	474	165	6, 308
Portales fine sandy loam	32, 167	31, 362	6, 140	1, 899	71, 568
Portales loam	9, 611	17, 520	2, 837	802	30, 770
Potter soils	226	56	3, 295	96	3, 673
Randall clay	2, 080	325	1, 815	113	4, 333
Randall fine sandy loam	490	128	247	23	888
Springer loamy fine sand	27	367	4, 695	137	5, 226
Stegall loam	13, 119	168	407	374	14, 068
Stegall loam, shallow	733	20	298	28	1, 079
Tivoli fine sand	42	884	34, 503	948	36, 377
Zita fine sandy loam	4, 076	6, 459	933	306	11, 774
Zita loam	1, 850	6, 100	616	229	8, 795
Zita loamy fine sand	1, 118	253	473	49	1, 893
Saline lakes				1, 916	1, 916
Total	221, 321	149, 476	149, 490	16, 673	536, 960

subsurface soil; those beginning with "B" are subsoil (in soils where the B horizon is thin or lacking, the upper C horizon is called subsoil); and those beginning with "C" are substratum, or parent material. It may also be helpful to remember that the small letter "p" indicates a plowed layer, and that the small letters "ca" indicate an accumulation of calcium carbonate. Some soils do not have a B horizon, and the A horizon may be directly underlain by the C horizon or a transitional AC horizon.

Layers, or horizons, in soils are measured from the top of the mineral soil material downward. The distance from the top to the bottom of each layer is indicated in inches. In soils, one layer is seldom followed immediately by another layer in such a way that the layers can be divided by a straight line. Boundaries between horizons have thickness and shape. The terms for thickness are (1) *abrupt*, if less than 1 inch thick; (2) *clear*, if about 1 to 2½ inches thick; (3) *gradual*, if 2½ to 5 inches thick; and (4) *diffuse*, if more than 5 inches thick. The shape of the boundary is described as *smooth*, *wavy*, *irregular*, or *broken*.

Soil scientists use Munsell notations to indicate the color of a soil precisely and provide the equivalent in words for those not familiar with the system. They com-

Figure 6.—**Profile of Amarillo fine sandy loam, 0 to 1 percent slopes.**

pare a sample of the soil with a standard color chart. The Munsell notation, and its less exact approximation in words, are read from the chart; for example, "reddish brown (5YR 5/4, dry)." In the example given, "5YR" is the hue, and "5/4" expresses value and chroma in hue 5YR. The notation "5YR 5/4" is in the range equivalent to the words "reddish brown;" the color was observed when the soil was dry. In this report the first notation is for dry soil, and the word "dry" is generally omitted.

Soil scientists record all the characteristics of a soil profile in a systematic way, so that they can study the differences among soils. These characteristics (such as color, texture, and thickness of the horizons) differ from place to place.

A soil profile may be examined by digging a pit or looking at a fresh road cut. A typical example is the pit or fresh road cut in an Amarillo fine sandy loam (fig. 6). The surface soil, or A horizon, is about 10 inches thick and is a reddish-brown, moderately sandy material. Below this layer is the upper part of the B horizon. It is a little darker, about 18 inches thick, and contains more clay. The lower subsoil, or lower B horizon, is yellowish red, about the same texture as the upper part of the B horizon, and 22 inches thick.

Below the B horizon is a light-pinkish layer that is high in calcium carbonate, or caliche. This is the C_{ca} horizon. The next layer below the C_{ca} horizon is the parent material, a reddish-yellow material. This is the C horizon. The parent material in this instance is wind-deposited material laid down many years ago. Amarillo fine sandy loam probably formed in this type of material after many soil-forming processes had taken place.

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By observing another pit or road cut, we can see that the layers are different. For example, Mansker fine sandy loam has different layers, or horizons, from those in an Amarillo fine sandy loam. The texture of the surface layer is about the same, but the Mansker soil is brown. The surface layer of the Mansker fine sandy loam is only about 8 inches thick and contains small concretions of calcium carbonate and is strongly calcareous. This is underlain by an AC horizon that extends from a depth of 8 to 16 or 18 inches and is grayish brown. There is an increasing amount of caliche gravel and calcium carbonate in the subsoil. In a Mansker soil the C_{ca} horizon occurs at 20 inches, or less, below the surface. In an Amarillo soil, the C_{ca} horizon occurs in places at a depth of 50 inches.

Mansker fine sandy loam supplies nutrients, air, and water to plant roots in a different way than Amarillo fine sandy loam. Mansker soils are on slopes, ridges, and knolls; Amarillo soils are on nearly level to gently sloping plains.

The soil within one mapping unit may not have uniform characteristics. The thickness of layers may differ slightly from place to place. Also, there may be small differences in color, depth, structure, texture, and content of lime. Most boundaries are not distinct between soils, as soils tend to merge with each other.

Small areas of different soils are included in a mapping unit. The differences are not shown on soil maps, because these small areas require the same management practices for crop production and control of erosion as the soil in which they are included.

Many technical terms, such as texture, structure, consistence, and calcareous are explained in the Glossary in the back of this report and in the "Soil Survey Manual." [1]

Active Dunes

Active dunes (Ad).—This miscellaneous land type consists of areas within the Sandhills that are subject to continuous wind erosion. They have little or no vegetation to protect the surface.

Areas of this miscellaneous land type range from 5 to more than 100 acres in size. About one-third of a mapped area is blownout land, and two-thirds is sand-dune land. These dunes have slopes of 3 to 20 percent on the west side and 10 to 40 percent on the east side. In places they are slightly calcareous. The floor of the blownout areas is usually a pale-brown (10YR 6/3, dry) sandy clay loam, and the dunes are light-gray (10YR 7/2) fine sand. In some places, small sand dunes bisect the blownout areas from north to south.

Active dunes are most unstable in the center and to the leeward, or east side. Because of vegetation, such as sacaton, sand bluestem, yucca, and saltgrasses that grow in clumps (fig. 7), other extremities of the dunes are slightly more stable.

Where dune profiles are exposed, stratified fine sands are visible. Concretions of calcium carbonate and remains of snail shells blown from the blownout area are present in places.

[1] SOIL SURVEY STAFF. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook No. 18. 503 pp., illus., 1951.

Figure 7.—**Beginning of natural revegetation on Active dunes.**

This land type should be fenced and used only for wildlife because of the limited vegetation and very high hazard of wind erosion. (Capability unit VIIIe–1.)

Amarillo Series

The Amarillo series consists of deep, medium- to coarse-textured soils that have a reddish-brown subsoil. These soils are underlain by soft, pink caliche at a depth of 30 to 60 inches. They are on the broad, nearly level to gently sloping plains in all parts of the county.

The surface soil is brownish and about 1 foot thick. The upper subsoil is reddish-brown sandy clay loam, also about 1 foot thick. It has moderate, coarse, prismatic and weak, subangular blocky structure. The lower subsoil is yellowish-red to reddish-yellow sandy clay loam, 1 to 2 feet thick. It has a weak, prismatic structure and is slightly limy in the lower part.

The parent material is yellowish-red to reddish-yellow, calcareous sandy clay loam. A pink to yellowish-red horizon of calcium carbonate accumulation is in the upper part of the parent material. This accumulation has been leached from the soil above.

The Amarillo soils have sandier subsoil than the Olton soils. They are more reddish and generally lighter colored than the Portales soils, which are limy to the surface. The sandy surface soil is thinner than in the Brownfield soils. Arvana soils differ from the Amarillo soils in having rocklike caliche within 36 inches of the surface.

Some areas of Amarillo soils are mapped as a complex with Arvana soils. This complex is described under the Arvana series.

Amarillo Fine Sandy Loams

The soils of this type have a surface layer of brown to reddish-brown fine sandy loam, 6 to 14 inches thick. Most of these soils are under cultivation and are productive. Under irrigation, crops respond to applications of nitrogen and phosphate.

Included with the soils of this type are small areas of Portales, Arvana, Olton, or Zita soils.

Small areas of Amarillo fine sandy loams have been eroded to some extent. Since some of the clay and silt in the plow layer has blown away, the upper 3 to 6 inches of the surface soil is coarser than formerly.

Profile of an Amarillo fine sandy loam in a cultivated field (3 miles north and 4 miles west of Needmore):

A_{1p} 0 to 10 inches, reddish-brown (5YR 5/4) fine sandy loam, slightly darker reddish brown (5YR 4/4) when moist; structureless; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

B_2 10 to 28 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; worm casts and fine pores are common; noncalcareous; gradual boundary.

B_3 28 to 50 inches, yellowish-red (5YR 5/6) sandy clay loam, slightly darker yellowish red (5YR 4/6) when moist; compound weak, coarse, prismatic, and subangular blocky structure; hard when dry, friable when moist; many fine pores; few worm casts; weakly calcareous in lower 6 inches; clear boundary.

C_{ca} 50 to 62 inches, pink (5YR 8/4, dry), very strongly calcareous sandy clay loam; about 40 percent carbonates by volume; diffuse boundary.

C 62 to 72 inches +, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; very strongly calcareous.

The color of the surface soil ranges from brown to reddish brown.

The color of the B_2 horizon is usually reddish brown. The compound structure—coarse, prismatic and fine, subangular blocky—ranges from weak to moderate in grade. The thickness ranges from 10 to 20 inches.

The color of the B_3 horizon ranges from reddish brown to reddish yellow. The compound structure is generally weak, coarse, prismatic and weak, subangular blocky. The thickness ranges from 10 to 30 inches.

The color of the C_{ca} horizon ranges from reddish yellow to pinkish white, but it is generally pink. Many fine to medium, segregated hard and soft concretions of calcium carbonate occur within this horizon in places. This horizon contains from 30 to 60 percent of carbonates by volume. The thickness is usually about 18 inches but ranges from 10 to 45 inches. The depth to the C_{ca} horizon ranges from 30 to 60 inches, or more.

Indurated caliche occurs below 42 inches in places where these soils are associated with Arvana soils.

Amarillo fine sandy loam, 0 to 1 percent slopes (AfA).—This soil occurs in broad, smooth, nearly level areas. The hazard of wind erosion is moderate. (Capability unit IIIe–2 (dryland); capability unit IIe–2 (irrigated); Mixed Land range site.)

Amarillo fine sandy loam, 1 to 3 percent slopes (AfB).—This soil occupies low ridges, knolls, and gentle slopes around playas. It occurs within larger areas of Amarillo fine sandy loam, 0 to 1 percent slopes.

This is a productive soil, but there is a moderate hazard of wind and water erosion. In small areas sheet and gully erosion have removed 3 to 4 inches of the surface soil. (Capability unit IIIe–1 (dryland or irrigated); Mixed Land range site.)

Amarillo fine sandy loam, 3 to 5 percent slopes (AfC).—This soil occurs to the northwest of playas and on the upper slopes of draws and escarpments. Areas are less than 50 acres in size. This soil is within less sloping areas of Amarillo fine sandy loam.

The hazard of wind erosion is moderate. The hazard of water erosion is high because of the slopes. If the soil is not protected, both sheet and gully erosion are common, especially where the soil has been washed down slopes and deposited on more productive soils. (Capability unit IVe-3 (dryland or irrigated); Mixed Land range site.)

Amarillo Loamy Fine Sands

The soils of this type have a surface layer of brown loamy fine sand, 8 to 16 inches thick. The water-holding capacity is low in this layer.

Amarillo loamy fine sands are low in fertility. Under irrigation, crops respond to the application of nitrogen and phosphate.

Some areas of these soils have been damaged by wind erosion. In areas where the wind has shifted the surface soil and removed the silt and clay, the texture of the surface soil may be fine sand.

Profile of an Amarillo loamy fine sand in a cultivated field (6 miles south and 2 miles east of Muleshoe):

A_{1p} 0 to 14 inches, brown (7.5YR 5/4) loamy fine sand, darker brown (7.5YR 4/4) when moist; structureless; loose when dry, very friable when moist; noncalcareous; abrupt boundary.

B_2 14 to 24 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; few worm casts; many very fine pores; noncalcareous; gradual boundary.

B_3 24 to 46 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, coarse, prismatic structure; hard when dry, friable when moist; many fine pores; noncalcareous; clear boundary.

C_{ca} 46 to 60 inches, pinkish-white (5YR 8/2), heavy sandy clay loam, pinkish gray (5YR 7/2) when moist; hard when dry, friable when moist; about 40 percent carbonates by volume; very strongly calcareous; diffuse boundary.

C 60 to 70 inches +, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; very strongly calcareous.

The color of the A_{1p} horizon ranges from light brown to brown, hue 7.5YR to 10YR.

The color of the B_2 horizon is usually reddish brown. The compound structure—coarse, prismatic and fine, subangular blocky—ranges from weak to moderate in grade. The thickness ranges from 8 to 20 inches.

The color of the B_3 horizon ranges from yellowish red to reddish yellow, hue 5YR to 7.5YR. The compound structure—coarse, prismatic and fine, subangular blocky—ranges from weak to moderate in grade. The lower few inches of the B_3 horizon are calcareous in places. The thickness ranges from 12 to 30 inches.

The color of the C_{ca} horizon ranges from reddish yellow to pinkish white but is generally pink. This horizon contains 20 to 50 percent of carbonates by volume. The thickness is usually from 12 to 18 inches but ranges from 6 to 36 inches.

The color of the C horizon ranges from reddish brown to reddish yellow.

Amarillo loamy fine sand, 0 to 3 percent slopes (AmB).—This soil occupies broad, gently undulating areas that are mainly in a band about 4 miles wide, south of the Sandhills and east of Coyote Lake. The hazard of wind erosion is high. Included with this soil are small areas of Brownfield, Springer, and Zita soils. (Capability unit IVe-1 (dryland); capability unit IIIe-4 (irrigated); Sandy Land range site.)

Amarillo Loams

The soils of this type are similar to other Amarillo soils, but they have a surface layer of brown to reddish-brown loam that is 6 to 10 inches thick. They occupy broad, smooth, nearly level areas south of the Sandhills and to the north and east of Stegall, where they are associated with Stegall loam. They are also in small areas near Circle Back in association with Olton soils. Other associated soils are the Arvana, Zita, and Amarillo fine sandy loams.

Most of the Amarillo loams are cultivated and are used for dryland farming. Under dryland farming, they are productive but droughty. The hazard of wind erosion is slight. Under irrigation, yields are increased by applications of nitrogen and phosphate.

Small areas of Arvana, Olton, Stegall, and Portales soils and Amarillo fine sandy loam are included with Amarillo loams.

Profile of an Amarillo loam in a nearly level, cultivated area (1.5 miles southeast of Circle Back):

A_{1p} 0 to 10 inches, brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) when moist; structureless; hard when dry, friable when moist; noncalcareous; abrupt boundary.

B_2 10 to 23 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; many worm casts and fine pores; noncalcareous; gradual boundary.

B_3 23 to 36 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; compound weak, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; many fine pores and few worm casts; weakly calcareous at 30 inches; gradual boundary.

C_{ca} 36 to 46 inches, pink (5YR 7/4) clay loam, light reddish brown (5YR 6/4) when moist; about 40 percent carbonates by volume; very strongly calcareous; diffuse boundary.

C 46 to 60 inches +, reddish-yellow (5YR 6/6) sandy clay loam; yellowish red (5YR 5/6) when moist; very strongly calcareous.

The color of the surface soil ranges from reddish brown to brown, hue 5YR to 7.5YR. In most areas the texture is loam, but some small areas with a sandy clay loam surface soil are included.

The color of the B_2 horizon is generally reddish brown. The compound structure—coarse, prismatic and fine, subangular blocky—ranges from weak to moderate in grade.

The color of the B_3 horizon ranges from reddish brown to reddish yellow, hue 5YR to 7.5YR. The compound structure—coarse, prismatic and subangular blocky—ranges from weak to moderate in grade.

The color of the C_{ca} horizon ranges from pinkish white to reddish yellow but is usually pink. The texture ranges from sandy clay loam to clay loam. This horizon is made up of 30 to 60 percent carbonates by volume. The thickness is usually about 12 inches but ranges from 6 to 30 inches. Indurated caliche is below a depth of 42 inches in places where Amarillo loams are associated with Arvana or Stegall soils.

Amarillo loam, 0 to 1 percent slopes (AlA).—This soil occurs in smooth, nearly level areas. The rainfall is low, and the hazard of wind erosion is slight. (Capability unit IIIce–1 (dryland); capability unit IIe–1 (irrigated); Deep Hardland range site.)

Amarillo loam, 1 to 2 percent slopes (AlB).—This soil occupies the slopes around playas and is surrounded by larger areas of Amarillo loam, 0 to 1 percent slopes. Small areas have slopes as great as 3 percent. The hazard of water erosion is moderate. (Capability unit IIIe–3 (dryland or irrigated); Deep Hardland range site.)

Arch Series

The Arch series consists of light-colored soils that are high in content of lime. These soils are shallow and range from medium textured to moderately coarse textured.

Arch soils are on broad, level to nearly level areas along Blackwater Draw or in areas within the basins surrounding saline lakes. The areas where these soils were formed were probably at one time shallow lakes or broad drainageways. Since then, these soils have apparently received extra lime from the fluctuating water tables. The parent materials are chalky earths that appear to be modified by deposits of calcium carbonate from ground water.

The surface soil is grayish loam, 6 to 12 inches thick. The subsoil is generally clay loam, about 8 inches thick. The structure is weak, granular and subangular blocky A whitish horizon of calcium carbonate accumulation is below the subsoil. In many areas along Blackwater Draw, the substrata are strongly calcareous sands.

The Arch soils are associated with the Church soils, which are more clayey; the Portales soils, which are darker and deeper; the Drake soils, which are duned; and the Likes soils, which are sandier, duned, and deeper.

Arch Loams

In the southern half of the county, the soils of this type are on broad, slightly depressed areas just above the Church soils. In the northeastern part of the county, they are in areas that were apparently old stream channels or lakebeds.

Profile of an Arch loam in a cultivated field (2 miles west of Muleshoe):

A_{1p} 0 to 11 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; structureless; hard when dry, friable when moist; few, very fine concretions of calcium carbonate; very strongly calcareous; abrupt boundary.

AC 11 to 24 inches, light-gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) when moist; compound weak, prismatic and weak, granular structure; slightly hard when dry, friable when moist; many worm casts; fine and very fine pores; very strongly calcareous; clear boundary.

C_{ca} 24 to 30 inches, light-gray (10YR 7/1) clay loam, gray (10YR 6/1) when moist; many fine and very fine pores; few, fine, soft and hard concretions; about 50 percent carbonates by volume; very strongly calcareous; gradual boundary.

D_1 30 to 36 inches, light-gray (10YR 7/1, dry) fine sandy loam; strongly calcareous; clear boundary.

D_2 36 to 48 inches, light-gray (10YR 7/1, dry) fine sand; very strongly calcareous; gradual boundary.

D_3 48 to 72 inches +, light-gray (10YR 7/1, dry) sandy clay; very strongly calcareous.

In most areas the texture of the surface soil is loam, but some small areas with a sandy clay loam surface soil are included. The color throughout the profile ranges from pale brown to white, hue 10YR. Hard and soft, medium to fine concretions of calcium carbonate occur throughout the profile in places.

Arch loam (Ao).—This soil is very susceptible to wind erosion because of the high content of lime in the surface soil. Wind erosion has removed 2 to 4 inches of the surface soil from small areas. Crops that tolerate a high content of lime are best suited to irrigated areas. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Arch Fine Sandy Loams

The soils of this type are mainly in slightly depressed areas on the northern side of the Sandhills in association with the Drake, Likes, and Portales soils. They also occur in Blackwater Draw and in the large basins surrounding most of the saline lakes. They differ from the Arch loams mainly by having a fine sandy loam surface soil.

Profile of an Arch fine sandy loam in a cultivated field (2 miles east of Muleshoe):

A_p 0 to 11 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; strongly calcareous; abrupt boundary.

AC 11 to 21 inches, light-gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) when moist; compound weak, coarse, prismatic and weak, granular structure; hard when dry, friable when moist; very strongly calcareous; gradual boundary.

C_{ca} 21 to 48 inches +, white (10YR 8/2) clay loam, white (10YR 8/2) when moist; very strongly calcareous.

The color of the surface soil ranges from brown to light gray, hue 10YR. In most areas the texture is fine sandy loam, but small areas with a loamy fine sand surface soil are included. The thickness ranges from 6 to 12 inches.

The color of the subsoil ranges from light brownish gray to white, hue 10YR. The texture ranges from sandy clay loam to clay loam. The compound structure is weak, coarse, prismatic and weak, subangular blocky or granular. The thickness ranges from 6 to 12 inches.

Arch fine sandy loam (An).—This soil is only moderately suited to cultivation, even under irrigation, because of the high hazard of wind erosion and the high content of lime. Some areas of this soil have had 2 to 4 inches of the surface soil removed by wind erosion. In areas where wind has removed some of the silt and clay, the surface soil is coarser textured. Native and tame grasses are best suited to this soil. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Arvana Series

The Arvana series consists of shallow to moderately deep, reddish-brown, moderately coarse textured soils. They are underlain by indurated caliche at a depth of 10 to 36 inches. These soils are on broad, nearly level to gently sloping plains in the southern half and in the northwestern part of the county.

The moderately deep Arvana soils have a reddish-brown fine sandy loam surface soil, slightly less than 1 foot thick. The upper subsoil is reddish-brown sandy clay loam, also about 1 foot thick. The structure is moderate, coarse, prismatic and weak, subangular blocky. The lower subsoil is yellowish-red to reddish-brown sandy clay loam, about 1 foot thick, over rocklike, platy caliche. This layer has weak, prismatic structure.

The shallow Arvana soils are similar to the moderately deep Arvana soils in color, structure, and texture. They have about 6 inches of surface soil, 10 inches of upper subsoil, and 3 inches of lower subsoil. Rocklike caliche usually occurs no deeper than 20 inches below the surface.

The Arvana soils have a sandier subsoil than the Olton and Stegall soils. They are darker colored than the Portales soils, which are limy to the surface. They differ from the Amarillo soils in having rocklike caliche within 36 inches of the surface. They are not as gray nor as shallow as the Kimbrough soils.

Some areas of Arvana soils are mapped as a complex with Amarillo soils.

Arvana Fine Sandy Loams

The soils of this type have 6 to 11 inches of brown to reddish-brown fine sandy loam surface soil. They are mostly cultivated and are productive. Under irrigation, crops respond to the application of nitrogen and phosphate.

Included with Arvana fine sandy loams are small areas of Amarillo and Portales fine sandy loams; Arvana fine sandy loams, shallow; Arvana-Amarillo loams; and Olton and Stegall soils. Also included are small areas having moderately severe wind erosion.

Areas of Arvana fine sandy loams have slight to moderate wind erosion. The plow layer is slightly coarser because erosion has removed some of the silt and clay.

Profile of an Arvana fine sandy loam in a nearly level, native pasture (4 miles north and 2.5 miles west of Goodland):

A 0 to 10 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; compound weak, prismatic and weak, granular structure; slightly hard when dry, friable when moist; many fine pores; noncalcareous; gradual boundary.

B_2 10 to 26 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; many worm casts and fine pores; noncalcareous; gradual boundary.

B_3 26 to 34 inches, yellowish-red (5YR 5/6) sandy clay loam, slightly darker yellowish red (5YR 4/6) when moist; weak, coarse, prismatic structure; hard when dry, friable when moist; few worm casts and fine pores; noncalcareous; abrupt boundary.

D_r 34 to 40 inches +, indurated, platy caliche.

The color of the surface soil ranges from reddish brown to brown, hue 5YR to 7.5YR. In most areas the texture is fine sandy loam, but some areas with a light loam surface soil are included.

The color of the B_2 horizon is usually reddish brown but ranges from dark reddish brown to red. The structure ranges from moderate, coarse, prismatic to compound prismatic and weak, subangular blocky.

The color of the B_3 horizon ranges from yellowish red to red. In places this horizon is calcareous. The thickness ranges from 5 to 14 inches.

The depth to indurated caliche ranges from 20 to 36 inches. This rocklike caliche is platy and has fragments 2 to 4 inches thick and 10 to 20 inches in diameter. The fragments overlap from 20 to 50 percent. The total thickness of hard caliche ranges from about 6 inches to several feet.

Arvana fine sandy loam, 0 to 1 percent slopes (AvA).—This soil occurs on broad, smooth, nearly level areas. It is subject to moderate wind erosion. (Capability unit IIIe–1 (dryland or irrigated); Mixed Land range site.)

Arvana fine sandy loam, 1 to 3 percent slopes (AvB).—This soil occurs in small areas. It occupies low ridges, knolls, and gentle slopes around playas.

This is a productive soil, but it is subject to both wind and water erosion. (Capability unit IIIe–1 (dryland or irrigated); Mixed Land range site.)

Arvana Fine Sandy Loams, Shallow

The soils of this type are shallow and have a brown or reddish-brown surface layer, about 6 inches thick. The subsoil is reddish-brown sandy clay loam. It is underlain by hard caliche at a depth that ranges from 10 to 20 inches but is typically 16 to 20 inches.

Most areas of Arvana fine sandy loams, shallow, are cultivated. The shallowness of these soils, however, restricts their moisture-holding capacity and their capacity to hold plant nutrients. Irrigation is expensive because small and frequent waterings are required. Most areas of these soils are in the southern half of the county.

Soils of this type include small areas of Mansker, Kimbrough, and Stegall soils in places.

Profile of Arvana fine sandy loam, shallow, in a nearly level, cultivated area (3 miles south and 0.5 mile east of Baileyboro):

A_{1p} 0 to 5 inches, reddish-brown (5YR 4/4) fine sandy loam; dark reddish brown (5YR 3/4) when moist; structureless; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

B_2 5 to 14 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, coarse, prismatic structure; hard when dry, friable when moist; few worm casts; many fine pores; noncalcareous; gradual boundary.

B_3 14 to 18 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; weakly calcareous.

D_r 18 inches +, indurated, platy caliche.

In most areas the texture of the surface soil is fine sandy loam, but some areas with a loam surface soil are included.

In places the B_3 horizon is calcareous. In some areas it is absent. Some rock outcrops occur locally.

Arvana fine sandy loam, shallow, 0 to 1 percent slopes (AxA).—This soil is in nearly level areas, usually less than 100 acres in size. The hazard of wind erosion is moderate. (Capability unit IVe–7 (dryland or irrigated); Mixed Land range site.)

Arvana fine sandy loam, shallow, 1 to 3 percent slopes (AxB).—Except for slope, this soil is very similar to Arvana fine sandy loam, shallow, 0 to 1 percent slopes. It is harder to irrigate but otherwise has the same management problems. (Capability unit IVe–7 (dryland or irrigated); Mixed Land range site.)

Arvana-Amarillo Complex

This complex consists of areas of Arvana and Amarillo soils that were too intricately mixed to map separately at the scale used. It is made up of about 60 percent Arvana soils, which are underlain by rocklike caliche, and 40 percent Amarillo soils, which are underlain by soft caliche. The rocklike caliche occurs inconsistently and ranges from a few inches to several feet in thickness. This complex occurs mainly in the southwestern part of the county on smooth and level to gently sloping plains. It is used mainly for crops.

The Arvana and Amarillo soils have formed from wind-modified outwash material. They have about the same color, texture, and structure as that of the outwash material. In most areas the surface soil is loam, but in small areas it is fine sandy loam.

Because of the medium-textured surface soil, these soils are fairly resistant to wind erosion. The surface soil forms more wind-resistant aggregates than the fine sandy loam type. During dry years, small areas have had slight wind erosion. In areas where wind has removed some of the silt and clay, the surface soil is coarser.

Typical Arvana and Amarillo soils are described under the separate series.

Arvana-Amarillo loams, 0 to 1 percent slopes (AyA).—This soil is productive, but the amount of rainfall is low. The hazard of wind erosion is slight to moderate. (Capability unit IIIce-1 (dryland); capability unit IIe-1 (irrigated); Deep Hardland range site.)

Arvana-Amarillo loams, 1 to 2 percent slopes (AyB).—This is a productive soil that is droughty under dryland farming. The hazard of water erosion is moderate. (Capability unit IIIe-3 (dryland or irrigated); Deep Hardland range site.)

Berthoud Series

The Berthoud series consists of deep, brown to grayish-brown, friable, calcareous, loamy soils. These soils occupy long, narrow areas on lower slopes along draws and below escarpments. They occur as alluvial fans that formed from materials washed from higher lying soils.

The surface soil is brownish and about 15 inches thick. The subsoil is light brownish, moderately fine textured, and about 18 inches thick. The structure is weak, prismatic and granular. These soils are slightly limy. The light-brownish substratum is moderately fine textured and more limy than the soil above.

The associated soils are the Mansker soils, which are shallow and are on the upper slopes of the draws; the Potter soils, which are very shallow and occur as the rims of escarpments; and Loamy alluvial land, which is the dark soil in the bottom of the draws.

Berthoud Loams

The soils of this type have 10 to 18 inches of loam surface soil. They occur along the lower slopes of the escarpments to the north and west of the saline lakes in the Muleshoe National Wildlife Refuge of the U.S. Department of the Interior. They are usually in long, narrow areas, 100 to 400 yards wide and ½ to 2 miles long. The more sloping areas have the least width. Berthoud loams are used mostly for range.

Included with soils of this type are small areas of Mansker and Potter soils.

Profile of a Berthoud loam in a native pasture on the game refuge (800 feet north of Goose Lake, which is about 17 miles south of Muleshoe):

A_1 0 to 14 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; compound weak, prismatic and weak, granular structure; slightly hard when dry, friable when moist; few, fine, soft and hard concretions of calcium carbonate; few worm casts; many fine pores; strongly calcareous; gradual boundary.

AC 14 to 32 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; structure, consistence, and special features same as in A_1 horizon; strongly calcareous; diffuse boundary.

D 32 to 48 inches +, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) when moist; many fine to medium, soft and hard concretions of calcium carbonate; very strongly calcareous.

The color of the surface soil ranges from brown to grayish brown, hue 7.5YR to 10YR. In most areas the texture is loam, but some areas with a sandy clay loam surface soil are included. The thickness ranges from 10 to 18 inches.

The color of the subsoil ranges from light brown to very pale brown, hue 7.5YR to 10YR. In most areas the texture is clay loam, but in some areas it is loam and sandy clay loam. The thickness ranges from 14 to 30 inches.

The substratum ranges in color from brown to very pale brown. The texture ranges from sandy clay loam to clay. In many places this horizon contains rounded quartz and sandstone pebbles that are probably of the Cretaceous period.

Berthoud loam, 3 to 8 percent slopes (BhD).—This soil is highly susceptible to water erosion because of its steep slopes. (Capability unit VIe-7; Deep Hardland range site.)

Berthoud loam, 1 to 3 percent slopes (BhB).—This soil occurs in broader, less sloping areas than Berthoud loam, 3 to 8 percent slopes. It usually occurs below Berthoud loam, 3 to 8 percent slopes, and also along shallow draws, below Mansker and Potter soils.

The hazard of water erosion is moderate. (Capability unit IIIe-3 (dryland or irrigated); Deep Hardland range site.)

Berthoud Fine Sandy Loams

The soils of this type have 12 to 20 inches of fine sandy loam surface soil over about 18 inches of sandy clay loam subsoil. They are mainly on the lower slopes of draws below Mansker and Potter soils. They are used mainly for range.

Profile of a Berthoud fine sandy loam in a gently sloping area (about 6.5 miles north and 3 miles west of Enochs):

A_1 0 to 16 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; compound weak, prismatic and weak, granular structure; slightly hard when dry, friable when moist; many worm casts and fine and very fine pores; strongly calcareous; gradual boundary.

AC 16 to 36 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak, granular structure; slightly hard when dry, friable when moist; common, soft and hard concretions of calcium carbonate; very strongly calcareous; gradual boundary.

D 36 to 60 inches +, light reddish-brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) when moist; structureless; slightly hard when dry, friable when moist; very strongly calcareous.

Berthoud fine sandy loams are porous and contain many worm casts. The compound structure—prismatic and subangular blocky or granular—is weak. Fine to medium concretions occur throughout the profile in places.

The color of the surface soil ranges from brown to grayish brown, hue 7.5YR to 10YR. In most areas the texture is fine sandy loam, but small areas with a loam surface soil are included in places. Except for the sandy loam texture, the subsoil has characteristics similar to those of the surface soil.

The substratum varies widely and in places contains rounded quartz and sandstone pebbles, apparently of the Cretaceous period.

Berthoud fine sandy loam, 3 to 5 percent slopes (BeC)—Included with this soil, as mapped, are small areas of Loamy alluvial land and Potter and Mansker soils.

The hazard of water erosion on Berthoud fine sandy loam, 3 to 5 percent slopes, is high because of steepness of slope. This soil has moderate gully and sheet erosion in small areas. (Capability unit IVe–3 (dryland or irrigated); Mixed Land range site.)

Berthoud-Mansker Fine Sandy Loams

This complex consists of areas of Berthoud and Mansker soils that were too closely intermingled to map separately. It occupies the lower slopes of draws and escarpments.

In most areas the surface soil is fine sandy loam, but in small areas it is loam. Most of this complex is used for range.

Typical Berthoud and Mansker soils are described under the separate series.

Berthoud-Mansker fine sandy loams, 5 to 8 percent slopes (BmD).—The hazard of water erosion is high on these soils because of their slopes. Small areas under cultivation have moderate gully and rill erosion. (Capability unit VIe–3; Mixed Land range site.)

Brownfield Series

The Brownfield series consists of deep, light-colored, coarse-textured soils with a reddish sandy clay loam subsoil. These soils occur on the broad, undulating plains in the Sandhills.

The fine sand surface layer is about 20 inches thick. The upper subsoil is a red sandy clay loam, about 15 inches thick. It has moderate, coarse, prismatic and weak, subangular blocky structure. The lower subsoil is a yellowish-red sandy clay loam, about 15 inches thick. It has weak, prismatic and subangular blocky structure. These soils usually have no C_{ca} horizon. The parent material is a yellowish-red fine sandy loam or light sandy clay loam.

Associated with the Brownfield soils are the Tivoli soils, which make up sand dunes; the Springer soils, which are sandier than the Brownfield in the subsoil; and the Gomez-Arch complex, which consists of grayer and more limy soils.

Brownfield Fine Sands

Brownfield fine sands are gently undulating to hummocky. Most of the soils of this type are used for range. Since these soils are less droughty than most, the range is productive.

About 7.5 percent of the county is Brownfield fine sands. Under irrigation, suitable grasses or close-spaced crops that produce high residue may be grown. The very high hazard of wind erosion on the sandy surface soil makes Brownfield fine sands unsuitable for crops that produce little residue, such as cotton or sesame. These crops do not provide enough residue to protect the soil.

In areas where Brownfield fine sands are cultivated, wind erosion has shifted the surface soil and caused small hummocks or dunes to accumulate along fence rows. Deep breaking has not been successful, because of the depth to the clayey subsoil.

Profile of a Brownfield fine sand (4 miles south of Muleshoe):

A_1 0 to 6 inches, brown (7.5YR 4/4) fine sand, dark brown (7.5YR 3/4) when moist; single grain; loose when dry or moist; noncalcareous; gradual boundary.

A_{12} 6 to 21 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; single grain; loose when dry or moist; noncalcareous; clear boundary.

B_2 21 to 36 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; very hard when dry, firm when moist; few fine and very fine pores; noncalcareous; gradual boundary.

B_3 36 to 60 inches, yellowish-red (5YR 5/8) sandy clay loam, slightly darker yellowish red (5YR 4/8) when moist; compound weak, prismatic and weak, subangular blocky structure; very hard when dry, firm when moist; few fine and very fine pores; noncalcareous; gradual boundary.

C 60 to 72 inches +, yellowish-red (5YR 5/6), light sandy clay loam, yellowish red (5YR 4/6) when moist; structureless; hard when dry, firm when moist; noncalcareous.

The color of the surface soil ranges in places from brown to light brown or reddish yellow, hue 5YR to 7.5YR.

The color of the B_2 horizon ranges from red to reddish brown, hue 2.5YR to 5YR. The texture ranges from light to heavy sandy clay loam. The compound structure—coarse, prismatic and fine to medium, subangular blocky—ranges from weak to moderate in grade.

The color of the B_3 horizon ranges from yellowish red to reddish yellow, hue 5YR. The texture ranges from sandy clay loam to fine sandy loam. The structure ranges from moderate, coarse, prismatic to a compound structure weak, prismatic and weak, subangular blocky.

In areas near the Blackwater Draw and in other isolated areas, a fluctuating water table has deposited a calcium carbonate accumulation in the upper part of the C horizon.

The color of the C horizon is yellowish red in most areas. The texture ranges from sandy clay loam to loamy fine sand.

Brownfield fine sand, thick surface (Br).—The surface layer of this soil consists of fine sand, 18 to 30 inches thick. It overlies 2 to 4 feet of sandy clay loam subsoil. The hazard of wind erosion is very high. (Capability unit VIe–1 (dryland); capability unit IVe–5 (irrigated); Sandy Land range site.)

Brownfield soils, severely eroded (Bs3).—These soils occur in cultivated fields that have not been protected from the wind. They are therefore severely eroded. The mapped areas range from 10 to over 200 acres in size.

Sandy material occurs on the surface as hummocks and gall spots. The hummocks are sandy accumulations, 10 to 28 inches high. They make up 80 to 90 percent of the mapped area. The gall spots are small areas from which the wind has removed the surface soil. In places these gall spots have on the surface a layer of fine sand as much as 12 inches deep. In some places the clayey B horizon is exposed.

Profile characteristics below the eroded surface layer are the same as for Brownfield fine sand, thick surface.

Eroded fields are roughly smoothed by the use of land-leveling equipment. Farmers carry the tops of the hummocks into the gall spots. This practice removes most of the signs of erosion for short periods, but production is lowered. Farmers then have to rebuild the soil. Once soils have been eroded to this extent, it is very difficult to control further wind erosion.

These soils are best suited to native and tame grasses. (Capability unit VIe–6; Sandy Land range site.)

Church Series

The soils of the Church series are grayish, slowly permeable, and moderately fine textured. They are high in lime. These soils occur in low areas surrounding saline lakes and in depressions along Blackwater Draw.

The surface layer is grayish clay loam, about 1 foot thick. The structure is moderate, medium to fine, subangular blocky and blocky. The subsoil is gray, light clay, about 8 inches thick. The structure is moderate, medium to fine, blocky and subangular blocky. The C_{ca} horizon is light clay, about 1 foot thick. Its structure is moderate, fine, subangular blocky and blocky. The parent material is light-gray clay.

Associated with the Church soils are the Arch soils, which have a less heavy subsoil and a lighter colored surface soil; the Portales soils, which are browner and are clayey; and the Berthoud soils, which are browner and less clayey.

Church Clay Loams

The soils of this type are used mainly for range. They receive extra water as runoff from adjacent slopes. They are poorly suited to cultivation. Under dryland farming, they are very droughty. The frequent yellowing of sorghum plants on irrigated areas indicates a high content of lime that makes some of the plant food unavailable. In some cultivated areas, the surface soil is coarser than usual because wind erosion has removed some of the silt and clay.

Church clay loams are best suited to range. Present vegetation includes blue grama, buffalograss, alkali sacaton, and inland saltgrass.

Profile of a Church clay loam in a cultivated field (4 miles west of Muleshoe):

A_{1p} 0 to 6 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; few worm casts; very strongly calcareous; abrupt boundary.

A_{12} 6 to 13 inches, light-gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) when moist; compound moderate, fine, subangular blocky and moderate, fine, blocky structure; hard when dry, friable when moist; many fine and very fine pores; few worm casts; very strongly calcareous; gradual boundary.

AC 13 to 21 inches, light-gray (10YR 7/2) clay, light brownish gray (10YR 6/2) when moist; compound moderate, fine, subangular blocky and moderate, fine, blocky structure; very hard when dry, firm when moist; many fine and very fine pores; few small shells; very strongly calcareous; gradual boundary.

C_{ca} 21 to 27 inches, white (10YR 8/1) clay, also white (10YR 8/1) when moist; compound moderate, fine, subangular blocky and moderate, fine, blocky structure; very hard when dry, firm when moist; few fine and very fine pores; many small shell fragments; very strongly calcareous; gradual boundary.

C 27 to 48 inches +, light-gray (10YR 7/1) clay, light gray (10YR 7/1) when moist; compound moderate, fine, subangular blocky and moderate, fine, blocky structure; very hard when dry, firm when moist; many small shell fragments; very strongly calcareous.

The color of the surface layer ranges from light gray to dark grayish brown, hue 2.5Y to 10YR. In most areas the texture is clay loam, but in some small areas it is clay. The thickness ranges from 6 to 18 inches.

The color of the subsoil ranges from light brownish gray to white, hue 2.5Y to 10YR. In most areas the texture is clay, but in some it is clay loam. The compound structure—fine to medium, subangular blocky and blocky—ranges from moderate to strong in grade. The thickness ranges from 4 to 12 inches.

Where Church clay loams have had a high water table, it is hard to see where the C_{ca} horizon ends and where the parent material begins. This is because of the very high content of lime in both horizons.

Some areas are apparently saline. In most areas small shells and shell fragments are below the subsoil. Gypsum crystals occur in places below 4 feet.

Church clay loam (Ch).—This soil has slopes that are usually less than 1 percent, but small areas having slopes as much as 1.5 percent are included.

The hazard of wind erosion is high because of the high lime content of the surface soil. Crops tolerant of a high lime content are best suited to irrigated areas. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Drake Series

The soils of the Drake series are gray, loamy, and very strongly calcareous. They make up low dunes to the leeward (east and southeast) of playas, of ancient watercourses, of saline lakes, and of low areas where limy earth occurs. They were formed in wind-deposited materials when the prevailing winds were from the west and northwest.

Drake soils occur in all parts of the county. They occupy areas, 10 to 30 acres in size, in association with playas. Where they are associated with saline lakes, they occupy areas larger than 200 acres.

The surface soil is grayish loam, about 6 inches thick. It has a weak, granular structure. The subsoil is light brownish gray and moderately fine textured. It has a weak, granular and prismatic structure. The parent material is light-brownish gray to light gray and is moderately fine textured.

In some steep, cultivated areas of Drake soils, both rill and gully erosion have removed the surface soil. Wind erosion has also removed the surface soil from many cultivated areas.

Associated with the Drake soils are the Portales soils, which are deeper and darker; the Church and Arch soils, which were formed in depressed areas; and the Zita soils, which are deeper and darker and are noncalcareous in the surface soil and subsoil.

Drake Soils

Profile of Drake soils on the Muleshoe National Wildlife Refuge of the U.S. Department of the Interior (about 400 feet east of Goose Lake):

A_1 0 to 6 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; weak, granular structure; soft when dry, friable when moist; few, fine pores; very strongly calcareous; clear boundary.

AC 6 to 15 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; compound weak, prismatic and weak, granular structure; slightly hard when dry, friable when moist; common, fine pores; very strongly calcareous; gradual boundary.

C 15 to 72 inches +, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; weak, granular structure; soft when dry, friable when moist; few small shell fragments; very strongly calcareous.

The color of the surface soil ranges from light gray to brown, hue 2.5Y to 10YR. The fine sandy loam and clay loam textures occur in places.

The color of the subsoil ranges from grayish brown to white, hue 2.5Y to 10YR. The texture ranges from sandy clay loam to clay loam.

Drake soils, 1 to 3 percent slopes (DrB).—These soils have a profile very similar to the one described, except that the surface soil is slightly darker and thicker. They occur in areas generally less than 30 acres in size.

These soils are highly susceptible to wind erosion. The hazard of water erosion is moderate. The yellowing of sorghum plants grown on these soils indicates a high content of lime that makes some of the plant food unavailable. (Capability unit IVes–1 (dryland); capability unit IIIes–1 (irrigated); High Lime range site.)

Drake soils, 3 to 5 percent slopes (DrC).—These soils have a profile very similar to the one described. They occur mainly to the east and southeast of playas in areas less than 50 acres in size.

These soils are best suited to range. The hazard of wind and water erosion is high. If irrigated, these soils will produce only fair yields of close-spaced crops that produce large amounts of residue. (Capability unit VIe–4 (dryland); capability unit IVe–4 (irrigated); High Lime range site.)

Drake soils, 5 to 20 percent slopes (DrE).—These soils occur mainly to the leeward of saline lakes. Most areas are used mainly for range. Small areas with slopes greater than 20 percent are included.

The hazard of wind and water erosion and the steep slopes make these soils unsuitable for cultivation. Good range management is needed to prevent erosion. (Capability unit VIe–4; High Lime range site.)

Gomez Series

The Gomez series consists of deep, grayish-brown sandy soils over white or light-gray, soft caliche.

The surface layer is loose loamy fine sand, about 15 inches thick. The subsoil is pale-brown fine sandy loam, about 1 foot thick. It has a weak, prismatic structure. Below the subsoil is a caliche layer of light-gray sandy clay loam.

These soils were formed from sandy material under slightly restricted drainage. The parent materials apparently were calcified by fluctuating water tables.

Associated with the Gomez soils are the Likes soils, which are hummocky; the Brownfield soils, which are redder and have no C_{ca} horizon; the Drake soils, which consist of duned, limy material; and the Tivoli soils, which are on sand dunes.

In Bailey County the Gomez soils are mapped only as a complex with the Arch soils, which are more limy and have been calcified nearer the surface.

Gomez-Arch Complex

This complex consists of areas of Gomez and Arch soils that were too closely associated or intricately mixed to map separately at the scale used. The Gomez soils are predominant and rarely make up less than 50 percent of the complex. The Arch soils generally make up 20 to 50 percent of the complex. They generally occupy the low areas where the fluctuating water table is near the surface.

This complex occurs on gently undulating and slightly depressed plains, west of Coyote Lake and along the southern edge of Blackwater Draw.

Profile of Gomez loamy fine sand in a native pasture in an area of Gomez-Arch complex that contains about 20 percent of Arch soils (8 miles south and 10 miles west of Muleshoe):

A_1 0 to 15 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain and weak, granular structure; loose when dry or moist; noncalcareous; gradual boundary.

AC 15 to 28 inches, pale-brown (10YR 6/3), heavy fine sandy loam, brown (10YR 5/3) when moist; compound weak, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist; many fine and very fine pores; few threads of calcium carbonate in lower 6 inches; strongly calcareous; gradual boundary.

C_{ca} 28 to 48 inches, white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) when moist; structureless; slightly hard when dry, friable when moist; about 40 percent carbonates by volume; many fine and medium, segregated concretions of calcium carbonate; very strongly calcareous; diffuse boundary.

C 48 to 72 inches +, white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) when moist; structureless; slightly hard when dry, friable when moist; very strongly calcareous.

The color of the surface layer ranges from brown to grayish brown, hue 10YR. The texture ranges from loamy fine sand to fine sand.

The color of the subsoil ranges from very pale brown to brown, hue 10YR. The texture ranges from fine sandy loam to sandy clay loam. This horizon ranges from weakly to strongly calcareous.

Areas with a weak B horizon, about 6 inches thick, occur west of Coyote Lake. This horizon is noncalcareous sandy clay loam. The compound structure—coarse, prismatic and subangular blocky—ranges from weak to moderate in grade. The color ranges from brown to yellowish brown, hue 7.5YR to 10YR. This weak B horizon also occurs in a few transitional areas between Brownfield soils and the Gomez-Arch complex in other parts of the county.

The color of the C_{ca} horizon ranges from white to light gray, hue 10YR. The texture ranges from sandy clay loam to fine sandy loam. This horizon contains 20 to 50 percent carbonates by volume and has few to many segregated concretions.

The texture of the C horizon ranges from loamy fine sand to sandy clay loam. This horizon ranges from weakly to very strongly calcareous.

Typical Arch soils are described under the Arch series.

Gomez-Arch complex (Ga).—The hazard of wind erosion is very high on this complex. (Capability unit VIe–1 (dryland); capability unit IVe–5 (irrigated); Sandy Land range site.)

Gomez-Arch complex, severely eroded (Ga3).—The soils of this complex are in cultivated fields where severe wind erosion has occurred because the soils were not properly protected.

Sandy hummocks and gall spots occur on the surface. The hummocks are areas where a sandy layer, 10 to 28 inches high, has accumulated. They make up 80 to 90 percent of the mapped area. The gall spots are small areas where the wind has removed the surface soil. In some places these spots have as much as 12 inches of loamy fine sand on the surface; in others the clayey and limy subsoil may be exposed.

Some farmers use land-leveling equipment to smooth the eroded fields. Thus the tops of the hummocks are carried into the gall spots. This practice removes most of the signs of erosion for short periods. Continued farming on these areas, however, is unprofitable unless suitable measures for rebuilding the soils are used.

Because the hazard of wind erosion is very high, the soils of this complex are not suited to cultivation. (Capability unit VIe–6; Sandy Land range site.)

Kimbrough Series

The Kimbrough series consists of brown to grayish-brown, very shallow soils that have formed over thick beds of rocklike caliche. They occur in nearly level to moderately sloping areas in the southern half of the county, mainly west of the game refuge.

The brownish-colored loamy surface layer is usually about 5 inches deep and has granular structure. It is neutral to moderately limy and, in many places, has small caliche rocks on the surface.

The Kimbrough soils are less deep and less reddish than the Arvana soils, less deep and less compact than the Stegall soils, and less sloping than the Potter soils.

Kimbrough Soils

The Kimbrough soils are used mainly for range. They are shallow and are therefore poorly suited to cultivation.

Profile of a Kimbrough soil in a native pasture (3 miles north and 4 miles west of Goodland):

A_1 0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

D_r 4 inches +, indurated, platy caliche that is smooth on the upper surfaces and knobby underneath; material has hardness on Mohs' scale of about 4.

In most areas the texture of the A_1 horizon is fine sandy loam, but in some areas it is loam and sandy clay loam. The depth ranges from 1 to 10 inches. The color ranges from brown to dark grayish brown, hue 7.5YR to 10YR. In places this horizon is calcareous.

Kimbrough soils (Km).—These soils are very shallow. Small areas of Potter and Mansker soils are included with these soils in places. (Capability unit VIIs–1; Shallow Land range site.)

Likes Series

The Likes series consists of deep, grayish-brown, moderately coarse textured soils over loose loamy fine sand.

These soils occur as dunes on the northern side of the Sandhills. The largest area is in the western half of the county.

The surface layer is fine sandy loam, about 1 foot thick. The subsoil is pale-brown fine sandy loam, about 8 inches thick. These soils apparently were formed from fairly recent deposits that consist of a mixture of sandy soils and calcareous soils.

The Likes soils are associated with the Tivoli soils, which are on the sandier dunes; the Brownfield soils, which are redder and have a sandy clay loam subsoil; and the Drake soils, which are on dunes high in lime.

In Bailey County the Likes soils are mapped only as a complex with Arch soils. The Arch soils are more limy and occur in flats between duned areas of Likes soils.

Likes-Arch Complex

This complex consists of areas of Likes and Arch soils that were too closely intermingled to be mapped separately at the scale used. It occurs on a hummocky plain. The Likes soils form the hummocks, and Arch soils are in the areas between the hummocks. Areas of transition between the hummocks and flats are similar to Gomez soils. Most of this complex is used for range.

Profile of a Likes fine sandy loam near the top of a small dune in an area of Likes-Arch complex, hummocky (10.5 miles west and 1 mile south of Muleshoe):

A_1 0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; weakly calcareous; gradual boundary.

AC 10 to 19 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak, granular structure; slightly hard when dry, friable when moist; strongly calcareous; clear boundary.

C 19 to 32 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; single grain; loose when dry or moist; weakly calcareous; clear boundary.

A_b 32 to 45 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, fine subangular blocky structure; very hard when dry, firm when moist; weakly calcareous; clear boundary.

C_{cab} 45 to 60 inches +, white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) when moist; structureless; hard when dry, friable when moist; very strongly calcareous.

The color of the surface layer ranges from grayish brown to pale brown. In most areas the texture is fine sandy loam, but in some areas it is loamy fine sand. The surface layer ranges from weakly to strongly calcareous. The thickness ranges from 8 to 20 inches.

The subsoil has the same range in characteristics as the surface soil, except that it is generally strongly calcareous.

The color of the C horizon ranges from brown to light yellowish brown, hue 7.5YR to 10YR. In most places the texture is loamy fine sand, but it ranges from fine sandy loam to fine sand. This horizon ranges from weakly to strongly calcareous. The thickness ranges from a few inches to several feet.

A typical Arch soil is described under the Arch series.

Likes-Arch complex, hummocky (La).—About 84 percent of the total area of this complex consists of hummocks, and about 16 percent consists of areas between the hummocks. The hummocks are about 4.5 feet high and nearly 500 feet wide.

In order to facilitate sprinkler irrigation, some farmers have tried to smooth the areas between the hummocks with land-leveling equipment. They carry the tops of the hummocks into the lower areas between the dunes. The practice is very undesirable because the loose loamy fine sand, approximately 1.5 feet below the surface, is exposed. This exposed soil is very highly susceptible to wind erosion. Because of this hazard and the low natural fertility, crops are difficult to establish on this soil, and yields are usually low.

This complex is used mainly for range. It contains moderate amounts of the Sandy Land type of vegetation. (Capability unit VIe–2 (dryland); capability unit IVe–6 (irrigated); Mixed Land range site.)

Loamy Alluvial Land

Loamy alluvial land (Ld).—This miscellaneous land type consists of deep, loamy soils forming in alluvial materials washed from higher lying soils. It occupies narrow flood plains, 50 to 150 feet wide, and occurs in all parts of the county except the Sandhills. It is subject to occasional flooding during rainy periods. The water quickly recedes, however, and causes little damage.

Most areas have a dark loamy surface layer, about 1 foot thick. Some areas have an overwash of stratified, reddish sandy loam. The color of the surface layer ranges from brown to very dark brown. The texture is loam in most places but ranges from fine sandy loam to clay loam. The upper subsoil is very dark grayish-brown clay loam, about 10 inches thick. The structure is weak to moderate, subangular blocky and prismatic. The lower subsoil is a brown clay loam, about 1 foot thick. The structure is weak, subangular blocky and prismatic. The subsoil has about the same range in color as the surface soil. The texture ranges from sandy clay loam to light clay.

Some areas of this land type are calcareous. Others are noncalcareous to a depth of 6 feet or more.

Associated soils are the Berthoud soils, which are grayer than Loamy alluvial land; the Mansker soils, which are shallow; the Potter soils, which are very shallow; and the Amarillo soils, which are redder.

This miscellaneous land type is droughty under dryland farming. The hazard of wind erosion is slight. (Capability unit IIIce–1 (dryland); capability unit IIe–1 (irrigated); Mixed Land range site.)

Lubbock Series

The Lubbock series consists of deep, brown, moderately sandy and sandy soils with a compact subsoil. These soils occur in nearly level, slightly depressed areas. Most areas are no larger than 30 acres.

The brownish-colored surface layer is 8 to 16 inches thick. The upper subsoil is a clay loam about the same color as the surface soil. The structure is weak to moderate, prismatic and subangular blocky. The lower subsoil is a brown to grayish-brown clay that has moderate, medium to fine, blocky and subangular blocky structure. In many places the lower few inches of the subsoil are calcareous. The pinkish to yellowish-brown C_{ca} horizon is a clay loam that ranges from 1 to several feet thick.

The associated soils are the Amarillo soils, which have a redder, less compact subsoil than the Lubbock soils; the Olton soils, which are redder; the Zita soils, which are more porous; and the Randall soils, which are the dark, clayey soils of the playa floors.

Lubbock Fine Sandy Loams

The soils of this type have a brown fine sandy loam surface layer, 6 to 14 inches thick. Most of these soils are under cultivation and are very productive. Because of their slightly depressed positions, they receive runoff from the surrounding soils. This helps to increase dryland yields. Crops in irrigated areas respond to nitrogen and phosphate fertilizers.

Small areas of Amarillo, Olton, and Zita soils are included with Lubbock fine sandy loams.

Profile of a Lubbock fine sandy loam in a cultivated area (5.5 miles north and 3 miles east of Muleshoe):

A_{1p} 0 to 8 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; structureless; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

A_{12} 8 to 14 inches, brown (7.5YR 4/2), heavy fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, prismatic structure; hard when dry, friable when moist; many worm casts and fine to medium pores; noncalcareous; gradual boundary.

B_1 14 to 24 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) when moist; compound moderate, medium, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; many fine to medium pores, few worm casts; noncalcareous; gradual boundary.

B_2 24 to 35 inches, dark grayish-brown (10YR 4/2), light clay, very dark grayish brown (10YR 3/2) when moist; compound moderate, medium, subangular blocky and moderate, medium, blocky structure; very hard when dry, firm when moist; few, fine to medium pores, distinct clay films; noncalcareous; gradual boundary.

B_3 35 to 42 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; compound weak, subangular blocky and weak, blocky structure; very hard when dry, friable when moist; few films of calcium carbonate on surfaces of peds; few fine to medium pores; weakly calcareous; clear boundary.

C_{ca} 42 to 60 inches +, light brownish-gray (10YR 6/2) clay loam; structureless; slightly hard when dry, friable when moist; many fine and very fine, soft and hard concretions of calcium carbonate; about 40 percent carbonates by volume.

If the associated soil is an Amarillo soil, the color of the A horizon ranges from reddish brown to brown, hues 5YR and 7.5YR. If the associated soil is a Zita soil, the color ranges from brown to grayish brown.

The range in color of the B_1 horizon is the same as that of the A horizon. The texture ranges from sandy clay loam to clay loam. The structure is compound weak, prismatic and subangular blocky in most places.

The color of the B_2 horizon ranges from brown to very dark grayish brown, hues 7.5YR and 10YR. The texture ranges from heavy clay loam to clay. The depth to the B_2 horizon ranges from 18 to 30 inches.

The color of the B_3 horizon ranges from brown to light gray, hue 7.5YR to 10YR. The texture ranges from clay loam to light clay.

The color of the C_{ca} horizon ranges from pink to light gray, hue 7.5YR to 10YR. The texture is clay loam in most places.

Lubbock fine sandy loam (Lu).—This soil is subject to moderate wind erosion. As a result some areas have lost silt and clay from the plow layer.

Some small areas around playas have slopes that are as much as 1.5 percent. (Capability unit IIIe–2 (dryland); capability unit IIe–2 (irrigated); Mixed Land range site.)

Lubbock Loamy Fine Sands

This type comprises the sandier soils of the Lubbock series. These soils have a brown loamy fine sand surface layer, 8 to 16 inches thick, and a dark-brown light clay subsoil, 24 to 36 inches thick. They occupy depressed areas within large areas of Amarillo loamy fine sand or Amarillo fine sandy loams. Nearly all of these soils occur to the south of the Sandhills and east of Coyote Lake.

Lubbock loamy fine sands are low in fertility and have a low water-holding capacity in the sandy surface layer. Under irrigation, crops on soils of this type respond to nitrogen and phosphate fertilizers.

Profile of a Lubbock loamy fine sand in a cultivated field:

A_1 0 to 13 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; single grain; soft when dry, loose when moist; noncalcareous; abrupt boundary.

B_1 13 to 17 inches, brown (7.5YR 4/2), light sandy clay loam, dark brown (7.5YR 3/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; few fine and very fine pores; noncalcareous; clear boundary.

B_{21} 17 to 24 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; compound moderate, coarse, prismatic and weak, subangular blocky structure; hard when dry, friable when moist, few fine and very fine pores; noncalcareous; clear boundary.

B_{22} 24 to 36 inches, brown (7.5YR 4/2), light clay, dark brown (7.5YR 3/2) when moist; moderate, medium, blocky structure; hard when dry, firm when moist; distinct clay films; noncalcareous; gradual boundary.

B_3 36 to 42 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; compound weak, blocky and weak, subangular blocky structure; hard when dry, friable when moist; weakly calcareous; gradual boundary.

C_{ca} 42 to 72 inches +, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) when moist; structureless; hard when dry, friable when moist; about 40 percent carbonates by volume; very strongly calcareous.

The color of the surface layer ranges from light brown to brown, hue 7.5YR. The texture is loamy fine sand in most places. The thickness ranges from 8 to 16 inches.

Except for the sandy clay loam texture in the upper part of the B horizon, the subsoil has the same range in characteristics as that of Lubbock fine sandy loam.

Lubbock loamy fine sand (Lk).—The hazard of wind erosion is high.

Small areas of Amarillo, Zita, and Randall soils are included with this soil in places. Small, severely eroded areas are also included. In these areas the wind has shifted the original surface layer and removed the silt and clay; the present surface layer is fine sand. (Capability unit IVe–1 (dryland); capability unit IIIe–4 (irrigated); Sandy Land range site.)

Mansker Series

The Mansker series consists of grayish-brown to brown, shallow, calcareous loamy soils. These soils occur mainly on convex slopes above draws and playas in all parts of the county.

The brownish loamy surface layer is about 8 inches thick. The grayish-brown subsoil is moderately fine textured and about 8 inches thick. Its structure is weak, prismatic and granular. These two layers overlie a lime-enriched zone from 5 inches to 2 or more feet thick. The parent material is a pink to reddish-yellow sandy clay loam that is limy.

Associated with these soils are the Portales and Berthoud soils, which are deeper; the Amarillo soils, which are deeper, redder, and noncalcareous; the Arvana soils, which are redder and noncalcareous; and the Potter soils, which are shallower.

Mansker Fine Sandy Loams

The soils of this type have a fine sandy loam surface layer and a loam to clay loam subsoil. Permeability is moderate to moderately rapid. About two-thirds of the acreage of these soils is used for cultivated crops. Crop yields are limited, however, by the shallowness of the soil. Irrigation is expensive because small and frequent waterings are required.

Included with these soils are small areas of Portales, Potter, Amarillo, and, in some places, Arvana soils. Also included are small areas that have a sandier surface layer than normal because wind erosion has removed some of the silt and clay.

Profile of a Mansker fine sandy loam in a gently sloping, cultivated field (2 miles east and ¾ mile south of Needmore):

A_p 0 to 8 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; structureless; many fine and medium, soft and hard concretions of calcium carbonate; strongly calcareous; abrupt boundary.

AC 8 to 16 inches, grayish-brown (10YR 5/2), light clay loam, dark grayish brown (10YR 4/2) when moist; compound weak, prismatic and weak, granular structure; slightly hard when dry, friable when moist; many fine to medium, soft and hard concretions of calcium carbonate; many worm casts and fine pores; very strongly calcareous; clear boundary.

C_{ca} 16 to 28 inches, very pale brown (10YR 7/4), light clay loam, light yellowish brown (10YR 6/4) when moist; structureless; slightly hard when dry, friable when moist; about 50 percent carbonates by volume; very strongly calcareous; diffuse boundary.

C 28 to 46 inches +, pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) when moist; very strongly calcareous.

The thickness of the surface layer ranges from 4 to 10 inches. The color ranges from brown to grayish brown, hues 7.5YR and 10YR.

The range in color of the subsoil is about the same as that of the surface soil. The compound structure is generally weak, granular and weak, prismatic. The texture ranges from loam to clay loam. The thickness ranges from 6 to 10 inches.

The C_{ca} horizon ranges from 6 to 24 inches in thickness. The color ranges from pale brown to white, hue 10YR, and from light brown to pink, hue 7.5YR. In places this horizon is weakly indurated.

The range in color of the C horizon is the same as that of the C_{ca} horizon, but this layer rarely has more than 20 percent carbonates by volume.

Concretions of calcium carbonate are common throughout the profile. Worm casts are abundant above the C_{ca} horizon in most places.

Mansker fine sandy loam, 0 to 1 percent slopes (MfA).—This soil has a slightly darker surface soil in places (dark brown, 10YR 4/3) than the more sloping areas of Mansker soils. It occurs in smooth, nearly level areas, usually less than 50 acres in size. It is a shallow soil. The risk of wind erosion is moderate. In places 3 to 4 inches of the surface soil have been lost through sheet and gully erosion. (Capability unit IVe–2 (dryland); capability unit IIIe–5 (irrigated); Mixed Land range site.)

Mansker fine sandy loam, 1 to 3 percent slopes (MfB).—This soil occurs on gentle slopes above playas or draws. Areas are generally less than 50 acres in size. The soil is shallow, and the hazard of wind erosion is moderate. (Capability unit IVe–7 (dryland or irrigated); Mixed Land range site.)

Mansker fine sandy loam, 3 to 5 percent slopes (MfC).—This soil occurs in moderately sloping areas, most of which are less than 30 acres in size. The soil is shallow, and the hazard of water erosion is greater than on the less sloping Mansker fine sandy loams. In small areas most of the surface soil has been removed by sheet and gully erosion. Included are small areas of Portales, Potter, and Berthoud soils and small, eroded areas. (Capability unit VIe–3; Mixed Land range site.)

MANSKER LOAMS

The soils of this type have a loam surface layer and a clay loam subsoil. They occur mainly in the southwestern part of the county. About 80 percent of their acreage is used for cultivated crops.

Irrigation is difficult because shallowness limits water-holding capacity and makes frequent waterings necessary. In places 2 to 4 inches of the surface soil have been removed by wind erosion.

Included with Mansker loams are small areas of Portales and Potter soils. Small areas that have had moderately severe wind erosion are also included.

Profile of a Mansker loam in a nearly level, cultivated field (1½ miles south and ½ mile east of Goodland):

A_p 0 to 8 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; structureless; hard when dry, friable when moist; common, fine to medium, soft and hard concretions of calcium carbonate; strongly calcareous; abrupt boundary.

AC 8 to 18 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; compound weak, prismatic and weak, granular structure; hard when dry, friable when moist; common, fine to medium, soft and hard concretions of calcium carbonate; very strongly calcareous; clear boundary.

C_{ca} 18 to 30 inches, pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) when moist; many fine to medium concretions that are mostly hard; very strongly calcareous; diffuse boundary.

C 30 to 60 inches +, reddish-yellow (7.5YR 7/6) clay loam, reddish yellow (7.5YR 6/6) when moist; very strongly calcareous.

In most areas the texture of the surface layer is loam, but in small areas it is sandy clay loam. The range in color is the same as for the surface layer of Mansker fine sandy loam. Except for the loam texture of the surface layer and an estimated 5 percent more clay in the subsoil, the profile characteristics are about the same as for Mansker fine sandy loam.

Mansker loam, 0 to 1 percent slopes (MkA).—This soil occupies smooth, nearly level areas, most of which are less than 30 acres in size. It is shallow, and the hazard of wind erosion is moderate. (Capability unit IVe–2 (dryland); capability unit IIIe–5 (irrigated); Shallow Land range site.)

Mansker loam, 1 to 3 percent slopes (MkB).—Except for stronger slopes, this soil is similar to Mansker loam, 0 to 1 percent slopes. It is harder to irrigate but, otherwise, has the same management problems. In small areas about half the surface soil has been lost through water erosion. (Capability unit IVe–7 (dryland or irrigated); Shallow Land range site.)

Olton Series

The Olton series consists of brown, deep, slowly permeable, medium-textured soils. These soils are underlain by soft, pink caliche at a depth of 30 to 60 inches. They occupy broad, nearly level plains, mainly in the southeastern part of the county. Most of these soils are farmed as dryland.

The brownish loam surface layer is 6 to 12 inches thick. The reddish-brown clay loam subsoil is 25 to 50 inches thick. About the upper one-third of the subsoil has weak to moderate, prismatic and subangular blocky structure. The middle one-third of the subsoil has moderate, fine to medium, subangular blocky and blocky structure. The lower one-third has weak, subangular blocky and blocky structure. Beneath the subsoil is a pink to yellowish-red horizon of calcium carbonate accumulation. The carbonate has been leached from the soil above it. The parent material is light reddish-brown to yellowish-brown clay loam that is limy.

Associated with the Olton soils are the Amarillo soils, which are sandier and less clayey in the subsoil; the Portales soils, which are grayer and calcareous; and the Stegall soils, which are underlain by rocklike caliche.

OLTON LOAMS

In the few small areas where the soils of this type are irrigated, they are productive and respond to nitrogen and phosphate fertilizers. Under dryland farming, they are droughty.

Profile of an Olton loam in a cultivated field (1 mile east of Circle Back):

A_p 0 to 8 inches, brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) when moist; structureless; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

B_{21} 8 to 12 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; compound moderate, medium, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist; many fine to medium pores; patchy clay films; noncalcareous; clear boundary.

B_{22} 12 to 26 inches, reddish-brown (5YR 4/3), heavy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium and fine, subangular blocky structure; hard when dry, firm when moist; distinct clay films and many fine pores; noncalcareous; clear boundary.

B_3 26 to 38 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; calcareous at 32 inches; a few, fine to very fine calcium carbonate concretions in the lower 6 inches; clear boundary.

C_{ca} 38 to 60 inches, pink (5YR 8/4) clay loam, light reddish brown (5YR 6/4) when moist; very strongly calcareous; about 40 percent carbonates by volume; diffuse boundary.

C 60 to 72 inches +, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) when moist; very strongly calcareous; a few, soft concretions of calcium carbonate.

In most areas the texture of the surface layer is loam, but in some areas it is sandy clay loam and clay loam. In most places the color of the surface soil is brown, but in some it is reddish brown or dark brown, hue 5YR to 7.5YR.

In most areas the texture of the subsoil is heavy clay loam, but in some it is light clay. In most places the B_{21} and B_{22} horizons are reddish brown. The range in color is the same as that of the surface soil. The compound structure of the B_{21} horizon is usually moderate, medium, prismatic and weak to moderate, subangular blocky. The thickness ranges from 4 to 12 inches. The structure of the B_{22} horizon ranges from moderate to strong, fine to medium, subangular blocky to compound moderate to strong, fine to medium, subangular blocky and blocky. The thickness ranges from 6 to 15 inches. The B_3 horizon is reddish brown in most places, but in some it is yellowish red. The hue is usually 5YR. The structure ranges from weak, fine, subangular blocky to blocky. The thickness ranges from 10 to 24 inches.

In most areas the color of the C_{ca} horizon is pink, but in some it is white or reddish yellow. The thickness ranges from 12 to 30 inches. The volume of carbonates is usually about 40 percent in this horizon, but it ranges from 30 to 60 percent. The depth to the C_{ca} horizon ranges from 30 to 60 inches.

In most areas the C horizon is a pink or light reddish-brown clay loam that is calcareous.

Olton loam, 0 to 1 percent slopes (OtA).—This soil has low rainfall. The hazard of wind and water erosion is slight. Included with this soil are small areas of Amarillo, Lubbock, and Portales soils. (Capability unit IIIce-1 (dryland); capability unit IIe-1 (irrigated); Deep Hardland range site.)

Portales Series

The Portales series consists of grayish-brown, moderately deep, moderately permeable soils. These soils are medium and moderately coarse textured and are calcareous. They are underlain by soft, white caliche at a depth of 24 to 40 inches. They occupy broad, nearly level plains and gently sloping areas in all parts of the county.

The brownish loamy surface layer is about 16 inches thick. The subsoil is light brownish gray and slightly more than 1 foot thick. It is moderately fine textured and has a weak, prismatic and subangular blocky structure. A light-gray horizon of calcium carbonate accumulation occurs below the subsoil. It has been leached from the soil above it. The parent material is white or very pale brown. It is moderately fine textured and limy.

Portales soils are related to the Zita soils, which are darker and noncalcareous; the Mansker soils, which are shallower; the Church soils, which are more clayey and limy; the Arch soils, which are less deep and more limy; and the Berthoud soils, which have no C_{ca} horizon. They are also related to the Drake soils, which occur as dunes consisting of material high in lime; and the Potter and Kimbrough soils, which are very shallow.

Portales soils are associated with the Amarillo soils, which are redder and noncalcareous; the Olton soils, which are slowly permeable, redder, and noncalcareous; and the Arvana soils, which are redder and noncalcareous and are underlain by rocklike caliche.

Portales Loams

The soils of this type have a brown to grayish-brown loam surface layer, 8 to 20 inches thick, and a light brownish-gray subsoil, 10 to 20 inches thick.

These soils occur in all parts of the county; the largest area is in the northeastern part. They are mostly under cultivation and are droughty when farmed as dryland. They are productive under irrigation. Crops respond to nitrogen and phosphate fertilizers.

Deep breaking is not suitable for Portales loams because it increases the lime content of the surface soil in many places. In such places erosion has increased. In some areas the wind has removed 3 to 4 inches of the surface soil. Here, the texture has been made coarser by the removal of silt and clay.

Included with areas of Portales loams are small areas of Arch and Mansker soils. Also included in places are small areas of Amarillo, Arvana, and Zita soils.

Profile of a Portales loam under cultivation (4 miles north and 3.5 miles east of Goodland):

A_p 0 to 9 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; strongly calcareous; abrupt boundary.

A_{12} 9 to 20 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; compound weak, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; many worm casts and fine and very fine pores; strongly calcareous; clear boundary.

AC 20 to 32 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; compound weak, prismatic and weak, subangular blocky structure; hard when dry, friable when moist; many worm casts; very strongly calcareous; gradual boundary.

C_{ca} 32 to 44 inches, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) when moist; about 40 percent carbonates by volume; clear boundary.

C 44 to 60 inches +, clay loam that is white (10YR 8/1) when moist or dry; very strongly calcareous.

In most areas the texture of the surface layer is loam, but in some areas it is sandy clay loam or clay loam. The color of the surface layer ranges from brown to grayish brown, hues 7.5YR and 10YR. The subsoil is about one value higher than the surface soil.

The color of the C_{ca} and C horizons ranges from white to pale brown, hues 7.5YR and 10YR. In most areas the texture of the parent material is clay loam, but in some it is sandy clay loam.

Most areas of Portales loams have many worm casts in the solum. In some places small, weakly indurated concretions of calcium carbonate occur throughout the profile.

In a few places where Portales loam is associated with Arvana or Kimbrough soils, there is rocklike caliche instead of a C_{ca} or C horizon.

Portales loam, 0 to 1 percent slopes (PmA).—This soil occurs in broad, smooth, nearly level areas. It is subject to slight wind and water erosion. (Capability unit IIIce-1 (dryland); capability unit IIe-1 (irrigated); Deep Hardland range site.)

Portales loam, 1 to 3 percent slopes (PmB).—This soil generally occurs in convex positions above watercourses and playas. It occupies smaller areas than Portales loam, 0 to 1 percent slopes. Most of these areas are less than 50 acres in size.

The hazard of wind erosion is slight to moderate. The hazard of water erosion is moderate. The soil is droughty when farmed as dryland. In irrigated areas, crops respond to nitrogen and phosphate fertilizers. (Capability unit IIIe-3 (dryland or irrigated); Deep Hardland range site.)

PORTALES FINE SANDY LOAMS

The soils of this type have a fine sandy loam surface layer, 6 to 15 inches thick. They have a sandy clay loam subsoil, 14 to 30 inches thick. The C_{ca} horizon occurs at a depth of 22 to 40 inches.

Portales fine sandy loams occur in all parts of the county, usually in areas less than 300 acres in size. Most of these soils are cultivated and are productive. In irrigated areas, crops respond to nitrogen and phosphate fertilizers.

Included with Portales fine sandy loams are small areas of Amarillo, Arvana, Mansker, Arch, and Berthoud soils. Also included are small areas that have moderately severe wind erosion. In these areas some of the silt and clay in the plow layer has been blown away, and the upper 3 to 6 inches of surface soil may be loamy fine sand.

Profile of a Portales fine sandy loam in a cultivated area (2.5 miles north and 1¾ miles east of Muleshoe):

A_{1p} 0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam' dark grayish brown (10YR 4/2) when moist; structureless; soft when dry, friable when moist; few fine to medium concretions of calcium carbonate; strongly calcareous; abrupt boundary.

A_{12} 8 to 12 inches, dark grayish-brown (10YR 4/2), heavy fine sandy loam, very dark grayish brown (10YR 3/2) when moist; compound weak, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist; many fine to medium pores and worm casts; few fine concretions of calcium carbonate, 5 to 20 millimeters in diameter; strongly calcareous; gradual boundary.

AC 12 to 36 inches, light brownish-gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) when moist; compound weak, prismatic and weak, subangular blocky structure; slightly hard when dry, friable when moist; many worm casts and fine to medium pores; few fine to medium concretions of calcium carbonate, 5 to 30 millimeters in diameter, that are more numerous in lower part of horizon; very strongly calcareous; gradual boundary.

C_{ca} 36 to 60 inches, light-gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) when moist; structureless; slightly hard when dry, friable when moist; about 30 percent carbonates by volume; many hard concretions less than 30 millimeters in size; gradual boundary.

C 60 to 72 inches +, very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) when moist; structureless; slightly hard when dry, friable when moist; very strongly calcareous.

In most places the texture of the surface layer is fine sandy loam, but some small areas have a thin mantle of loamy fine sand. The color of the surface soil ranges from brown to grayish brown, hues 7.5YR and 10YR.

The subsoil has about the same range in color as the surface soil.

The color of the C_{ca} horizon ranges from pale brown to white or pink, hues 7.5YR and 10YR. In most places the texture of the C_{ca} horizon is sandy clay loam, but it ranges from sandy clay loam to clay loam.

In a few places where Portales fine sandy loam is associated with Arvana and Kimbrough soils, there is indurated caliche instead of a C_{ca} or C horizon.

Portales fine sandy loam, 0 to 1 percent slopes (PfA).—This soil occupies smooth, nearly level areas. It is subject to moderate wind erosion. (Capability unit IIIe-2 (dryland); capability unit IIe-2 (irrigated); Mixed Land range site.)

Portales fine sandy loam, 1 to 3 percent slopes (PfB).—This soil occurs in smaller, more sloping areas around playas and watercourses than Portales fine sandy loam, 0 to 1 percent slopes.

This soil is productive. The hazard of wind and water erosion is moderate. In some small areas, most of the surface soil has been washed away by sheet and gully erosion. (Capability unit IIIe-1 (dryland or irrigated): Mixed Land range site.)

Potter Series

The Potter series consists of pale-brown to grayish-brown soils that are very shallow and calcareous. These soils are underlain by deep beds of caliche or highly calcareous material. They occupy areas above stream channels in all parts of the county, as well as the breaks above the saline lakes in the southern part. Slopes range from 2 to 30 percent.

The brownish, medium-textured surface layer is about 6 inches thick. The structure is moderate, medium. granular..

Associated with the Potter soils are the Mansker soils, which are deeper; the Kimbrough soils, which are noncalcareous and are underlain by rocklike caliche; and the Portales and Berthoud soils, which are darker and much deeper.

POTTER SOILS

The profile of a Potter soil in a native pasture (about 4 miles east and 1 mile south of Enochs):

A 0 to 5 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; many fine and very fine concretions of calcium carbonate; very strongly calcareous; clear boundary.

C 5 to 20 inches +, pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) when moist; structureless; many fine to large, soft and hard concretions of calcium carbonate; about 50 percent carbonates by volume.

The texture of the surface soil is loam in most places, but it is fine sandy loam and clay loam in some areas. Soft and hard calcium carbonate concretions are common on the surface of Potter soils. Caliche rocks more than 1 foot in diameter occur in many places along escarpments.

Potter soils (Ps).—Because these soils are shallow and steep, they are not suited to cultivation. Included with these soils are small areas of Mansker and Kimbrough soils. (Capability unit VIIs-1; Shallow Land range site.)

Randall Series

The Randall series consists of dark-gray, deep, compact soils in playas. These playas receive runoff from surrounding soils and are submerged for long periods.

Areas of Randall soils are usually less than 50 acres in size; the average size is about 25 acres. These soils are a few feet to more than 100 feet below the surrounding plains.

The dark-gray clay or fine sandy loam surface layer is about 2 feet thick and has blocky structure or is massive.

The gray clay subsoil is also about 2 feet thick. It has blocky structure or is massive. The parent material is a light-gray clay that is massive.

Randall soils are associated with the Lubbock soils, which are less dark and less clayey; the Zita soils, which are sandier; the Kimbrough soils, which are very shallow and are underlain by rocklike caliche; and the Amarillo soils, which are redder and less clayey.

Randall Clays

The soils of this type have a dark-gray to black clay surface layer, 10 to 30 inches thick. They have a gray clay subsoil, 10 to 30 inches thick. About half the acreage of these soils is used for range.

Profile of a Randall clay (2 miles west of Stegall):

A_1 0 to 10 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; compound moderate, medium, blocky structure and massive; very hard when dry, friable when moist, and very sticky and plastic when wet; noncalcareous; diffuse boundary.

A_{12} 10 to 20 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; massive; very hard when dry, firm when moist, and very sticky and plastic when wet; noncalcareous; diffuse boundary.

AC 20 to 50 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; massive; extremely hard when dry, very firm when moist, and sticky and plastic when wet; few dark concretions (probably manganese compounds); diffuse boundary.

C 50 to 72 inches +, light-gray (10YR 7/2) clay, light brownish gray (10YR 6/2) when moist; massive; extremely hard when dry, very firm when moist, and very sticky and plastic when wet; few mottles of light olive brown (2.5Y 5/6, dry) and grayish brown (2.5Y 5/2, dry); few films and threads of calcium carbonate; strongly calcareous.

In most areas the texture of the surface layer is clay, but a few inches of sandier overwash are common. The color ranges from gray to black, hue 10YR to 2.5Y. The structure ranges from weak, blocky to massive or may be compound weak, blocky, and massive.

The color of the subsoil ranges from grayish brown to very dark gray, hue 10YR to 2.5Y.

In some of the small playas, Randall clays have a thinner solum and are calcareous throughout the profile.

Randall clay (Ra).—This soil can be cultivated if runoff from the surrounding soils is controlled. Small areas of Lubbock and Zita soils are included with this soil in places. (Capability unit VIw–1.)

Randall Fine Sandy Loams

The soils of this type occur mainly within the band of Amarillo loamy fine sand immediately south of the Sandhills and east of Coyote Lake. They occur in small depressions, most of which are less than 20 acres in size.

Profile of a Randall fine sandy loam (about 3 miles north of Circle Back):

A_p 0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; structureless; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

A_{12} 9 to 22 inches, dark-gray (10YR 4/1) sandy clay loam; moderate, medium, blocky structure; hard when dry, friable when moist; few worm casts and fine pores; noncalcareous; diffuse boundary.

AC 22 to 36 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; strong, medium, blocky structure and massive; very hard when dry, friable when moist; noncalcareous; diffuse boundary.

C 36 to 72 inches +, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; massive; extremely hard when dry, very firm when moist, and plastic and sticky when wet; noncalcareous.

The color of the surface layer ranges from dark brown to grayish brown, hue 10YR. The texture of the surface layer is fine sandy loam in most places, but some areas have a loamy fine sand and loam surface layer.

The range in color of the subsoil is the same as that of Randall clay. The depth to the clayey subsoil ranges from 10 to 30 inches. Randall fine sandy loams are noncalcareous in most places.

Randall fine sandy loam (Rf).—This soil has a dark grayish-brown fine sandy loam surface layer, 6 to 18 inches thick, and a grayish clay subsoil, 10 to 30 inches thick. Areas of this soil are generally less than 20 acres in size and are surrounded by Amarillo loamy fine sand.

Because of its sandier surface soil, this soil absorbs water more rapidly than Randall clay. It is, therefore, not submerged as long. Furthermore, the surrounding soils are sandier than those surrounding Randall clay, and runoff into the playas is less. Because of these characteristics, this soil is more suitable for cultivation than Randall clay, although it is wet at times. Included with this soil in places are small areas of Lubbock and Zita soils. (Capability unit IVw–1.)

Springer Series

The Springer series consists of reddish-brown, deep, coarse-textured soils. These soils occur in the western part of the Sandhills. They are on undulating plains or hummocky areas of narrow ridges, round hills, or knolls.

The reddish sandy surface layer is about 1 foot thick. The upper subsoil is a red fine sandy loam, about 1½ feet thick. The structure is weak, prismatic. The lower subsoil is a yellowish-red loamy fine sand, about 1 foot thick. It is single grained. The parent material is a loose, red loamy fine sand that is noncalcareous.

The associated soils are the Brownfield soils, which have a sandier surface soil and a more clayey subsoil; the Tivoli soils, which are less red and sandier throughout the profile; and the Amarillo soils, which have a less red subsoil.

Springer Loamy Fine Sands

The soils of this type are used mainly for range. These soils are poorly suited to cultivation because of a sandy surface soil that erodes easily. In small areas under cultivation, wind has eroded the plow layer by shifting the surface soil and removing some of the silt and clay. In these areas the surface soil is as coarse as fine sand in some places.

Profile of a Springer loamy fine sand in a native pasture (10 miles west and 6.5 miles south of Muleshoe):

A_1 0 to 15 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; single grain; loose when dry, very friable when moist; noncalcareous; clear boundary.

B_2 15 to 32 inches, red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) when moist; weak, prismatic structure; slightly hard when dry, friable when moist; noncalcareous; gradual boundary.

B_3 32 to 48 inches, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) when moist; single grain;

loose when dry, very friable when moist; noncalcareous; gradual boundary.

C 48 to 72 inches +, red (2.5YR 5/6) loamy fine sand, red (2.5YR 4/6) when moist; single grain; loose when dry, friable when moist; contains thin strata of fine sand; noncalcareous.

The color of the surface layer is reddish brown in most places but ranges from reddish brown to light brown, hue 5YR to 7.5YR. The texture ranges from loamy fine sand to fine sand. The depth ranges from 10 to 20 inches.

The color of the B_2 horizon is red in most places but ranges from reddish brown to yellowish red, hue 2.5YR to 5YR. The structure ranges from weak, prismatic to moderate, coarse, prismatic. The texture is uniformly fine sandy loam. The thickness ranges from 10 to 30 inches.

The color of the B_3 horizon is yellowish red in most places but ranges to reddish yellow, hue 5YR. The texture ranges from loamy fine sand to fine sandy loam. This horizon is single grained where the texture is loamy fine sand, and it has weak, prismatic structure where the texture is fine sandy loam. The thickness ranges from 10 to 30 inches.

In places there is a weak C_{ca} horizon that is pink. A buried soil, instead of a C_{ca} or C horizon, occurs in some places. In most areas the C horizon is a pink to red, loose loamy fine sand.

Springer loamy fine sand, hummocky (Sh).—This soil has a range in slope of 3 to 8 percent. Areas of this soil are mainly on a series of ridges or knolls from 10 to 30 feet high, from 50 to 500 feet wide, and as much as one-half mile long.

The risk of wind and water erosion is high. (Capability unit VIe-5; Sandy Land range site.)

Springer loamy fine sand, undulating (Sf).—This soil has a range in slope of 0 to 3 percent. It occurs as an undulating plain between Springer loamy fine sand, hummocky, and Brownfield fine sand, thick surface. Most of this soil is used for range, but when cultivated, the risk of wind erosion is high. In small areas the surface soil has been eroded by wind. (Capability unit VIe-1 (dryland); capability unit IVe-5 (irrigated); Sandy Land range site.)

Stegall Series

The Stegall series consists of dark-brown, shallow to moderately deep, medium-textured soils. These soils are underlain by indurated caliche at a depth of 10 to 36 inches. They occur on broad, nearly level to gently sloping areas north and west of Stegall.

The moderately deep Stegall soils have a brownish surface soil, about 7 inches thick. The upper subsoil is a brown to dark-brown clay loam, about 15 inches thick. The structure is moderate, fine to medium, subangular blocky and blocky. The lower subsoil is a brown clay loam, about 8 inches thick. The structure is weak, subangular blocky. The hardened caliche below this soil consists of large, platelike units that are several feet in diameter and 1 to 2 feet thick.

The color, structure, and texture of the shallow Stegall soils are similar to those of the moderately deep Stegall soils. They have about 6 inches of surface soil and 10 inches of subsoil. The rocklike caliche usually occurs no deeper than 20 inches in the shallow Stegall soils.

Associated with the Stegall soils are the Amarillo soils, which are redder, sandier, and more permeable and are not underlain by indurated caliche; the Arvana soils, which are redder, sandier, and more permeable; the Portales soils, which are grayer, limy to the surface, and more permeable and are not underlain by indurated caliche; and the Kimbrough soils, which are very shallow.

Stegall Loams

The soils of this type have a dark-brown to brown loam surface soil, 4 to 8 inches thick, over a brown to dark-brown clay loam subsoil, 16 to 30 inches thick.

Most areas of Stegall loams are cultivated and are productive. They are droughty when farmed as dryland. These soils are fairly resistant to wind and water erosion. In small areas, however, 3 to 4 inches of the surface soil has been removed by wind erosion. In these areas the wind has removed part of the silt and clay from the surface soil, and as a result, the texture is fine sandy loam in places.

Included with some areas of Stegall loams are small areas of Amarillo, Arvana, Portales, and Olton soils.

Profile of a Stegall loam in a cultivated field (1 mile west and 1.2 miles north of Stegall):

A_p 0 to 7 inches, dark-brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) when moist; weak, granular structure; hard when dry, friable when moist; noncalcareous; abrupt boundary.

B_{21} 7 to 13 inches, dark-brown (7.5YR 4/3), heavy clay loam, dark brown (7.5YR 3/3) when moist; compound moderate, fine, blocky and moderate, fine, subangular blocky structure; very hard when dry, firm when moist; discontinuous clay films; few fine pores; noncalcareous; gradual boundary.

B_{22} 13 to 22 inches, brown (7.5YR 4/3), heavy clay loam, dark brown (7.5YR 3/3) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; continuous clay films; noncalcareous; clear boundary.

B_3 22 to 30 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; few worm casts; few small concretions of calcium carbonate in lower part; abrupt boundary.

D 30 inches +, indurated caliche; a few platy fragments in the upper part.

In most areas the surface soil is loam, but in some it is sandy clay loam and clay loam. The color of the surface soil ranges from dark reddish brown to brown or strong brown, hues 5YR and 7.5YR.

The color of the B_{21} horizon is the same as that of the surface soil. This horizon is less than 7 inches thick in most places and is missing locally.

The color of the B_{22} horizon ranges from reddish brown to brown or dark brown, hue 5YR to 7.5YR. The texture ranges from medium to heavy clay loam. The thickness ranges from 4 to 10 inches.

The color of the B_3 horizon ranges from reddish brown to brown, hue 5YR to 7.5YR. This horizon is lacking in some places. The thickness ranges from 6 to 18 inches. The depth to the indurated caliche ranges from 20 to 36 inches.

Stegall loam, 0 to 1 percent slopes (StA).—This soil occurs on broad, smooth, nearly level areas. It is droughty and subject to slight wind erosion. (Capability unit IIIce-1 (dryland); capability unit IIe-1 (irrigated); Deep Hardland range site.)

Stegall loam, 1 to 2 percent slopes (StB).—This is a productive soil. It is droughty under dryland farming.

The hazard of water erosion is moderate. (Capability unit IIIe–3 (dryland or irrigated); Deep Hardland range site.)

STEGALL LOAMS, SHALLOW

These soils are 10 to 20 inches deep over indurated caliche. They generally occur in nearly level areas less than 100 acres in size. They are usually associated with Kimbrough soils and Stegall loams.

The shallowness of these soils restricts fertility and water-holding capacity. Therefore, their use for cultivated crops is limited. These soils are droughty and produce little stubble that will help to control erosion.

Profile of a Stegall loam, shallow, in a cultivated area (3 miles north and 4.5 miles east of Stegall):

A_p 0 to 6 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; compound weak, subangular blocky and weak, granular structure; hard when dry, friable when moist; noncalcareous; abrupt boundary.

B_2 6 to 16 inches; reddish-brown (5YR 4/3), heavy clay loam, dark reddish brown (5YR 3/3) when moist; compound moderate, fine, subangular blocky and moderate, fine, blocky structure; very hard when dry, firm when moist; noncalcareous; abrupt boundary.

D 16 inches +, indurated, platy caliche.

Stegall loams, shallow, have the same range in color and texture in the solum as Stegall loams. The limited depth to the indurated caliche is the main difference in characteristics.

The surface soil is in most places less than 8 inches thick. In most areas the B_2 horizon makes up the subsoil, but in places a B_3 horizon less than 4 inches thick is present.

Stegall loam, shallow, 0 to 1 percent slopes (SwA).—The risk of wind erosion is moderate on this soil. Included with this soil are Stegall loams and Arvana, Kimbrough, and Olton soils. (Capability unit IVe–7 (dryland or irrigated); Shallow Land range site.)

Tivoli Series

The soils of the Tivoli series consist of light-brown, deep fine sand. These soils occur as vegetated dunes within the Sandhills. The dunes are 5 to 75 feet high, have a rather sharp crest, and have side slopes as steep as 40 percent. They are generally V-shaped, the bottom of the V pointing east.

The light-brown surface soil is about 8 inches thick. Below the surface soil are several feet of loose, yellowish fine sand.

The Tivoli soils are associated with the Brownfield soils, which have a more clayey subsoil; the Springer soils, which are redder and have a less sandy subsoil; and the Gomez, Likes, and Arch soils, which are grayer and less sandy.

TIVOLI FINE SANDS

Nearly all of the soils of this type are used for range. Because of the high risk of wind erosion and the characteristic dunes, these soils are not suited to cultivation.

Profile of a Tivoli fine sand (3 miles south and 1.5 miles west of Muleshoe):

A_1 0 to 8 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) when moist; the upper 2 inches are brown (10YR 5/3) when dry; single grain; loose when dry or moist; noncalcareous; clear boundary.

C 8 to 60 inches +, yellow (10YR 7/6) fine sand, brownish yellow (10YR 6/6) when moist, becoming yellow (10-YR 8/6) in lower 22 inches; single grain; loose when dry or moist; noncalcareous.

The color of the surface soil ranges from brown to yellow, hue 10YR. The darker color is usually the result of organic-matter staining. The color of the subsoil ranges from pale brown to reddish yellow. Small areas of Tivoli fine sands are calcareous in places.

Tivoli fine sand (Tv).—This soil should be used only for range. (Capability unit VIIe–1; Sandy Land range site.)

Zita Series

The Zita series consists of dark-brown to grayish-brown, moderately deep, medium- to coarse-textured soils. These soils are underlain by a white, chalky carbonate zone at a depth of 20 to 36 inches. They are in all parts of the county except the Sandhills.

The dark-brown surface layer is nearly 1 foot thick. The subsoil is also about 1 foot thick and about the same color as the surface layer. It is moderately fine textured and has a weak to moderate, subangular blocky and prismatic structure. The white chalky zone below the subsoil is 1 to several feet thick and has 30 to 60 percent carbonates by volume.

The Zita soils are associated with the Amarillo soils, which are redder; the Lubbock soils, which have a clay subsoil; and the Olton soils, which are redder and have a more clayey subsoil. The related soils are the Portales soils, which are less dark and calcareous than the Zita; the Mansker soils, which are shallow and calcareous; and the Arch soils, which are much grayer and calcareous.

ZITA FINE SANDY LOAMS

The soils of this type have a dark-brown fine sandy loam surface layer, 6 to 10 inches thick, over a sandy clay loam subsoil, 10 to 18 inches thick. Most of these soils are cultivated and are productive. Under irrigation, crops respond to nitrogen and phosphate.

Included with Zita fine sandy loams are small areas of Portales and Lubbock fine sandy loams. Small areas subject to moderately severe wind erosion are also included. In some areas the surface soil is coarser than it formerly was because the wind has removed part of the silt and clay.

Profile of a Zita fine sandy loam in a cultivated area (about 3 miles south and 2½ miles west of Enochs):

A_{1p} 0 to 7 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; structureless; hard when dry, friable when moist; noncalcareous; abrupt boundary.

A_{12} 7 to 22 inches, dark-brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) when moist; compound weak, prismatic and weak, granular structure; hard when dry, friable when moist; many worm casts and fine pores; noncalcareous; clear boundary.

AC 22 to 30 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; compound weak, prismatic and weak, granular structure; hard when dry, friable when moist; many worm casts and fine pores; strongly calcareous; clear boundary.

C_{ca} 30 to 55 inches, white (10YR 8/2) clay loam, light gray (10YR 7/2) when moist; structureless; hard when dry, friable when moist; many fine, soft concretions of calcium carbonate; about 40 percent carbonates by volume; very strongly calcareous; gradual boundary.

C 55 to 72 inches +, white (10YR 8/1) clay loam, light gray (10YR 7/1) when moist; structureless; very strongly calcareous.

The color of the surface soil ranges from brown to very dark grayish brown, hue 7.5YR to 10YR. The texture of the surface soil is fine sandy loam in most places, but it is loam in some small areas.

In most areas the subsoil is porous and contains many wormholes. The texture is sandy clay loam in most places, but in some it is clay loam. The range in color is the same as that of the surface soil.

The C_{ca} horizon ranges in color from pale brown to white, hue 10YR, and from light brown to pink, hue 7.5YR. The texture ranges from sandy clay loam to clay loam. Calcium carbonate ranges from 30 to 60 percent of total volume.

The C horizon has the same range in characteristics as the C_{ca} horizon, except for a smaller percentage of carbonates by volume.

Zita fine sandy loam, 0 to 1 percent slopes (ZfA).—This soil is moderate to high in fertility and in moisture-holding capacity. It is a productive soil, and under irrigation, good yields can be expected.

The risk of wind erosion is moderate. (Capability unit IIIe–2 (dryland); capability unit IIe–2 (irrigated); Mixed Land range site.)

Zita fine sandy loam, 1 to 3 percent slopes (ZfB).—This soil is very similar to Zita fine sandy loam, 0 to 1 percent slopes, except that it occurs in smaller areas. Slopes are mostly less than 2 percent. This soil generally occurs in association with playas.

This is a productive soil, but there is a moderate hazard of wind and water erosion. (Capability unit IIIe–1 (dryland or irrigated); Mixed Land range site.)

Zita Loams

The soils of this type have a dark-brown loam surface layer, 6 to 10 inches thick, over a clay loam subsoil, 10 to 18 inches thick. They occupy level areas around playas in the southern half of the county. They also occupy slightly depressed areas that have good surface drainage. They occur in large areas north of the Sandhills in association with Portales loams.

In small areas wind has removed part of the silt and clay from the surface soil. As a result, the surface soil is coarser than usual.

Profile of a Zita loam (about 1 mile south and 1 mile east of Enochs):

A_{1p} 0 to 8 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; structureless; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary.

A_{12} 8 to 24 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; many worm casts and fine pores; noncalcareous; abrupt boundary.

AC 24 to 28 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; many worm casts and fine pores; few films and threads of calcium carbonate; strongly calcareous; clear boundary.

C_{ca} 28 to 50 inches +, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) when moist; structureless; hard when dry, friable when moist; few, fine, soft and hard concretions of calcium carbonate; about 40 percent carbonates by volume; very strongly calcareous.

The color of the surface layer ranges from brown to very dark grayish brown, hue 7.5YR to 10YR. In most places the texture is loam, but in some it is sandy clay loam and clay loam.

The subsoil has the same range in color as the surface soil. Its structure ranges from weak to moderate, medium, subangular blocky to compound moderate, coarse, prismatic and subangular blocky.

The C_{ca} horizon ranges in color from white to pale brown (pink in places), hue 7.5YR to 10YR. The percentage of carbonates is 30 to 60 percent of total volume.

The C horizon is about the same as the C_{ca} horizon.

Zita loam, 0 to 1 percent slopes (ZmA).—This soil is productive, but it is droughty when farmed as dryland. Rainfall is low in this area. Yields are increased in irrigated areas by fertilizing the soil. The hazard of wind erosion is slight. Included with this soil, as mapped, are small areas of Portales, Olton, Lubbock, and Amarillo soils. (Capability unit IIIce–1 (dryland); capability unit IIe–1 (irrigated); Deep Hardland range site.)

Zita Loamy Fine Sands

The soils of this type have a brown to dark-brown loamy fine sand surface layer, 8 to 16 inches thick. This is underlain by a dark-brownish sandy clay loam subsoil, 8 to 18 inches thick. These soils are generally in slightly depressed areas around playas or ancient drainage courses between saline lakes. They are mainly in an ancient watercourse east of Coyote Lake. They are surrounded by Amarillo loamy fine sand in most places.

The sandy surface layer of Zita loamy fine sands is low in fertility and water-holding capacity. Under irrigation, crops respond to the application of nitrogen and phosphate.

Profile of a Zita loamy fine sand (approximately 6½ miles south of Muleshoe):

A_{1p} 0 to 14 inches, dark-brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) when moist; structureless; loose when dry or moist; noncalcareous; abrupt boundary.

A_{12} 14 to 24 inches, dark-brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; many worm casts and fine pores; noncalcareous; diffuse boundary.

C_{ca} 24 to 40 inches, light-gray (10YR 7/1) clay loam, gray (10YR 6/1) when moist; structureless; slightly hard when dry, friable when moist; many fine pores and few worm casts; about 40 percent carbonates by volume; very strongly calcareous; gradual boundary.

C 40 to 50 inches +, pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) when moist; structureless; slightly hard when dry, friable when moist; many fine to medium, soft and hard concretions of calcium carbonate; very strongly calcareous.

The color of the surface layer ranges from dark brown to pale brown, hue 7.5YR to 10YR. In most areas the texture is loamy fine sand, but in some small areas it is fine sand.

The color of the subsoil ranges from brown to very dark grayish brown, hue 7.5YR to 10YR. In most areas the texture of the subsoil is sandy clay loam, but in some it is clay loam. The structure is generally weak, subangular blocky, but in places it is compound. Where it is compound, it is fine and medium subangular blocky and coarse, prismatic and ranges from weak to moderate in grade.

The color of the C_{ca} horizon ranges from pale brown to white, hue 10YR, and from light brown to pink, hue 7.5YR. The C_{ca} horizon ranges in depth from 24 to 40 inches, but the depth is 26 to 30 inches in most places.

Zita loamy fine sand, 0 to 3 percent slopes (ZnB).—This soil is productive. The hazard of wind erosion is high because of the sandy surface soil.

Included with this soil in places are small areas of Lubbock, Gomez-Arch, and Randall soils. Small areas that have had moderately severe wind erosion are also included. In places where the wind has shifted the surface layer and removed part of the silt and clay, the texture is as coarse as fine sand. (Capability unit IVe-1 (dryland); capability unit IIIe-4 (irrigated); Sandy Land range site.)

Figure 8.—The surface soil is protected by properly managed residues.

Use and Management of the Soils

This section has several parts. In the first, some of the hazards affecting the use of the soils are noted. The second deals with wind erosion and its control. The third is a discussion of the general management practices used on cropland in the county. In the fourth part, the system used in classifying the soils according to capability is explained, the soils of the county are grouped into capability units, and the management of each capability unit is discussed. The yields of the soils suitable for cultivation are given in the fifth part. In the last part, the range sites and their management are discussed.

Some Hazards Affecting the Use of the Soils

Erosion and loss of organic matter are hazards on all soils farmed in the county. Hardpans are problems on many. Shallowness and high lime content affect the use of some of the soils. Lack of moisture is a hazard to crops in years when the rainfall is less than 18 inches.

Erosion control is the biggest problem in the management of the soils of the county. Wind erosion is particularly active on the sandier soils. Farmers may have to roughen the surface of these soils with tillage implements several times in a single season. A small rain, however, may melt the clods, and the soil may blow and drift severely. Constant care and maximum use of crop residues are required to reduce erosion (fig. 8). Wind erosion and its control are discussed more fully in the section "Wind Erosion and Its Control."

Water erosion causes soil loss on many areas of farmland. Much of the acreage of these eroded areas is still farmed, but yields are reduced and crops are less profitable. Usually the risk of water erosion is greatest on sloping areas (slopes greater than 2 percent). Water erosion, generally gully erosion, can occur wherever water collects and runs downslope. Besides causing loss of soil, runoff from localized thundershowers of medium to high intensity causes flooding, leaching, and alkali accumulation in small areas. In addition, much water is wasted.

Both wind and water erosion are less likely to occur on range or pasture if the native soil is in good to excellent condition. Rangeland erodes where native grasses are sparse or weak because of overgrazing. In some eroded places, plants apparently stand on pedestals because the soil has been washed or blown away around them.

Soils in Bailey County have not been farmed long and are moderately high in nutrients. After longer use, however, nutrients may be depleted if proper management is not practiced. As a result, yields will decline and erosion will increase.

The organic-matter content of most of the soils in the county has steadily decreased since the soils have been cultivated. The long, hot days during summer allow the organic matter to decay very fast if there is ample moisture. The loss of organic matter in the soils decreases their moisture-holding and fertility-holding capacity, causes poor tilth, and lessens the rate of penetration of air and water. The addition of cotton burs or barnyard manure, or the growing of legumes, are the main practices used to maintain organic matter in the surface layer of the soils.

Another hazard in the use of some of the soils is the formation of hardpans. This occurs after heavy equipment has run over the surface or after the soil has been plowed at the same depth for several years. The compacted soil retards root growth and water penetration and makes the soil less productive. Effective methods of dealing with hardpans are chiseling or deep plowing to a depth below the compacted area.

Some of the soils of the county are shallow or high in lime. The kinds of crops that can be grown on these soils are limited. If these soils are kept in cultivation, they should be planted to crops tolerant of these limitations or to soil-improving crops.

Wind Erosion and Its Control

No farm in Bailey County is safe from the damage caused by high winds. Wind erosion, therefore, has a major influence on soil management. Effective control of erosion requires the cooperation of all farmers in an area, because soil blown from unprotected fields will damage the soils on adjoining farms.

Effects of wind erosion.—The effects of wind erosion are serious and extensive. Many crops are lost, and soil fertility is greatly reduced. Railways and highways are sometimes buried under drifted soil. Traffic accidents are common during duststorms. Insects and weed seeds are blown far and wide with drifting soil. Fences, hedges, and shelterbelts are sometimes buried or ruined. At times, farm buildings are ruined by drifts and sand blasting. Duststorms are disagreeable or unbearable, both to farm families and to town and city people. The most serious effects of wind erosion are the loss of fine soil fractions (silt, clay, and organic matter) that are gradually sorted and moved to distant places.

The wind acts like a sieve on some soils. It removes the fine fractions and leaves the coarse ones. The coarse fractions are not fertile and are little more than the soil skeleton. The plants get their food from the finer soil particles.

In sandy regions large dunes accumulate around fences, windbreaks, or farm homes that offer resistance to the wind (fig. 9).

The finer textured soils (loams and clay loams) are least affected by wind erosion, because tillage usually roughens and clods them so that they can resist blowing. However, wind winnowing has removed enough of the organic matter, silt, and clay from the surface soil in most areas to make it coarser textured than when it was first cultivated. Thus, soils become more susceptible to erosion, have less capacity to hold water and plant nutrients, and are more likely to form plowpans.

The same effects of wind erosion also occur in most cultivated areas mapped as fine sandy loams. Wind erosion removes most of the organic matter, silt, and clay from the plow layer of these soils. The remaining sandy layer lacks plant food and is highly susceptible to wind erosion. To offset these effects, farmers have plowed deeper to bring more clayey material from below. This process has been repeated so often that in many areas the surface layer, to a depth of 10 to 12 inches, probably has changed from a fine sandy loam to a loamy fine sand.

Wind erosion has had the most drastic effects on loamy fine sands and fine sands. In cultivated areas fence-row dunes up to 10 feet high are common. In places abandoned fields have lost all of the thick, sandy surface layer. The blowing of sterile sand from these areas to adjoining areas of more productive soils is especially damaging.

***Figure 9.*—Wind erosion, showing sand accumulation on fence line.**

Rangeland also shows the effects of wind erosion. Some of the soil is shifted or removed. Generally, however, the soil is blown onto the rangeland from cultivated areas. In some places several acres are covered with 6 inches to 3 feet of sand. In such areas the good grasses are smothered, and weeds and brush grow.

One of the least noticeable, yet most damaging effects of wind erosion, is the blowing of clay and silt from cultivated land to rangeland. These materials are carried many miles and deposited as a thin mantle on the rangeland. Though this mantle is only 1/8 to 1/2 inch thick, it is almost impervious to water. It increases runoff and water erosion and thus takes greatly needed moisture from the good grasses.

Evidence of the removal of plant nutrients by wind erosion is shown by the following comparisons. Samples of dust deposited on snow and ice in Iowa by a duststorm originating in the Texas-Oklahoma Panhandle early in 1937 were compared with samples from a small dune formed by the same wind at Dalhart, Tex.[2] The dust contained about 10 times as much organic matter, 9 times as much nitrogen, 19 times as much phosphoric acid, and about 1 1/2 times as much potash as the dune sand. Compared to a virgin soil near Dalhart, the dust contained more than 3 times as much nitrogen and organic matter, about 5 times as much phosphoric acid, and 1 1/4 times as much potash.

Types of wind erosion.—There are three main types of soil movement by wind. They are (1) floating, (2) bouncing, and (3) creeping. During a duststorm, soil may float or move in the air. This is the type of movement that is usually noticed. The bouncing of particles causes the other two types of movement. The particles that move in a series of short bounces are the size of very fine to medium sand and are moved directly by the wind. These particles, in turn, may cause larger particles to creep along the surface as they strike them, or they may detach, lift, and suspend in the air particles the size of clay and silt. The material that moves by bouncing or creeping stays near its place of origin.[3] After the dust is suspended in air, it may be blown hundreds of miles.

Factors in wind erosion.—Soil cloddiness, surface roughness, and amounts of crop residues on the surface are the three main factors that influence the susceptibility of soil to wind erosion. These factors are closely interrelated.

A clod the size of an alfalfa seed (0.84 millimeter) will resist blowing. Clod formation is directly related to soil texture. Normally from 0 to 12 percent of the clods in sandy soils are large enough to resist wind erosion. The fine sandy loam soils have from 12 to 35 percent of these clods, but loams and clay loams average about 50 percent clods of nonerodible size. On the average, coarse-textured soils are more than 8 times more erodible than

[2] BENNETT, HUGH HAMMOND. SOIL CONSERVATION. 993 pp., illus. 1939.

[3] CHEPIL, W. S., WOODRUFF, N. P., and ZINGG, A. W. FIELD STUDY OF WIND EROSION IN WESTERN TEXAS. U.S. Dept. Agr. SCS-TP-125, 59 pp., illus. 1955.

moderately coarse textured soils, and they are more than 40 times more erodible than medium- and fine-textured soils.

Control of wind erosion.—Control of wind erosion depends on the conservation of clay and organic matter. When wind erosion occurs, eventually so much fine material is lost that there is no longer enough clay to produce clods.

The rougher the surface, the higher the wind needed to start soil blowing. Roughness of a field depends on the height, length, spacing, and type of vegetative cover. It also depends on the size, shape, and spacing of clods, ridges, and ripples. For example, listing has long been depended on to help control soil blowing. The effectiveness of listing depends largely on whether enough clay and moisture are in the soil to produce clods and on the amount of stalk or stubble left standing in the beds. It also depends on surface roughness produced by listing.

Residues from the previous crops can be used to help control soil blowing. They help to slow down the wind at the ground surface. Standing stubble reduces wind force more than flattened stubble, and close-spaced stubble reduces it more than the same amount of wide-spaced stubble.

The best way to control wind erosion is by maintaining a vegetative cover or by properly managing crop residues. If adequate residues are not available, emergency tillage should be used to produce roughness and clods.

Some areas in Bailey County have been eroded to the extent that they are no longer cultivated. It is evident that many other soils will eventually erode to the same degree if wind erosion is not controlled.

General Management Practices

Low rainfall, high winds, a short growing season, and the hazard of erosion are the factors that determine the type of management practices needed on cropland in Bailey County. Management practices are classified by their function, such as protection of the soil, improvement of the soil, and practices to maintain fertility.

A discussion of the principal management practices used in Bailey County follows. These practices are referred to in the section "Capability Groups of Soils."

Conservation cropping systems.—A conservation cropping system is designed to control soil erosion, conserve soil moisture, and maintain or improve soil productivity. It is a system whereby cash crops are grown, and the surface soil is protected from erosion by a cover of either dead or growing crops.

A conservation system for dryland must be based on the two main crops, cotton and grain sorghum. Cotton is a crop that depletes the soil under average farming because it returns little residue to the soil. Grain sorghum is a crop that produces much residue, and this residue can be managed to protect the soil. The frequency of growing crops that produce much residue depends on the hazard of wind erosion.

Some cropping systems that have proved satisfactory in Bailey County for dryland farming are as follows:

1. On soils slightly susceptible to wind erosion:
   One year of cotton followed by 1 year of grain sorghum.

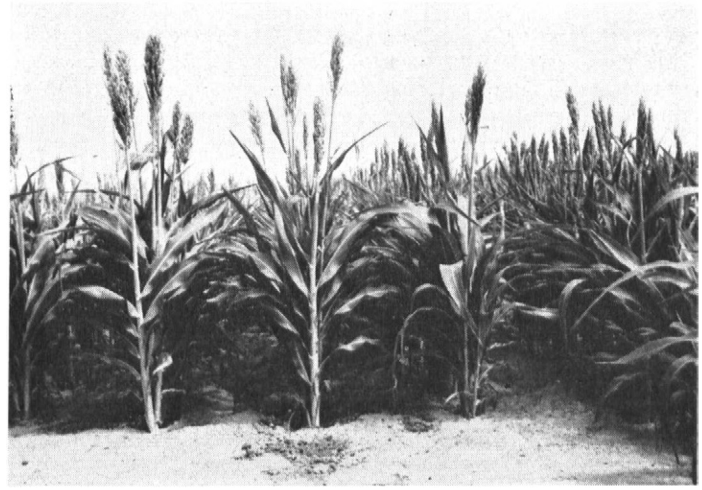

Figure 10.—**Grain sorghum planted in 20-inch rows.**

2. On soils moderately susceptible to wind erosion:
   One year of cotton followed by 2 years of grain sorghum.
3. On soils highly susceptible to wind erosion.
   Grain sorghum grown continuously in close-spaced rows (24 inches or less apart). (Fig. 10.)

Cotton and grain sorghum are the main irrigated crops in the county, but other crops can be grown under irrigation. Some cropping systems that have proved satisfactory for irrigated farming are as follows:

1. On soils slightly susceptible to wind erosion:
   a. Two years of cotton followed by 3 years of alfalfa.
   b. Two years of cotton followed by 1 year of fertilized grain sorghum.
2. On soils moderately to highly susceptible to wind erosion:
   a. Moderately susceptible—1 year of cotton followed by 1 year of fertilized grain sorghum.
   b. Highly susceptible—continuous cotton overseeded with vetch or rye, or both; or 1 year of cotton followed by 2 years of grain sorghum planted in close-spaced rows.
3. On soils very highly susceptible to wind erosion (all crops should be close spaced or sown):
   a. Three years of alfalfa followed by 3 years of grain sorghum.
   b. Three years of perennial grasses followed by 3 years of grain sorghum.

These rotations are the minimum that can be used to meet the needs of the soil. Other rotations can be used to improve soil conditions. The county agent or representatives of the Blackwater Valley Soil Conservation District should be consulted about alternate cropping systems.

Mulching.—This is a system of managing crop residues so that they are left on or near the surface to protect the surface soil from erosion. Protection is needed especially during fall, winter, and spring. These are the seasons of greatest blowing.

Crops that generally produce enough residue to permit mulching are grain and forage sorghums, small grains, perennial grasses, and legumes, such as alfalfa, winter peas, and sweetclover. Mulching these crops will (1) provide cover when crops are not growing and thus protect the soil from wind and water erosion; (2) conserve moisture by increasing the water-intake rate and by reducing evaporation of soil moisture; and (3) help maintain the organic content and structure of the soil.

During dry years, or on the sandier soils, there may not be enough residue to control erosion. Under such conditions, application of cotton burs or tillage can be used to provide additional roughness or cloddiness to supplement the cover.

Application of cotton burs.—Cotton burs are used to protect erodible land that did not produce enough cover. They are also used to protect bare areas, such as new terraces, freshly leveled land, and waterways. Burs are also added to soils in poor physical condition to improve the tilth.

Cotton burs protect the surface soil from erosion by shielding it from the wind. Other beneficial effects of burs are as follows: (1) They increase the infiltration rate, (2) reduce runoff, (3) return nitrogen, phosphorus, and potassium to the soil, and (4) improve the biological condition of the soil by adding organic matter.

A minimum of 3 tons per acre of dry burs is needed on dryland; the optimum amount is 4 to 5 tons. On irrigated land, 3 to 12 tons per acre can be applied. The optimum amount is about 8 tons per acre.

On irrigated land, 10 pounds of nitrogen per ton of burs should be added.

If cotton burs are applied, they should be spread evenly over the surface to increase yields and reduce erosion.

Cover cropping.—A cover crop is any crop that provides a solid ground cover and is planted mainly for summer or winter protection of the soil. The main cover crops planted in the county are small grain, vetch, Austrian winter peas, and sweetclover. These crops are usually planted in fall and left on the ground until about April. They are then plowed under. In this way enough time passes for the plants to decay before the next crop is planted.

The main purpose of a cover crop is to protect the surface of the soil from wind and water erosion. By the addition of organic matter to the soil, cover crops also improve soil tilth, fertility, and biological activity. These crops may be used for winter pasture.

Stripcropping.—This is a system of growing crops in alternate strips, or bands, at right angles to the natural slope of the land or the prevailing wind. These strips are vegetative barriers to wind and water erosion. Stripcropping helps to protect cotton from sandblasting during windstorms and protects soil from wind erosion after harvest. The main crops grown in protective strips are grain and forage sorghums and tall-growing perennial grasses. Cotton is the main crop grown in the areas that need protection by stripcropping.

Deep breaking.—This practice is widely used to protect highly erodible soils that have sandy surface layers. Deep breaking is used to bring some of the clayey subsoil to the surface and thus form more stable clods that will protect the soil against wind erosion.

Deep breaking is needed where one-fourth to one-third of the furrow slice is clayey material. After deep breaking, wind erosion can be further controlled by the combined use of crop residue, cloddiness, and roughness. Deep breaking alone is not enough to protect the soil for a long period.

If erosion continues after deep breaking, or the clayey material is not within the reach of the deep-breaking plow, the resulting surface material is more hazardous to handle than the original surface material.

Soils high in lime are not suitable for deep breaking, since they will not form clods that resist wind erosion.

Use of commercial fertilizers.—Fertilization of irrigated land began about 1950 in Bailey County. From 1955 to the present, it has been widely accepted.

Under irrigation almost all soils respond well to nitrogen and phosphate fertilizers. Sandy soils and soils high in lime respond favorably to potash. The proper use of fertilizer on irrigated cropland increases yields of cotton about half a bale per acre and increases grain sorghum yields about 2,000 to 3,000 pounds per acre.

If row crops are grown, fertilizer should be placed 10 inches to the sides and 2, 3, or 4 inches below the seed. Because of the short growing season, part of the nitrogen and all of the phosphate fertilizer should be applied before planting. The crop should be sidedressed with nitrogen at least once during the growing season.

All applications of fertilizer should be based on needs determined by soil tests, previous crops grown, and amount of irrigation water available. The amounts and types of fertilizer needed vary with the type of soil, needs of the crop to be planted, previous cropping history, climatic conditions, and many other things.

Moisture is the limiting factor in dryland farming, and fertilization is generally considered unprofitable.

Terraces and contour farming.—These mechanical practices are used to hold water on the land and also to prevent water erosion. Holding water on the land, or moisture conservation, is necessary for best yields in this area of low rainfall.

The success of terracing depends mainly on maintenance and management. If neglected, the terraces will deteriorate and erosion will result. Plowing parallel to terraces and in such a way as to move the soil into them is an important practice in keeping terraces repaired.

Terraces should always be supplemented by the best possible cropping system. Used alone, they do not improve soil fertility or prevent erosion. If terraces are properly supplemented by other practices, however, better crop yields will be produced and less erosion will occur than on unterraced fields.

All terraced land should be farmed on the contour. Contour farming should also be used on many nearly level soils where terraces are not needed. If terraces are needed, representatives of the Blackwater Valley Soil Conservation District, or other qualified people, should be consulted. Terracing should not be attempted by inexperienced people.

Irrigation.—As the demand for irrigation water in the county increases and the supply decreases, conservation of water by proper handling is becoming more important. The number of wells has increased from a few hundred before the second World War to more than 2,000 at present. Before the war, about 20,000 acres were irrigated by the

Figure 11.—Irrigation of sesame in Bailey County.

Figure 12.—Sprinkler irrigation of Amarillo loamy fine sand.

Figure 13.—Furrow irrigation of grain sorghum on Portales loam.

few wells; at present, almost 150,000 acres are irrigated by wells (fig. 11).

Water occurs at various depths throughout the county. Part of the water is pumped from about 40 feet below the ground, and some is pumped from as deep as 200 feet. Pumps range from 2 to 10 inches in size. The smaller ones pump 75 to 100 gallons per minute in areas where the water supply is marginal. The larger ones pump more than 1,000 gallons per minute in areas with more water.

Generally, the quality of the water is good. It does not contain enough minerals to be harmful to plants. In a few small areas, there are enough minerals to be harmful; however, irrigation of soils in these areas is ceasing.

Water is applied by sprinkler and surface-flow methods. Sprinkler irrigation is used on sandy soils, such as Amarillo loamy fine sand (fig. 12). On these soils the water-intake rate is high. Sprinkler irrigation is also used on sloping soils, such as Amarillo fine sandy loam, 3 to 5 percent slopes, and on soils, such as Likes-Arch complex, hummocky, where leveling is not practical. Surface irrigation systems require level or nearly level soils, such as Portales loam, 0 to 1 percent slopes, where erosion by irrigation water can be prevented. The main types of surface systems used in the county are furrow and border irrigation (fig. 13).

Many soil and water problems confront the farmers of the county. There is more land suited to irrigation than can be irrigated with the available water, and on many farms less than half the water applied to the land benefits growing crops. Every gallon of irrigation water or rainwater that is not used to benefit a growing crop represents a loss of money. Waste of water increases the cost of crop production and may damage both soil and crop. Some ways that farmers can save water are (1) by preventing loss of irrigation tailwater; (2) by using no more water than can be held in the root zone; (3) by avoiding haphazard watering, such as using unequal streams of water in the furrow, unsuitable furrow lengths, and improper irrigation methods on sloping soils; and (4) by holding rainwater where it falls.

Excessively long irrigation furrows cause much of the damage to irrigated soils. Large amounts of water are needed to wet the furrow to the end of these long runs. Water is wasted by the use of these long runs on the more nearly level soils, because the upper end of the field must be overirrigated to get water to the lower end. If large amounts of water are applied to sloping soils too quickly, soil is carried to the far end of the field or off the farm. Irrigation water should be applied slowly enough to prevent erosion of the surface soil.

Much irrigation water is lost when it is conveyed in open earthen ditches. The loss of water in a moderately rapidly permeable soil may be as much as 70 percent. The average loss on quarter-mile runs averages about one-fourth of the total amount in the ditch. Seepage causes much of the loss, but evaporation on hot days is high. Weeds in irrigation ditches increase seepage and evaporation.

Underground pipe is needed on most soils to increase irrigation efficiency and to distribute water evenly over the farm (fig. 14).

Specifications for the irrigation of all soils in Bailey County have been worked out. These specifications are based on scientific research, field tests, and local irrigation experiences. Representatives of the Blackwater Valley Soil Conservation District, or the county agricultural extension agent, will assist in designing an irrigation system or in solving other irrigation problems.

A conservation irrigation system, correctly designed, makes irrigation possible without erosion damage or undue loss of water. The water supply, the soil, the slope, and the crop to be irrigated largely determine the correct irrigation system. A conservation irrigation system can be established on a farm by the following steps:

1. Read the information in this soil survey that relates to your farm. Become familiar with the soils on your farm by studying the capability units in which they are placed.
2. Decide how to apply the water. Use methods suitable for the land irrigated. Use shorter row lengths for furrow irrigation than for sprinkler irrigation. Design suitable furrows for the crop irrigated. Do not plan to irrigate a larger acreage than can be accommodated by the existing water supply.
3. Plan the irrigation distribution system. Design a system that will supply enough water to all parts of the farm when needed.
4. Prepare all fields so that water can be applied with maximum efficiency. (To accomplish this, some land may need to be leveled (fig. 15).)
5. Make efficient use of irrigation water. Adjust the size of streams so they will not cause erosion but will apply just enough water to satisfy crop needs.

In planning irrigation systems, it is important to know that some soils differ greatly in their ability to hold water. Some absorb and hold large quantities of water; others take water slowly or have little water-holding capacity.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few 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, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is 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; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

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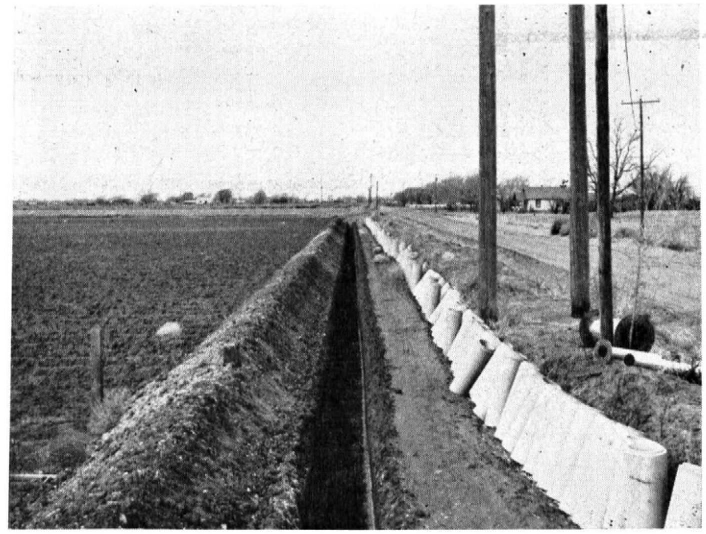

Figure 14.—**Installation of concrete pipe conserves irrigation water and helps to prevent seepage and evaporation.**

In class I there are no subclasses, because the soils of this class have a few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping of soils for making many statements about their management. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2.

Figure 15.—**Bench leveling is one system to use in installing a conservation irrigation system.**

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

Capability classes in the system, and the subclasses and units in Bailey County, are given in the following list. Because some of the hazards of climate are removed by irrigation, many of the soils are in a more favorable capability class for irrigation than for dryland farming. The capability grouping is one that covers the soils of several counties, and there are some gaps in the numbering system when only the units of this county are listed.

Class I.—Soils that have few limitations that restrict their use. (None in this county.)

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

- Subclass IIe.—Soils subject to moderate erosion if they are not protected.
  - Capability unit IIe–1 (irrigated).—Reddish-brown to grayish-brown loams, nearly level. The same soils make up unit IIIce–1, dryland.
  - Capability unit IIe–2 (irrigated).—Reddish-brown to grayish-brown fine sandy loams, nearly level. The same soils make up unit IIIe–2, dryland.

Class III.—Soils that 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.
  - Capability unit IIIe–1 (dryland or irrigated).—Reddish-brown to grayish-brown fine sandy loams, 0 to 3 percent slopes.
  - Capability unit IIIe–2 (dryland).—Reddish-brown to grayish-brown fine sandy loams, nearly level. (Irrigated, IIe–2.)
  - Capability unit IIIe–3 (irrigated or dryland).—Reddish-brown to grayish-brown loams, 1 to 3 percent slopes.
  - Capability unit IIIe–4 (irrigated).—Deep, brown to reddish-brown sandy soils, 0 to 3 percent slopes. (Dryland, IVe–1.)
  - Capability unit IIIe–5 (irrigated).—Reddish-brown to grayish-brown loams or fine sandy loams, shallow over caliche, 0 to 1 percent slopes. (Dryland, IVe–2.)
- Subclass IIIes.—Soils that are subject to moderate erosion and are moderately limited by a high lime content.
  - Capability unit IIIes–1 (irrigated).—Grayish soils, 0 to 3 percent slopes; high in lime. (Dryland, IVes–1.)
- Subclass IIIce.—Soils that are subject to a moderate climatic hazard of low rainfall and slight erosion.
  - Capability unit IIIce–1 (dryland).—Reddish-brown to grayish-brown loams, nearly level. (Irrigated, IIe–1.)

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVe.—Soils subject to very severe risk of erosion if they are cultivated and not protected.
  - Capability unit IVe–1 (dryland).—Deep, brown to reddish-brown sandy soils, 0 to 3 percent slopes. (Irrigated, IIIe–4.)
  - Capability unit IVe–2 (dryland).—Reddish-brown to grayish-brown loams or fine sandy loams, shallow over caliche, 0 to 1 percent slopes. (Irrigated, IIIe–5.)
  - Capability unit IVe–3 (dryland or irrigated).—Reddish-brown to grayish-brown fine sandy loams, 3 to 5 percent slopes.
  - Capability unit IVe–4 (irrigated).—Grayish soils, 3 to 5 percent slopes; high in lime.
  - Capability unit IVe–5 (irrigated).—Deep, light-colored sandy soils, 0 to 3 percent slopes. (Dryland, VIe–1.)
  - Capability unit IVe–6 (irrigated).—Brown to grayish-brown fine sandy loams, hummocky. (Dryland, VIe–2.)
  - Capability unit IVe–7 (dryland or irrigated).—Reddish-brown to grayish-brown loams and fine sandy loams, shallow over caliche, 0 to 3 percent slopes.
- Subclass IVes.—Soils that are subject to severe erosion and are moderately limited by a high lime content.
  - Capability unit IVes–1 (dryland).—Grayish soils, 0 to 3 percent slopes; high in lime. (Irrigated, IIIes–1.)
- Subclass IVw.—Soils that have a very severe limitation for cultivation because of excess water.
  - Capability unit IVw–1.—Moderately sandy soils of the playa beds.

Class V.—Soils that have little or no susceptibility to erosion but have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover. (None in this county.)

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, or wildlife food and cover.

- Subclass VIe.—Soil severely limited, chiefly by the risk of erosion, if protective cover is not maintained.
  - Capability unit VIe–1 (dryland).—Deep, light-colored sandy soils, 0 to 3 percent slopes. (Irrigated, IVe–5.)
  - Capability unit VIe–2 (dryland).—Brown to grayish-brown fine sandy loams, hummocky. (Irrigated, IVe–6.)
  - Capability unit VIe–3.—Grayish-brown, shallow and deep fine sandy loams, 3 to 8 percent slopes.
  - Capability unit VIe–4.—Soils high in lime; 3 to 20 percent slopes.
  - Capability unit VIe–5.—Deep, light-colored sandy soils, hummocky.
  - Capability unit VIe–6.—Deep, light-colored sandy soils, severely eroded.
  - Capability unit VIe–7.—Brownish loams, 3 to 8 percent slopes.

Subclass VIw.—Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw-1.—Dark-colored, poorly drained clays of the playa beds.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing or wildlife.

Subclass VIIe.—Soils very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIIe-1.—Light-colored, deep sandy soils of the Sandhills.

Subclass VIIs.—Soils very severely limited by their moisture-holding capacity, stones, or other features.

Capability unit VIIs-1.—Very shallow soils over hard or soft caliche, gently sloping to steep soils.

Class VIII.—Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIe.—Soils subject to extreme erosion.

Capability unit VIIIe-1.—Deep sand dunes, not stabilized.

CAPABILITY UNIT IIe-1, IRRIGATED; IIIce-1, DRYLAND

This unit consists of moderately shallow to deep, nearly level soils. These soils have a medium-textured surface soil and moderately fine textured subsoil. The soils are—

Amarillo loam, 0 to 1 percent slopes.
Arvana-Amarillo loams, 0 to 1 percent slopes.
Loamy alluvial land.
Olton loam, 0 to 1 percent slopes.
Portales loam, 0 to 1 percent slopes.
Stegall loam, 0 to 1 percent slopes.
Zita loam, 0 to 1 percent slopes.

These soils make up about 13 percent of the county. Most of the acreage is cultivated. About 65 percent is dry-farmed.

The soils are well suited to cultivation and, under good management, produce good yields. Their capacity to hold water and plant nutrients is high. Permeability is slow to moderate. The hazard of wind erosion is slight to moderate.

Cotton is the main cash crop grown on these soils. Grain sorghum, small grains, and vegetables are also grown. Legumes grown for hay or for soil improvement are alfalfa, vetch, sweetclovers, mungbeans, and cowpeas. These soils are well suited to native and tame grasses.

Dryland.—Mulching will keep stubble on or near the surface of areas farmed as dryland. It also increases water intake, reduces wind and water erosion, and maintains the organic content of the soil. If there is not enough stubble to protect the soil, chiseling or listing may be needed to prevent erosion. If cotton or other clean-tilled crops are grown, terraces and contour farming should be used.

The factor limiting crop production on these soils is moisture, not fertility. Practices to conserve moisture should be used to obtain maximum crop yields.

Cotton should be grown on the land about half of the time. A suitable rotation consists of cotton followed by grain sorghum or small grains. This rotation will produce enough stubble to protect the soil.

Irrigated.—A fertilized crop that produces much residue, such as sorghum or small grain, should be grown 1 year in 3 on irrigated areas. A rotation of cotton, cotton, and fertilized grain sorghum will maintain enough residue to protect the soil. A conservation irrigation system that includes the use of underground pipe increases irrigation efficiency.

For highest yields, these soils should be fertilized in amounts determined by soil tests and crop needs. If nitrogen and phosphate are not used, yields generally decline in a few years.

CAPABILITY UNIT IIe-2, IRRIGATED; IIIe-2, DRYLAND

This unit consists of moderately deep to deep, nearly level soils. These soils have a fine sandy loam surface soil and moderately fine textured subsoil. They are—

Amarillo fine sandy loam, 0 to 1 percent slopes.
Lubbock fine sandy loam.
Portales fine sandy loam, 0 to 1 percent slopes.
Zita fine sandy loam, 0 to 1 percent slopes.

These soils make up about one-fourth of the county. About 90 percent of this acreage is used for cultivated crops; about 35 percent of this cultivated acreage is irrigated.

These soils are well suited to cultivation and, under good management, produce high yields. Permeability is moderate. The capacity to hold water and plant nutrients is moderate to high. Because of the texture of the surface soil, the hazard of wind erosion is moderate. The hazard of water erosion is only slight because the soils are nearly level.

Cotton is the main cash crop grown on these soils; however, grain sorghum, small grain, and vegetables are also grown. The legumes grown for hay and for soil improvement are alfalfa, vetch, sweetclover, mungbeans, and cowpeas. These soils are well suited to native and tame grasses.

Dryland.—In areas farmed as dryland, stubble should be kept on the surface by some system of mulching. It will help maintain or increase the content of organic matter and also increase water intake and reduce erosion. If there is not enough stubble to protect the soil, chiseling or listing may be necessary to prevent wind erosion. Terraces and contour farming should be used on the long slopes to conserve moisture and control water erosion.

Cotton should be grown on the same soil only 1 year in 3. A rotation, consisting of cotton, sorghum, and sorghum will produce enough stubble to protect the soil.

Irrigated.—A fertilized crop that produces much residue or improves the soil should be grown 1 year in 3 in the irrigated areas. A rotation of cotton, cotton, and fertilized grain sorghum will maintain enough residue to prevent erosion.

To provide highest yields, the soils should be fertilized in amounts determined by soil tests and crop needs. Crop yields generally decline after the fourth or fifth year if nitrogen and phosphate are not used.

Land leveling is often needed for efficient use of irrigation water. In areas where soil has been removed, practices that improve the soil should be used to maintain crop yields. Some of these practices are (1) application of cotton burs or manure; (2) growing legumes, such as alfalfa or sweetclover; and (3) adding increased amounts of commercial fertilizer.

A conservation irrigation system that includes use of irrigation pipe is needed to get the most benefit from irrigation water.

CAPABILITY UNIT IIIe-1, DRYLAND OR IRRIGATED

This unit consists of moderately deep to deep, nearly level to gently sloping soils. These soils have a fine sandy loam surface soil and sandy clay loam subsoil. They are—

Amarillo fine sandy loam, 1 to 3 percent slopes.
Arvana fine sandy loam, 0 to 1 percent slopes.
Arvana fine sandy loam, 1 to 3 percent slopes.
Portales fine sandy loam, 1 to 3 percent slopes.
Zita fine sandy loam, 1 to 3 percent slopes.

The acreage of these soils makes up about 10 percent of the county. About 80 percent of this acreage is used for cultivated crops; about 30 percent of the cultivated area is irrigated.

Cotton is the main cash crop grown on these soils; however, grain sorghum and small grain are also grown. The legumes used for hay or soil improvement are alfalfa, sweetclover, mungbeans, and cowpeas. These soils are well suited to native and tame grasses.

Dryland.—Some system of mulch tillage should be used to keep stubble on the surface of areas farmed as dryland. Stubble increases water intake, reduces wind erosion, and maintains the content of organic matter in the soil. If there is not enough stubble to protect the soil, it may be necessary to chisel or list to control wind erosion. If cotton and other clean-tilled crops are grown, terraces and contour farming should be used.

Cotton should be grown only 1 year in 3 on the same soil. A rotation consisting of cotton, grain sorghum, and grain sorghum produces enough stubble to protect the soil.

Irrigated.—A fertilized crop that produces much residue or improves the soil should be grown about half of the time in irrigated areas. A rotation of cotton followed by fertilized grain sorghum will maintain residues.

A conservation irrigation system is needed to irrigate these soils most profitably. Land leveling is generally needed to complete the conservation irrigation system.

Highest yields will be obtained if the soils are fertilized in amounts determined by soil tests and crop needs. If nitrogen and phosphate are not used, the yields generally decline in a few years.

CAPABILITY UNIT IIIe-3, DRYLAND OR IRRIGATED

This unit consists of moderately shallow to deep, gently sloping soils. These soils have a medium-textured surface soil and moderately fine textured subsoil. They are—

Amarillo loam, 1 to 2 percent slopes.
Arvana-Amarillo loams, 1 to 2 percent slopes.
Berthoud loam, 1 to 3 percent slopes.
Portales loam, 1 to 3 percent slopes.
Stegall loam, 1 to 2 percent slopes.

The acreage of these soils makes up about 1 percent of the county. About 80 percent is used for cultivated crops; about three-fourths of this is farmed as dryland.

These soils are well suited to cultivation and, under good management, produce good yields. Permeability is slow to moderate. The capacity to hold plant nutrients is high. The hazard of wind erosion is slight to moderate. Because of gentle slopes, the hazard of water erosion is moderate.

Cotton is the main cash crop grown on these soils; however, grain sorghum and small grain are also grown. The legumes grown for hay and for soil improvement are alfalfa, vetch, sweetclover, mungbeans, and cowpeas. The soils are well suited to native and tame grasses.

Dryland.—Some system of mulching should be used to keep stubble on the surface of areas farmed as dryland. Stubble increases water intake, reduces wind erosion, and adds to the content of organic matter in the soil. If there is not enough stubble to protect the soil, chiseling or listing may be needed to prevent erosion. If cotton or other clean-tilled crops are grown, terraces and contour farming should be used.

Cotton should be grown only 1 year in 3. A rotation consisting of cotton, grain sorghum, and grain sorghum will produce enough stubble to protect the soil.

Irrigated.—In irrigated areas a fertilized crop that produces much residue or improves the soil should be grown about half of the time. A rotation commonly used—cotton followed by fertilized grain sorghum—will maintain enough residue to protect the soil.

A conservation irrigation system should be installed to irrigate efficiently and to prevent erosion by irrigation water. If the water supply is limited, a sprinkler system is one of the most economical methods of irrigating these soils.

Highest yields are obtained if the soils are fertilized in amounts determined by soil tests and crop needs. Crop yields decline after the fourth or fifth year unless nitrogen and phosphate are used.

CAPABILITY UNIT IIIe-4, IRRIGATED; IVe-1, DRYLAND

This unit consists of deep, nearly level to gently undulating soils. These soils have a loamy fine sand surface soil and a moderately fine textured subsoil. They are—

Amarillo loamy fine sand, 0 to 3 percent slopes.
Lubbock loamy fine sand.
Zita loamy fine sand, 0 to 3 percent slopes.

The acreage of these soils comprises nearly 9 percent of the county. Nearly three-fourths of this acreage is cultivated; 30 percent of the cultivated area is irrigated.

These soils are highly susceptible to wind erosion. Wind erosion can be decreased by keeping a continuous cover on the soil and by deep breaking to increase the clay content of the surface soil.

These soils have a sandy surface soil that is low in plant nutrients and moisture-holding capacity. Permeability is moderate.

Cotton is the main cash crop. Under dryland farming, cotton should be grown on these soils only after deep breaking. Grain sorghum and small grain are also grown.

Dryland.—If the soils have not been deep broken, a close-spaced crop that produces much residue should be grown each year in areas farmed as dryland. The stubble should be left on the surface to help control wind erosion and add to the content of organic matter. If there is not enough stubble to protect the soil, chiseling or listing may be needed to prevent wind erosion.

If, as a result of deep breaking, one-fourth to one-third of the furrow slice is moderately fine textured material, the hazard of wind erosion is greatly reduced. Cotton can then be grown 1 year in 3. A rotation that consists of cotton, grain sorghum, and grain sorghum should be used to produce enough stubble to protect the soil.

Irrigated.—A fertilized crop that produces much residue should be grown about half of the time in irrigated areas. A rotation of cotton and fertilized grain sorghum will maintain enough residue to control erosion. Deep breaking helps to control wind erosion by increasing the clay content of the surface soil.

The sandy surface soil of these soils erodes easily and has a high initial water-intake rate. Sprinkler irrigation systems are therefore best suited. Engineers serving the soil conservation district, or other qualified engineers, can assist in designing a sprinkler irrigation system.

Commercial fertilizer is needed to maintain production under irrigation.

CAPABILITY UNIT IIIe-5, IRRIGATED; IVe-2, DRYLAND

This unit consists of shallow, nearly level to gently sloping soils with a loamy surface soil and a moderately fine textured subsoil. They are—

Mansker loam, 0 to 1 percent slopes.
Mansker fine sandy loam, 0 to 1 percent slopes.

The acreage of these soils comprises about 0.5 percent of the county. About 70 percent of the acreage is used for cultivated crops; about half of this is irrigated.

The use of these soils for cultivated crops is limited. Because of shallowness, they are low in plant nutrients and in water-holding capacity. In addition, they are droughty and produce little stubble to help control wind erosion. The permeability is moderate. The hazard of wind erosion is moderate.

Cotton is the main cash crop grown on these soils under irrigation. Grain sorghum and small grains are grown under both dryland farming and irrigation. Cowpeas, vetch, and sweetclover are legumes used for hay and soil improvement. These soils are well suited to native and tame grasses.

Dryland.—Perennial grasses or close-spaced crops that have much residue should be grown on areas farmed as dryland. These crops will produce enough stubble to protect the soil. The residue should be stubble mulched for control of wind erosion.

Irrigated.—Fertilized crops that produce much residue or improve the soil should be grown 2 years in 3 in irrigated areas. A rotation of cotton, fertilized grain sorghum, and fertilized grain sorghum will maintain enough residue to protect the soil.

Because of limited water-holding capacity, these soils require small and frequent watering. Irrigation is therefore more costly than on soils with a higher water-holding capacity. A conservation irrigation system should be installed to irrigate these soils efficiently.

CAPABILITY UNIT IIIes-1, IRRIGATED; IVes-1, DRYLAND

This unit consists of moderately deep to shallow, nearly level to gently undulating soils that are high in lime. These soils have a loamy surface soil and a moderately fine to fine textured subsoil. They are—

Arch fine sandy loam.
Arch loam.
Church clay loam.
Drake soils, 1 to 3 percent slopes.

The acreage of these soils comprises about 5 percent of the county. More than three-fourths of this acreage is used for cultivated crops; about 65 percent of the cultivated acreage is irrigated.

These soils are poorly suited to dryland farming. Under irrigation, they are only moderately well suited to crops. Permeability is moderate. The capacity to hold water and plant nutrients is moderate to high.

Chlorosis (yellowing of foliage) of grain sorghum and small grain occurs when plant nutrients, particularly iron and nitrogen, are tied with lime in the soil. The nutrients become unavailable to plants, and yields are lowered.

Because of the high lime content of the surface soil, the hazard of wind erosion is high. The hazard of water erosion is slight in level areas and moderate in gently sloping areas.

Grain sorghum and small grains are the main crops grown. Cotton and alfalfa are also grown in irrigated areas. These soils are well suited to native and tame grasses.

Dryland.—Under dryland farming, these soils are best suited to perennial grasses. Cultivated areas require close-spaced crops that produce much residue every year to protect the soil. Grain sorghum and small grain generally produce enough stubble, but chiseling may be necessary to control erosion.

Irrigated.—Crops that improve the soil or fertilized crops that produce much residue should be grown 2 years in 3 in irrigated areas. A rotation of 1 year of cotton and 2 years of fertilized grain sorghum will maintain residues. Alfalfa produces fair yields of hay on these soils, but frequent watering is required.

A conservation irrigation system should be installed to irrigate most efficiently and to prevent erosion by irrigation water. The gently undulating surface of these soils prevents furrow irrigation. Sprinkler irrigation is used in many areas.

CAPABILITY UNIT IVe-3, DRYLAND OR IRRIGATED

This unit consists of deep, moderately sloping soils. These soils have a fine sandy loam surface soil and a sandy clay loam subsoil. They are—

Amarillo fine sandy loam, 3 to 5 percent slopes.
Berthoud fine sandy loam, 3 to 5 percent slopes.

The acreage of these soils makes up about 1 percent of the county. About half of the acreage is used for crops, and about 60 percent of this is irrigated.

These soils are poorly suited to cultivation because they are steep. They are highly susceptible to water erosion and moderately susceptible to wind erosion.

Sorghum and small grain are the main cultivated crops. The soils are best suited to native and tame grasses.

Dryland.—Some system of mulching should be used to keep stubble on the surface of areas farmed as dryland. A sown crop that produces much residue should be grown each year to protect the soil. Chiseling may be needed to control erosion.

Terraces and contour farming are needed to help control water erosion and to conserve moisture.

Irrigated.—Perennial grasses or a close-spaced crop that is fertilized and produces much residue should be grown each year in irrigated areas. Terracing or bench leveling is needed to prevent water erosion and to conserve moisture. A sprinkler irrigation system is best suited to these soils.

CAPABILITY UNIT IVe-4, IRRIGATED

This unit consists of deep, moderately sloping soils high in lime. These soils have a loamy surface soil and a moderately fine textured subsoil. They are—

Drake soils, 3 to 5 percent slopes.

These soils, if not irrigated, are in capability unit VIe-4.

These soils occupy about 0.6 percent of the county. Slightly more than 15 percent of their acreage is used for cultivated crops; less than 10 percent of the cultivated acreage is irrigated.

These soils are best suited to native and tame grasses. Permeability is moderate. The capacity to hold water and plant nutrients is moderate. The hazard of wind and water erosion is high.

Sorghum and perennial legumes are the main crops grown.

Dryland.—These soils are not suited to dryland farming. They are best suited to range.

Irrigated.—In irrigated areas a fertilized crop that produces much residue should be grown continuously; or perennial grasses may be grown to maintain enough residue to protect the soil.

Water erosion can be controlled on these soils by terracing or bench leveling.

A sprinkler irrigation system is best suited to these soils.

CAPABILITY UNIT IVe-5, IRRIGATED; VIe-1, DRYLAND

This unit consists of deep, gently undulating soils. These soils have a moderately coarse textured and coarse textured surface soil and a loamy subsoil. They are—

Brownfield fine sand, thick surface.
Gomez-Arch complex.
Springer loamy fine sand, undulating.

The acreage of these soils makes up about 10 percent of the county. About 13 percent of the acreage is in crops, and three-fourths of this is irrigated.

These soils should be cultivated only under irrigation. Permeability is moderate to moderately rapid. The capacity to hold water and plant nutrients is low. The sandy surface soil causes these soils to be very highly susceptible to wind erosion.

Grain sorghum, alfalfa, and small grain are the main crops grown. These soils are well suited to native and tame grasses.

Irrigated.—A continuous cover crop that produces much residue, such as sorghum, should be grown in irrigated areas. This crop should be close spaced (26 inches or less). Alfalfa and perennial grass can be grown for pasture.

A sprinkler irrigation system is the only kind suited to these soils. Fertilizer will be needed to maintain crop production.

CAPABILITY UNIT IVe-6, IRRIGATED; VIe-2, DRYLAND

This unit consists of deep, hummocky soils with a moderately coarse textured surface soil and subsoil. In this unit is—

Likes-Arch complex, hummocky.

The soils of this complex occupy slightly less than 1 percent of the county. About one-third of the acreage is cropland. About 60 percent of the cropland is irrigated.

The soils should be cultivated only under irrigation. Permeability is moderately rapid. The capacity to hold water and plant nutrients is low to moderate. The hazard of wind erosion is high.

Grain sorghum, alfalfa, and small grain are the main crops grown. These soils are well suited to native and tame grasses.

Irrigated.—A continuous cover crop that produces much residue, such as sorghum, should be grown on irrigated areas. This crop should be close spaced (26 inches or less). Fertilizer will help to maintain crop production.

Alfalfa and perennial grass can be grown for pasture. Because of the hummocks, sprinkler irrigation is the only type of irrigation suited to these soils.

CAPABILITY UNIT IVe-7, DRYLAND OR IRRIGATED

The soils of this unit are shallow and nearly level to gently sloping. They have a loamy surface soil and a moderately fine textured subsoil. The soils are—

Arvana fine sandy loam, shallow, 0 to 1 percent slopes.
Arvana fine sandy loam, shallow, 1 to 3 percent slopes.
Mansker loam, 1 to 3 percent slopes.
Mansker fine sandy loam, 1 to 3 percent slopes.
Stegall loam, shallow, 0 to 1 percent slopes.

These soils cover about 2 percent of the county. About 70 percent of their acreage is used for cropland, and about half of this is irrigated.

These soils are limited in use for cultivated crops. Their shallowness limits their capacity to hold water and plant nutrients. Permeability is moderate. Because of limited water-holding capacity, these soils produce only small amounts of stubble. The hazard of wind erosion is moderate.

Grain sorghum and small grains are grown under both dryland farming and irrigation. These soils are well suited to native and tame grasses.

Dryland.—Close-spaced crops that produce much residue or perennial grasses should be grown to control erosion in areas farmed as dryland. Stubble mulching the residue of close-spaced crops will also help to control erosion.

Irrigated.—Close-spaced crops that produce much residue or perennial grasses should be grown each year in irrigated areas. Irrigation of these soils is costly because they require small and frequent applications of water. A conservation irrigation system is needed to irrigate these soils efficiently.

CAPABILITY UNIT IVw-1

The soil in this unit is deep, dark, and poorly drained. It occurs in playa beds. It has a moderately sandy surface soil and a clayey subsoil. The soil is—

Randall fine sandy loam.

The soil is limited in area. It is seldom completely covered by water. After heavy rains, the surface layer usually is dry within a few days.

This soil can be successfully cultivated except during years of very high rainfall. Most of the acreage is used to grow grain sorghum or small grain.

CAPABILITY UNIT VIe-3

This unit consists of calcareous, shallow and deep, moderately sloping to sloping soils. These soils have a medium to moderately coarse textured surface soil and a moderately fine textured subsoil. The soils are—

Berthoud-Mansker fine sandy loams, 5 to 8 percent slopes.
Mansker fine sandy loam, 3 to 5 percent slopes.

These soils occupy less than 1 percent of the county. Most of their acreage is used for range.

These soils are not suited to cultivated crops. The hazard of water erosion is high because of steepness of slope. The soils should be used only for range.

More information on the use of these soils for range is given in the section "Range Management."

CAPABILITY UNIT VIe-4

This unit consists of deep, moderately sloping to moderately steep soils that are high in lime. These soils have a loamy surface soil and moderately fine textured subsoil. The soils are—

Drake soils, 3 to 5 percent slopes.
Drake soils, 5 to 20 percent slopes.

These soils occupy a small acreage in the county, most of which is in range.

These soils are unsuited to dryland farming. Only slopes of less than 5 percent should be irrigated because the risk of wind and water erosion is high. Drake soils, 3 to 5 percent slopes, if irrigated, are in capability unit IVe-4.

The soils of this unit are best suited to range. More information on the use of these soils for range is given in the section "Range Management."

CAPABILITY UNIT VIe-5

The soil of this unit is deep and undulating. It has a sandy surface soil and a moderately coarse textured subsoil. This soil is—

Springer loamy fine sand, hummocky.

This soil occupies about 1 percent of the county and is used mainly for range. It is not suited to cultivation, because it is hummocky and difficult to farm. Also, the sandy surface soil is highly susceptible to wind erosion.

This soil produces large amounts of usable range forage, but it should be managed with care to control erosion. More information on the use of this soil for range is given in the section "Range Management."

CAPABILITY UNIT VIe-6

This unit consists of eroded, deep, gently undulating soils. These soils have a coarse-textured surface soil and moderately fine textured subsoil. They are—

Brownfield soils, severely eroded.
Gomez-Arch complex, severely eroded.

These soils were cropped and have been severely eroded by wind. They occupy less than 1 percent of the county. Three-fourths of their area is irrigated.

These soils are so eroded that it is not profitable to grow cultivated crops. They should be planted to native and tame grasses. The sandy surface soil is highly susceptible to wind erosion.

A crop that produces much residue should be planted, such as close-spaced grain sorghum or small grain. The close-growing crop will provide a cover of litter in which to plant grasses.

CAPABILITY UNIT VIe-7

The soil of this unit is calcareous, deep, and moderately sloping to sloping. It has a medium-textured surface soil and a moderately fine textured subsoil. The soil is—

Berthoud loam, 3 to 8 percent slopes.

This soil occupies less than 1 percent of the county. Most of it is used for range.

Because of the steepness of slope, the hazard of water erosion is high on this soil. The soil is therefore not suited to cultivated crops and should be used only for range.

More information on the use of this soil for range is given in the section "Range Management."

CAPABILITY UNIT VIw-1

In this unit is a deep, dark, poorly drained, very heavy soil of the playa beds. It is—

Randall clay.

The acreage of this soil comprises about 1 percent of the county. About 50 percent of it is planted to crops. The soil is of limited use for crops because it is often flooded by runoff from surrounding areas. Some areas can be farmed during long, dry periods or if runoff is controlled.

Dryland or irrigated (if areas are protected from runoff).—Continuous crops that produce much residue should be grown. These crops add organic matter to the surface soil and increase the water-intake rate.

CAPABILITY UNIT VIIe-1

The soil of this unit is a deep, light-colored fine sand. It is—

Tivoli fine sand.

This soil occupies about 6 percent of the county; nearly all of it is in range.

The sandy surface soil makes this soil very highly susceptible to wind erosion. The soil is not suited to cultivation.

This soil has a high infiltration rate and therefore has little runoff. Since a high percentage of the soil moisture is available to plants, this soil can produce tall grasses.

More information on the use of this soil for range is given in the section "Range Management."

CAPABILITY UNIT VIIs-1

This unit consists of very shallow, gently sloping to steep soils. The soils are—

Kimbrough soils.
Potter soils.

These soils occupy about 2 percent of the county. Nearly all of this area is used for range. The soils are so shallow, less than 10 inches deep, that they are not suited to cultivation.

These soils support a small amount of range vegetation and require careful management that will control erosion. More information on use of these soils for range is given in the section "Range Management."

CAPABILITY UNIT VIIIe-1

In this unit is a miscellaneous land type that consists of dunes of deep fine sand. This land type is—

Active dunes.

This land type is continuously susceptible to wind action. It is suitable only for wildlife or as scenic or recreational areas. It should be fenced to prevent grazing by livestock.

Estimated Yields

The yields of any soil reflect the management that the soil has had. Consistently high yields on a particular soil show that a soil has been properly managed. Soil that is properly managed is also being conserved and improved. The farmers of Bailey County, as elsewhere, farm under various levels of management.

Table 3 shows estimated average acre yields for principal crops grown on cultivated soils under two levels of management. In columns A are yields obtained at a low level of management on dryland and on irrigated soils. In columns B are yields obtained at a high level of management on dryland and on irrigated soils.

The practices used on dryland at a low level of management are as follows:

1. No special effort is made to conserve water.
2. No soil-building crops are used in rotation.
3. Tillage alone is depended on to control wind erosion.

TABLE 3.—*Estimated average acre yields for principal crops grown on cultivated soils at two levels of management*

[Yields in columns A are obtained at a low level of management; those in columns B are obtained at a high level of management. Soils not listed in this table are not suited to cultivation]

Soil	Dryland				Irrigated			
	Cotton (lint)		Grain sorghum		Cotton (lint)		Grain sorghum	
	A	B	A	B	A	B	A	B
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Amarillo fine sandy loam, 0 to 1 percent slopes	145	175	800	1, 200	650	850	4, 000	7, 000
Amarillo fine sandy loam, 1 to 3 percent slopes	120	140	600	900	550	750	3, 000	5, 000
Amarillo fine sandy loam, 3 to 5 percent slopes	85	(1)	300	500	350	(1)	1, 500	3, 200
Amarillo loam, 0 to 1 percent slopes	140	170	800	1, 100	650	850	4, 000	7, 000
Amarillo loam, 1 to 2 percent slopes	120	140	600	800	550	750	3, 000	5, 000
Amarillo loamy fine sand, 0 to 3 percent slopes	125	150	700	900	525	700	3, 000	5, 000
Arch loam	85	(1)	450	560	400	500	1, 900	2, 400
Arch fine sandy loam	85	(1)	450	560	400	500	1, 900	2, 400
Arvana fine sandy loam, 0 to 1 percent slopes	135	160	775	1, 050	575	750	3, 500	6, 000
Arvana fine sandy loam, 1 to 3 percent slopes	115	135	580	800	500	650	2, 800	4, 500
Arvana fine sandy loam, shallow, 0 to 1 percent slopes	75	(1)	475	580	370	475	2, 300	2, 700
Arvana fine sandy loam, shallow, 1 to 3 percent slopes	65	(1)	465	570	340	465	2, 250	2, 650
Arvana-Amarillo loams, 0 to 1 percent slopes	140	170	800	1, 100	650	850	4, 000	6, 500
Arvana-Amarillo loams, 1 to 2 percent slopes	120	140	600	800	550	750	3, 000	5, 000
Berthoud fine sandy loam, 3 to 5 percent slopes	85	(1)	285	470	350	(1)	1, 500	2, 800
Berthoud loam, 1 to 3 percent slopes	115	135	550	750	500	625	2, 700	4, 200
Brownfield fine sand, thick surface	80	(1)	300	(1)	350	(1)	1, 800	3, 500
Brownfield soils, severely eroded	80	(1)	250	(1)	300	(1)	1, 500	2, 400
Church clay loam	70	(1)	400	(1)	425	550	2, 400	3, 000
Drake soils, 1 to 3 percent slopes	65	(1)	400	(1)	375	475	1, 800	2, 300
Drake soils, 3 to 5 percent slopes	50	(1)	350	(1)	300	(1)	900	1, 200
Gomez-Arch complex	80	(1)	350	(1)	400	(1)	1, 600	3, 300
Gomez-Arch complex, severely eroded	65	(1)	250	(1)	300	(1)	1, 000	2, 000
Likes-Arch complex, hummocky	85	(1)	400	(1)	300	(1)	1, 500	2, 400
Loamy alluvial land	140	175	800	1, 100	670	850	4, 000	7, 000
Lubbock fine sandy loam	150	180	900	1, 350	650	850	4, 000	7, 000
Lubbock loamy fine sand	125	150	700	900	525	700	3, 000	5, 000
Mansker fine sandy loam, 0 to 1 percent slopes	75	(1)	525	630	425	550	2, 400	3, 000
Mansker fine sandy loam, 1 to 3 percent slopes	65	(1)	515	610	400	500	2, 350	2, 900
Mansker fine sandy loam, 3 to 5 percent slopes	50	(1)	400	(1)	300	(1)	900	1, 200
Mansker loam, 0 to 1 percent slopes	80	(1)	500	600	425	550	2, 400	3, 000
Mansker loam, 1 to 3 percent slopes	70	(1)	500	600	400	500	2, 350	2, 900
Olton loam, 0 to 1 percent slopes	140	165	800	1, 000	650	850	4, 000	7, 000
Portales fine sandy loam, 0 to 1 percent slopes	130	160	750	1, 050	550	725	3, 500	5, 900
Portales fine sandy loam, 1 to 3 percent slopes	110	130	575	750	500	625	2, 600	4, 100
Portales loam, 0 to 1 percent slopes	130	160	700	900	560	780	3, 500	6, 000
Portales loam, 1 to 3 percent slopes	115	135	550	750	500	625	2, 700	4, 200
Randall fine sandy loam	145	(1)	900	1, 300	600	(1)	4, 000	7, 000
Springer loamy fine sand, undulating	80	(1)	300	(1)	350	(1)	1, 800	3, 500
Stegall loam, 0 to 1 percent slopes	140	165	800	1, 000	650	850	4, 000	7, 000
Stegall loam, 1 to 2 percent slopes	115	135	600	775	550	750	3, 000	5, 000
Stegall loam, shallow, 0 to 1 percent slopes	80	(1)	500	600	425	550	2, 400	3, 000
Zita fine sandy loam, 0 to 1 percent slopes	145	175	800	1, 200	650	850	4, 000	7, 000
Zita fine sandy loam, 1 to 3 percent slopes	120	140	600	900	550	750	3, 000	5, 000
Zita loam, 0 to 1 percent slopes	140	170	800	1, 100	650	850	4, 000	7, 000
Zita loamy fine sand, 0 to 3 percent slopes	125	150	700	900	525	700	3, 000	5, 000

[1] Crop not suitable because of the severe limitation of the soil or hazard to the soil if crop is grown.

The practices used on irrigated soils at a low level of management are as follows:

1. No special effort is made to save rainfall.
2. Crop residues are turned under.
3. Erratic irrigation is used with little regard to crop needs.
4. Fertilizer is not used or is used in a haphazard way.

The practices used on dryland at a high level of management are as follows:

1. All moisture that falls is saved by using contour farming, terraces, or both, according to the slope of the land.
2. Soil-building and high-residue crops are included in the cropping system.
3. Crop residues are used to help control wind erosion.

The practices used on irrigated soils at a high level of management are as follows:

1. A conservation irrigation system is used.
   a. All rainfall is saved.
   b. Water is used according to crop needs.
2. Fertilizer is used in amounts determined by soil tests and crop needs.
3. Crop residues are used to help control wind erosion.
4. Both soil-building and high-residue crops are included in the cropping system.

Nearly all the farmers of Bailey County follow a high level of insect and weed control.

Range Management[4]

Ranching in Bailey County ranks next in importance to irrigated and dryland farming. About 26 percent of the county is in native range. More than 60 percent of this range is in mixed prairie grass, free of woody plants. Other livestock enterprises, such as feedlot operations and improved irrigated pastures for grazing, are increasing in size and number. At present there are about 7,500 acres of irrigated grasses in the county that are used for grazing and for seed production.

At the time of the survey there were 24 ownerships considered as ranching units. These were primarily cow-calf operations and ranged in size from 2,000 to 44,000 acres.

Range sites and condition classes

Different kinds of range produce different kinds and amounts of grass. For proper range management, a rancher should know the different kinds of land or range sites in his holdings and the plants each site can grow. Management can then be used that will favor the growth of the best forage plants on each kind of land.

Range sites are kinds of rangeland that differ from one another in their ability to produce a significantly different kind or amount of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing use or management to maintain or improve the present vegetation. Climax vegetation is the stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment remains unchanged. Throughout most of the prairie and the plains, the climax vegetation is the combination of plants that was growing there 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 type of vegetation.

Range condition is classified by comparing the present vegetation with the climax vegetation on the site. Range condition is expressed as follows:

Condition class:	*Percentage of climax vegetation on the site*
Excellent	76–100
Good	51–75
Fair	26–50
Poor	0–25

Range in excellent or good condition provides more effective soil and water conservation and good forage yields. Range in poor condition needs the most intensive conservation practices if desirable vegetation is to be restored. As the range continues to improve, it responds more readily to management.

The determination of range sites and range conditions is a specialized procedure. Considerable knowledge of range management is needed to prepare a good plan for ranch operations.

Range sites in the county

Five distinct kinds of land make up the native grassland in Bailey County. These are known as range sites. They are Deep Hardland, High Lime, Mixed Land, Sandy Land, and Shallow Land. The largest is Sandy Land, a wide belt that runs east and west through the county south of Muleshoe. The Shallow Land and High Lime range sites are also extensive. The Shallow Land range site occurs mainly as escarpments adjacent to draws in the southern third of the county. The High Lime site comprises six large lakes and their adjacent lands and a part of Blackwater Draw near Muleshoe. Deep Hardland and Mixed Land are much less extensive than the other range sites because most of their area is in cultivation.

The Sandy Land range site will produce a wide variety of tall grasses when properly managed. The Mixed Land, Shallow Land, and High Lime range sites grow short and mid grasses. The Deep Hardland site grows short grasses. Inferior types of vegetation have invaded the range sites as a result of continued heavy use of the original forage. On the Sandy Land site, skunkbush, sand sagebrush, catclaw, yucca, queen's delight, and numerous weeds are the principal invaders. Mesquite and perennial broomweeds have invaded depleted Shallow Land and Mixed Land sites.

The five range sites in the county, the soils in each of them, the dominant climax vegetation, and the estimated production of usable air-dry forage are given in table 4.

Management principles and practices

High production of forage and conservation of soil, water, and plants on rangeland are obtained by maintenance of range already in good and excellent condition

[4] This section is by JOE B. NORRIS, range conservationist, Soil Conservation Service.

TABLE 4.—*Soils, acreage, climax vegetation, and estimated production of the range sites*

Range site and soils [1]	Approximate acreage of site	Dominant climax vegetation	Estimated production in pounds per acre of usable air-dry forage,[2] according to condition class	General soil description
	Acres			
Deep Hardland	7,630	Blue grama, side-oats grama, vine-mesquite, western wheatgrass, buffalograss, and tobosagrass.	Excellent, 700; good, 500; fair, 300; poor, 200.	Moderately deep to deep, medium-textured, moderately to slowly permeable soils ranging in color from reddish brown to grayish brown.
Amarillo loam, 0 to 1 percent slopes.				
Amarillo loam, 1 to 2 percent slopes.				
Arvana-Amarillo loams, 0 to 1 percent slopes.				
Arvana-Amarillo loams, 1 to 2 percent slopes.				
Berthoud loam, 1 to 3 percent slopes.				
Berthoud loam, 3 to 8 percent slopes.				
Olton loam, 0 to 1 percent slopes.				
Portales loam, 0 to 1 percent slopes.				
Portales loam, 1 to 3 percent slopes.				
Stegall loam, 0 to 1 percent slopes.				
Stegall loam, 1 to 2 percent slopes.				
Zita loam, 0 to 1 percent slopes.				
High Lime	14,793	Blue grama, side-oats grama, alkali sacaton, vine-mesquite, and giant and sand dropseed.	Excellent, 700; good, 500; fair, 300; poor, 200.	Moderately deep to shallow, medium to moderately coarse textured soils ranging in color from grayish brown to light gray, generally in the vicinity of lake areas.
Arch fine sandy loam.				
Arch loam.				
Church clay loam.				
Drake soils, 1 to 3 percent slopes.				
Drake soils, 3 to 5 percent slopes.				
Drake soils, 5 to 20 percent slopes.				
Mixed Land	22,741	Blue grama, side-oats grama, little bluestem, plains bristlegrass, and Arizona cottontop.	Excellent, 800; good, 600; fair, 400; poor, 200.	Shallow to deep, moderately coarse textured soils ranging in color from grayish brown to reddish brown.
Amarillo fine sandy loam, 0 to 1 percent slopes.				
Amarillo fine sandy loam, 1 to 3 percent slopes.				
Amarillo fine sandy loam, 3 to 5 percent slopes.				
Arvana fine sandy loam, 0 to 1 percent slopes.				
Arvana fine sandy loam, 1 to 3 percent slopes.				
Arvana fine sandy loam, shallow, 0 to 1 percent slopes.				
Arvana fine sandy loam, shallow, 1 to 3 percent slopes.				
Berthoud fine sandy loam, 3 to 5 percent slopes.				
Berthoud-Mansker fine sandy loams, 5 to 8 percent slopes.				
Likes-Arch complex, hummocky.				
Loamy alluvial land.				
Lubbock fine sandy loam.				
Mansker fine sandy loam, 0 to 1 percent slopes.				
Mansker fine sandy loam, 1 to 3 percent slopes.				
Mansker fine sandy loam, 3 to 5 percent slopes.				
Portales fine sandy loam, 0 to 1 percent slopes.				
Portales fine sandy loam, 1 to 3 percent slopes.				
Zita fine sandy loam, 0 to 1 percent slopes.				
Zita fine sandy loam, 1 to 3 percent slopes.				

[1] The following soils have not been assigned a range site: Randall clay and Randall fine sandy loam (total acreage in range, 2,062); and Active dunes.

[2] Pounds of forage produced under proper range management during average years.

TABLE 4.—*Soils, acreage, climax vegetation, and estimated production of the range sites*—Continued

Range site and soils [1]	Approximate acreage of site	Dominant climax vegetation	Estimated production in pounds per acre of usable air-dry forage,[2] according to condition class	General soil description
	Acres			
Sandy Land	88, 913	Indiangrass, switchgrass, sand bluestem, New Mexican feathergrass, needle-and-thread grass, sand lovegrass, hairy grama, giant dropseed, and big sandreed.	Excellent, 700; good, 450; fair, 300; poor, 175.	Moderately deep to deep, coarse-textured, moderately to rapidly permeable soils ranging in color from pale brown to brown.
Amarillo loamy fine sand, 0 to 3 percent slopes.				
Brownfield fine sand, thick surface.				
Brownfield soils, severely eroded.				
Gomez-Arch complex.				
Gomez-Arch complex, severely eroded.				
Lubbock loamy fine sand.				
Springer loamy fine sand, hummocky.				
Springer loamy fine sand, undulating.				
Tivoli fine sand.				
Zita loamy fine sand, 0 to 3 percent slopes.				
Shallow Land	13, 351	Blue grama, side-oats grama, little bluestem, New Mexican feathergrass, buffalograss, and hairy and black grama.	Excellent, 650; good, 500; fair, 350; poor, 200.	Shallow to very shallow, fine to medium-textured soils; brown in color.
Kimbrough soils.				
Mansker loam, 0 to 1 percent slopes.				
Mansker loam, 1 to 3 percent slopes.				
Potter soils.				
Stegall loam, shallow, 0 to 1 percent slopes.				
Total acres in range	149, 490			

and by improving the native vegetation. This vegetation is improved by managing the grazing so as to encourage the growth of the better native forage plants and to increase their number. Where native stands have been destroyed or depleted by overuse, drought, and selective grazing, suitable plants must be introduced.

Leaf development, root growth, flower-stalk formation, seed production, forage regrowth, and food storage in the roots are essential stages in the development and growth of grass. Maximum forage yields and high animal production are maintained by regulating grazing so as to allow these natural processes of growth.

Livestock are selective in grazing and seek out the more palatable and nutritious plants. If grazing is not carefully regulated, the better plants are eventually eliminated and second-choice plants increase. If heavy grazing is continued, even the second-choice plants are thinned out and undesirable plants take their place.

Research and the experience of ranchers have shown that continuous grazing of more than half the yearly volume of grass produced will damage plants to such extent that they will not respond quickly to management. This damage can be repaired only by several years of good management. Good management permits full development of the root systems and, in turn, increases forage yields. If about half the grass produced yearly is left on the range, it has the following effects:

1. It produces litter or mulch on the surface soil that reduces surface crusting and evaporation of moisture and increases the infiltration rate and content of organic matter.
2. It protects the surface layer from wind and water erosion.
3. It allows established plants to form root systems that reach to greater depths for water.
4. It provides a favorable seedbed for seedlings.
5. It reduces wide variations in soil temperatures. Grass can survive extremes in climate but does best when fluctuations are not so abrupt.
6. It increases food storage in roots for initial spring growth.
7. It provides a reserve of feed for the dry spells that otherwise might force the sale of livestock.
8. It maintains the better plants in high vigor. Healthy plants compete most successfully with invading plants.

The maintenance and improvement of suitable vegetation are essential in good range management. A livestock program that is in balance with the forage produced is also necessary. Severe droughts, snows, and other climatic extremes must be expected. Reserve pastures, stored feed, and a part of the herd kept readily salable are buffers against low forage yields. Flexibility of the herd allows the rancher to adjust his management without permanently damaging grassland or selling breeding animals.

Range practices and a range management program should be based on the needs of the land. The program should take into account specific sites and, particularly, specific range condition.

Some important management practices are discussed as follows:

Proper range use.—This is the rate of grazing that will maintain adequate residues for soil and water conservation. In addition, the quality of vegetation that has deteriorated is improved by this practice. Proper range use is necessary on all rangeland, regardless of the type of vegetation now grown.

Following are four basic range practices:

1. Proper number of livestock.—The number of livestock should be based on the amount of forage available throughout the year.
2. Proper distribution of grazing.—Grazing can be evenly distributed by fencing and by proper spacing of salting and watering places.
3. Proper season of use.—Seasons when forage is available, as well as those when it can be used most beneficially for livestock and for pasture and soil conservation, should be determined.
4. Proper kind of grazing animals.—The kind of of livestock that will graze the available forage without injury to the range should be selected. Cattle are best suited to the range in Bailey County.

Deferred grazing.—This is the postponement of grazing on a range so as to increase vigor of the forage or to permit the desirable plants to reproduce naturally by seed. In addition, deferred grazing will build up a reserve of forage for later use.

Salting.—Salting at different places periodically will improve grazing distribution. Salt normally should be located away from water, roads, or other well-traveled areas. These salting places draw livestock into areas that are not frequently grazed, because of their topography, lack of water, or odd shape.

Supplemental feeding.—This practice is needed during winter or when the supply of forage is low. Supplemental feeding should be away from water or salting areas. As with salting, the feeding places should be distributed so that the vegetation will not be depleted in any one area.

Chemical or mechanical control of undesirable plants.—This is one of the most important practices used to improve pasture. It has the following advantages: (1) Moisture that otherwise would be used by undesirable plants is released for the remaining vegetation; (2) desirable seedbeds are prepared when mechanical control is used; and (3) livestock handling is made easier.

Range seeding.—This is the establishment of perennial grasses to control loss of soil and water and to restore range that is in poor condition. Native grassland is seeded by broadcast seeding or by use of seed drills in conjunction with pitting machines, or "sand fighters."

A different method is used to establish perennial grasses on cropland. During the year before seeding, an annual crop of sudangrass or forage sorghum is drilled or broadcast. This crop is not allowed to mature and produce seed. During the following year, the desired grasses are planted in the undisturbed dead cover, which, if properly managed, creates a mulch. This mulch holds moisture near the surface of the soil, reduces high temperatures, and helps to prevent surface crusting.

Unlike annual crops, perennial grasses have a different method of growth and require more intensive seedbed preparation. After they are established, perennial grasses need management for maintenance and improvement.

Water developments.—A range conservation plan should provide for an adequate number of watering places. If possible, water should be so located over the entire range that livestock will not have to travel too far (fig. 16). Good distribution of water helps to achieve uniform use of the range. Generally, wells, ponds, springs, and pipelines furnish water for livestock. In some places water must be hauled. The nature of each range determines which type of water development is the most practical.

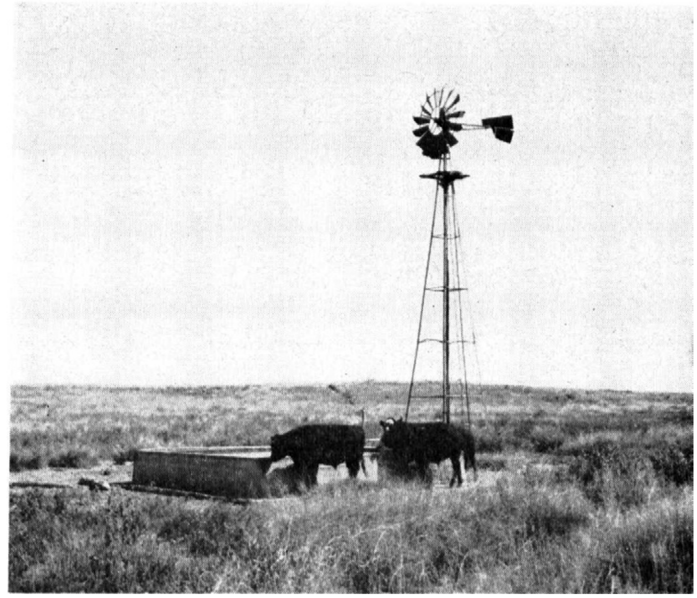

Figure 16.—Cattle drinking from a water facility that has been placed so as to get even distribution of grazing.

Fencing.—Fences should be constructed to permit good livestock and range management. Different kinds of stock may need separation, and sites may have to be provided for seasonal use. In some places range sites that are large enough and have enough differences should be fenced separately.

Engineering Applications[5]

The information in this section may be helpful in planning and making estimates of various engineering construction jobs. *It will not eliminate, however, the need for sampling and testing for design and construction of specific engineering works.*

Information in this report can be used to:

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural structures, such as farm ponds, irrigation systems, and soil and water conservation practices.
3. Make preliminary evaluations of soil and ground conditions that will aid in the selection of highway and airport locations.
4. Locate probable sources of topsoil and other construction material for use in structures.
5. Correlate performance of engineering structures with soil mapping units and thus develop infor-

[5] This section by Y. E. McAdams, area engineer, Soil Conservation Service, Lubbock, Tex.

mation that will be useful in designing and maintaining the structures.

6. Determine the suitability of soils for the cross-county movement of vehicles and construction equipment.
7. Obtain supplemental information from other published maps and reports and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes in the particular area.
9. Select locations for pipelines.

Some of the terms used by the soil scientists that may be unfamiliar to the engineer are defined in the Glossary.

Engineering Classification Systems

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials.[6] In this system soil materials are placed in seven principal groups. The groups range from A–1, in which are gravelly soils of high bearing capacity, to A–7, which consist of clap soil having low strength when wet.

Some engineers prefer to use the Unified soil classification system.[7] In this system, soil material is divided into 15 classes: 8 classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, SC), 6 for fine-grained (ML, CL, OL, MH, CH, OH), and 1 for highly organic material (Pt). Mechanical analyses are used to determine the GW, GP, SW, and SP classes of material; mechanical analyses, liquid limit, and plasticity index are used to determine GM, GC, SM, SC, and fine-grained soils. The soils of the county have been classified only in the SP, SM, SC, ML, CL, and CH classes of material.

Engineering Properties of the Soils

Brief descriptions of all the soils in Bailey County and estimates of properties that are significant to engineering are given in table 5. The Unified and AASHO classifications of the soils in table 5 are based on data from field tests or from the soil survey reports on Dawson, Hansford, Lamb, Lynn, and Terry Counties.

Permeability, as shown in table 5, was estimated for the soil material as it occurs without compaction.

The available water capacity in inches per inch of depth is an estimate of the capillary water when the soil is wet to field capacity. When the soil is air dry, this amount of water will wet the soil material to a depth of 1 inch without deeper percolation.

Dispersion for all the soils was estimated from experience of local personnel of the Soil Conservation Service.

The shrink-swell potential indicates the volume change of the soil material that can be expected with changes in moisture content. It is estimated primarily on the basis of the amount and type of clay present. In general, soils classified as CH and A–7 have a "high" shrink-swell potential. Clean sands and gravels (single grain) and those having small amounts of nonplastic to slightly plastic fines, as well as most other nonplastic to slightly plastic soil materials, have a "low" shrink-swell potential.

Additional information for the engineering section was based on experience of personnel of the Bureau of Public Roads and Texas State Highway Department and local representatives of the Soil Conservation Service.

[6] AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus. 1961.

[7] WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3-357, 3 v., Vicksburg, Miss. 1953.

TABLE 5.—*Brief descriptions of the soils and estimated*

Map symbol	Soil	Description	Depth from surface
Ad	Active dunes.	Fine sands having no vegetation and subject to active wind erosion; areas range from 5 to 100 acres in size and generally occur within areas of Tivoli fine sand; these dunes of fine sand range from about 10 to 20 feet in thickness.	*Inches* 0–72
AfA AfB AfC	Amarillo fine sandy loam, 0 to 1 percent slopes. Amarillo fine sandy loam, 1 to 3 percent slopes. Amarillo fine sandy loam, 3 to 5 percent slopes.	6 to 14 inches of fine sandy loam over 30 to 50 inches of moderately permeable, well-drained sandy clay loam; developed on unconsolidated alluvial and eolian, moderately sandy sediments.	0–10 10–28 28–50 50–62
AlA AlB	Amarillo loam, 0 to 1 percent slopes. Amarillo loam, 1 to 2 percent slopes.	Same as Amarillo fine sandy loam, but the surface layer is 6 to 12 inches of loam.	0–10 10–23 23–36 36–46
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes.	Same as Amarillo fine sandy loam, but the surface layer is 8 to 16 inches of loamy fine sand.	0–14 14–24 24–46
An	Arch fine sandy loam.	Surface layer is 6 to 12 inches of well-drained fine sandy loam that is strongly calcareous; developed from lacustrine and alluvial materials that apparently are modified by deposits of calcium carbonate from ground water; occupies shallow valleys and slight depressions.	0–11 11–21 21–48
Ao	Arch loam.	Similar to Arch fine sandy loam, but the surface layer is loam underlain by clay loam.	0–11 11–24
AvA AvB	Arvana fine sandy loam, 0 to 1 percent slopes. Arvana fine sandy loam, 1 to 3 percent slopes.	6 to 11 inches of moderately permeable fine sandy loam over well-drained sandy clay loam; developed from a thin mantle deposited over rocklike caliche; nearly level to gently sloping areas, mainly in the southern half of the county.	0–10 10–34
AxA AxB	Arvana fine sandy loam, shallow, 0 to 1 percent slopes. Arvana fine sandy loam, shallow, 1 to 3 percent slopes.	Same as Arvana fine sandy loam, but the sandy clay loam subsoil is thinner (6 to 12 inches thick) over rocklike caliche.	0–5 5–18
AyA AyB	Arvana loam, 0 to 1 percent slopes. Arvana loam, 1 to 2 percent slopes.	Very similar to Arvana fine sandy loam, but the surface layer is loam, and the subsoil is slightly more clayey; underlain by indurated caliche; occur in a complex with Amarillo loam (Arvana-Amarillo loams).	0–10 10–30
BeC	Berthoud fine sandy loam, 3 to 5 percent slopes.	Deep, well-drained, calcareous soil; developed from alluvial materials washed from higher, adjoining areas; occurs along the slope of draws and below escarpments on the north and west side of saline lakes.	0–16 16–36 36–60
BhB BhD	Berthoud loam, 1 to 3 percent slopes. Berthoud loam, 3 to 8 percent slopes.	Same as Berthoud fine sandy loam but has less sand throughout the profile.	0–14 14–32
Br	Brownfield fine sand, thick surface.	Profile has 18 to 30 inches of fine sand over 30 to 50 inches of well-drained, moderately permeable sandy clay loam; developed from sandy earths that apparently are eolian in origin; occurs as broad, undulating areas in the Sandhills of the county.	0–21 21–60
Bs3	Brownfield soils, severely eroded.	12 to 16 inches of fine sand overlying 20 to 30 inches of well-drained, moderately permeable sandy clay loam; developed from sandy earths that appear to be eolian.	0–21 21–60
Ch	Church clay loam.	6 to 8 inches of clay loam over strongly calcareous clay; poorly drained; occurs in nearly level areas, generally on the south and west sides of saline lakes; parent materials strongly calcareous clays formed under very wet conditions; this soil is saline in places.	0–13 13–21 21–48
DrB DrC DrE	Drake soils, 1 to 3 percent slopes. Drake soils, 3 to 5 percent slopes. Drake soils, 5 to 20 percent slopes.	Strongly calcareous soils that have little development; comprise dunes generally east of saline lakes and playas; areas are crescent shaped and are from 10 to 200 acres in size; parent materials are wind-deposited soils from playas and saline lakes.	0–6 6–15 15–72

physical properties significant to engineering

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Texture USDA	Unified	AASHO	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Fine sand	SP or SP–SM	A–3	100	99–100	2–6	1. 0–4. 0	0. 066	7. 0–7. 5	Low.
Fine sandy loam	SM–SC	A–4	100	100	40–50	0. 75–2. 0	0. 125	6. 7–7. 8	Low.
Sandy clay loam	CL	A–6	100	100	50–60		0. 150	7. 0–7. 8	Moderate.
Sandy clay loam	CL	A–6	95–100	95–100	60–65		0. 133	7. 5–8. 0	Moderate.
Sandy clay loam	CL	A–6	75–100	70–95	50–65		0. 125	8. 0–8. 5	Moderate.
Loam	CL	A–6	100	100	50–65	0. 5–1. 5	0. 150	7. 0–7. 8	Moderate.
Sandy clay loam	CL	A–6	100	100	65–70		0. 150	6. 8–7. 5	Moderate.
Sandy clay loam	CL	A–6	100	100	55–65		0. 125	7. 5–8. 0	Moderate.
Clay loam	CL	A–6	95–100	95–100	65–75		0. 125	8. 0–8. 5	Moderate.
Loamy fine sand	SM	A–2	100	100	15–20	1. 0–2. 0	0. 083	6. 7–7. 5	Low.
Sandy clay loam	SC	A–2 or A–6	100	100	30–40		0. 125	6. 8–7. 8	Moderate.
Sandy clay loam	SC	A–2	100	100	30		0. 125	7. 5–8. 0	Low.
Fine sandy loam	SM–SC	A–4	99–100	99–100	40–50	1. 0–2. 5	0. 125	8. 0–8. 5	Low.
Sandy clay loam	CL	A–6	99–100	99–100	50–65		0. 133	8. 0–8. 5	Moderate.
Clay loam	CL	A–6	95–100	95–100	50–65		0. 125	8. 0–8. 5	Moderate.
Loam	CL	A–6	99–100	99–100	55–65	0. 75–2. 0	0. 150	8. 0–8. 5	Moderate.
Clay loam	CL	A–6	99–100	99–100	60–70		0. 150	8. 0–8. 5	Moderate.
Fine sandy loam	SM–SC	A–4	100	100	40–50	0. 75–2. 0	0. 125	6. 7–7. 8	Low.
Sandy clay loam	CL	A–6	100	100	50–60		0. 141	7. 0–7. 8	Moderate.
Fine sandy loam	SM–SC	A–4	100	100	40–50	0. 75–2. 0	0. 133	6. 8–7. 5	Low.
Sandy clay loam	CL	A–6	100	100	50–60		0. 141	7. 0–7. 5	Moderate.
Loam	CL	A–6	100	100	50–65	0. 5–1. 5	0. 150	6. 8–7. 5	Moderate.
Sandy clay loam	CL	A–6	100	100	60–65		0. 125	7. 5–8. 0	Moderate.
Fine sandy loam	SM–SC	A–4	98–100	98–100	40–50	1. 5–3. 0	0. 133	7. 8–8. 3	Low.
Sandy clay loam	SC	A–4 or A–6	95–100	90–100	40–50		0. 141	7. 8–8. 3	Moderate.
Sandy clay loam	SC	A–4 or A–6	95–100	90–100	45–50		0. 141	7. 8–8. 3	Moderate.
Loam	ML or CL	A–4 or A–6	98–100	98–100	55–65	1. 0–2. 0	0. 166	7. 8–8. 3	Low to moderate.
Clay loam	ML or CL	A–6	95–100	95–100	55–70		0. 166	7–8–8. 3	Moderate.
Fine sand	SP or SM	A–2	100	100	5–10	1. 5–3. 0	0. 066	6. 5–7. 2	Low.
Sandy clay loam	SC	A–6	100	100	35–45		0. 125	6. 8–7. 2	Moderate.
Fine sand	SP or SM	A–2	100	100	5–10	1. 5–3. 0	0. 066	6. 5–7. 2	Low.
Sandy clay loam	SC	A–6	100	100	30–45		0. 125	6. 8–7. 2	Moderate.
Clay loam	CL or CH	A–6 or A–7–6	100	100	80–90	0. 2–0. 9	0. 166	7. 8–8. 3	High.
Clay	CL or CH	A–7–6	100	100	80–90		0. 183	8. 0–8. 5	High.
Clay	CL or CH	A–7–6	100	100	80–90		0. 150	8. 0–8. 5	High.
Clay loam	CL	A–6	100	100	50–60	0. 78–2. 5	0. 150	8. 0–8. 5	Moderate.
Clay loam	CL	A–6	100	100	55–65		0. 150	8. 0–8. 5	Moderate.
Clay loam	CL	A–6	100	100	55–65		0. 133	8. 0–8. 5	Moderate.

TABLE 5.—*Brief descriptions of the soils and estimated*

Map symbol	Soil	Description	Depth from surface
			Inches
Ga, Ga3	Gomez loamy fine sand.	12 to 18 inches of loamy fine sand over about 1 foot of calcareous fine sandy loam subsoil that overlies white chalky caliche; occurs in a complex with Arch soils (Gomez-Arch complex); in a broad, undulating plain mainly west of Coyote Lake.	0–15 15–28 28–48
Km	Kimbrough soils.	Very shallow fine sandy loam soils developed over thick beds of stone-like caliche; rock outcrops in some areas.	0–4
La	Likes fine sandy loam.	8 to 20 inches of calcareous fine sandy loam over 12 to 50 inches of calcareous loamy fine sand subsoil; occurs in a complex with Arch fine sandy loam (Likes-Arch complex, hummocky); occurs as low dunes or hummocks within the complex.	0–19 19–32
Ld	Loamy alluvial land.	Deep, dark soils along the bottoms of draws; well drained but subject to occasional overflow; parent materials have washed from higher soils.	0–60
Lk	Lubbock loamy fine sand.	Similar to Lubbock fine sandy loam, but the surface layer is 8 to 16 inches of loamy fine sand.	0–13 13–24 24–36
Lu	Lubbock fine sandy loam.	6 to 14 inches of fine sandy loam over 8 to 12 inches of clay loam over 8 to 14 inches of slowly permeable clay; 2 to 4 feet in depth over soft caliche; occurs on nearly level, slightly depressed areas ranging from 5 to 30 acres in size; well drained but may receive runoff from surrounding areas.	0–14 14–24 24–35
MfA MfB MfC BmD	Mansker fine sandy loam, 0 to 1 percent slopes. Mansker fine sandy loam, 1 to 3 percent slopes. Mansker fine sandy loam, 3 to 5 percent slopes. Mansker fine sandy loam, 5 to 8 percent slopes.	Profile is less than 20 inches in depth over clay loam caliche; occur throughout the county on slopes above playas and along natural drains. (Mansker fine sandy loam, 5 to 8 percent slopes, occurs only in a complex with Berthoud fine sandy loam.)	0–8 8–16 16–28
MkA MkB	Mansker loam, 0 to 1 percent slopes. Mansker loam, 1 to 3 percent slopes.	Similar to Mansker fine sandy loam, but the profile is more clayey------	0–8 8–18 18–30
OtA	Olton loam, 0 to 1 percent slopes.	Deep, well-drained, noncalcareous, slowly permeable loam; occurs as broad, nearly level areas mainly located in the east-central part of the county; soft caliche occurs 30 to 50 inches below the surface.	0–8 8–38 38–72
PfA PfB	Portales fine sandy loam, 0 to 1 percent slopes. Portales fine sandy loam, 1 to 3 percent slopes.	Well-drained and calcareous soils; parent materials are very strongly calcareous, solt caliche; occur throughout the county on nearly level to gently sloping areas.	0–12 12–36 36–60
PmA PmB	Portales loam, 0 to 1 percent slopes. Portales loam, 1 to 3 percent slopes.	Similar to Portales fine sandy loam, but the surface layer is loam, and the profile is more clayey.	0–9 9–32 32–60
Ps	Potter soils.	Soils are less than 10 inches deep over thick beds of soft caliche; occur along natural drains or escarpments to the north and west of saline lakes on slopes up to 30 percent.	0–5 5–20
Ra	Randall clay.	Profile consists of dense clays to a depth of several feet; the soil may be calcareous or noncalcareous; occupies areas in intermittent lakebeds that range in size from 5 to 60 acres; from 3 to 100 feet below the level of the surrounding plain; receives runoff from adjoining areas and is submerged for long periods; parent material is calcareous clay.	0–20 20–72
Rf	Randall fine sandy loam.	Similar to Randall clay, but the surface layer is sandier; profile is sandier in places.	0–22 22–72
Sf Sh	Springer loamy fine sand, undulating. Springer loamy fine sand, hummocky.	10 to 20 inches of loamy fine sand over a red fine sandy loam subsoil, 10 to 30 inches thick, that grades to loamy fine sand; topography has low knolls or ridges; occur in western part of the Sandhills.	0–15 15–32 32–72
StA StB	Stegall loam, 0 to 1 percent slopes. Stegall loam, 1 to 2 percent slopes.	Deep, well-drained, slowly permeable loams over thick beds of indurated caliche, 20 to 36 inches below the surface; occur on a broad, nearly level to gently sloping area in the southwestern part of the county.	0–7 7–30

physical properties significant to engineering—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Texture USDA	Unified	AASHO	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Loamy fine sand	SM–SC	A–2	100	100	10–20	1. 5–3. 0	0. 083	7. 5–8. 2	Low.
Fine sandy loam	SM–SC	A–4	99–100	99–100	40–50		0. 125	8. 0–8. 5	Low.
Sandy clay loam	CL	A–6	95–100	95–100	50–60		0. 125	8. 0–8. 5	Moderate.
Fine sandy loam	SM–SC	A–4	98–100	98–100	40–50	0. 5–1. 0	0. 083	7. 5–8. 2	Low.
Fine sandy loam	SM–SC	A–2 or A–4	100	100	30–40	2. 5–5. 0	0. 083	8. 0–8. 5	Low.
Loamy fine sand	SM–SC	A–2	100	100	10–20		0. 083	8. 0–8. 5	Low.
Fine sandy loam to clay loam.	SM, SC, or CL.	A–4 or A–6	100	100	35–65	0. 8–1. 8	0. 166	7. 5–8. 3	Moderate.
Loamy fine sand	SM	A–2	100	100	15–20	0. 8–1. 5	0. 100	6. 8–7. 5	Low.
Clay loam	CL	A–6	100	100	50–60		0. 150	7. 0–7. 5	Moderate.
Clay	CL or CH	A–6 or A–7–6	100	100	70–80		0. 200	7. 5–8. 3	High.
Fine sandy loam	SM–SC	A–4	100	100	40–50	0. 6–1. 2	0. 133	6. 8–7. 5	Low.
Clay loam	CL	A–6	100	100	50–80		0. 150	7. 0–7. 5	Moderate.
Clay	CL or CH	A–6 or A–7–6	100	100	70–80		0. 200	7. 5–8. 3	High.
Fine sandy loam	SM–SC	A–4	95–100	95–100	40–50	1. 5–3. 0	0. 125	8. 0–8. 3	Low.
Clay loam	CL	A–4 or A–6	98–100	98–100	50–60		0. 150	8. 0–8. 3	Moderate.
Clay loam	CL	A–4 or A–6	95–100	95–100	50–60		0. 066	8. 0–8. 5	Moderate.
Loam	CL	A–4	95–100	90–100	55–60	1. 0–2. 0	0. 166	8. 0–8. 3	Low.
Clay loam	CL	A–4 or A–6	95–100	95–100	60–65		0. 166	8. 0–8. 5	Moderate.
Clay loam	CL	A–6	95–100	95–100	60–65		0. 083	8. 0–8. 5	Moderate.
Loam	CL	A–6	100	100	55–65	0. 5–1. 0	0. 175	7. 5–8. 0	Moderate.
Clay loam	CL or CH	A–6 or A–7–6	100	100	70–80		0. 183	7. 2–7. 8	High.
Clay loam	CL or CH	A–6 or A–7–6	95–99	96–100	60–70		0. 133	8. 0–8. 5	Moderate.
Fine sandy loam	SM–SC	A–4	99–100	99–100	45–50	1. 5–3. 0	0. 125	8. 0–8. 5	Low.
Sandy clay loam	CL	A–6	99–100	99–100	50–60		0. 141	8. 0–8. 5	Moderate.
Sandy clay loam	CL	A–6	95–100	85–90	50–60		0. 100	8. 0–8. 5	Moderate.
Loam	CL	A–4 or A–6	98–100	98–100	55–65	1. 0–2. 0	0. 150	8. 0–8. 3	Moderate.
Clay loam	CL	A–6 or A–7	98–100	98–100	55–65		0. 150	8. 0–8. 3	Moderate.
Clay loam	CL	A–6 or A–7	96–100	95–100	55–65		0. 100	8. 0–8. 5	Moderate.
Loam	ML or CL	A–4 or A–6	90–100	85–95	50–60	1. 0–2. 0	0. 150	8. 0–8. 5	Low to moderate.
Loam	ML or CL	A–4 or A–6	85–95	85–95	50–60			8. 0–8. 5	Low to moderate.
Clay	CL or CH	A–7–6	100	100	60–70	0. 02–0. 2	0. 183	6. 8–8. 0	High.
Clay	CL or CH	A–7–6	100	100	75–90		0. 183	6. 8–8. 0	High.
Fine sandy loam	SM–SC	A–4	100	100	45–50	0. 2–0. 8	0. 125	6. 8–7. 5	Low.
Clay	CL or CH	A–6 or A–7–6	100	100	55–75		0. 183	6. 8–7. 5	High.
Loamy fine sand	SM	A–2	100	100	10–20	2. 5–5. 0	0. 083	6. 8–7. 5	Low.
Fine sandy loam	SM–SC	A–2 or A–4	100	100	30–40		0. 100	6. 8–7. 5	Low.
Loamy fine sand	SM–SC	A–2 or A–4	100	100	20–40		0. 066	6. 8–7. 5	Low.
Loam	CL	A–6	100	100	55–65	0. 5–1. 0	0. 175	7. 5–8. 0	Moderate.
Clay loam	CL	A–6 or A–7–6	100	100	70–80		0. 183	7. 2–7. 8	Moderate.

TABLE 5.—*Brief descriptions of the soils and estimated*

Map symbol	Soil	Description	Depth from surface
			Inches
SwA	Stegall loam, shallow, 0 to 1 percent slopes.	Very similar to Stegall loam, but indurated caliche occurs at a depth of 10 to 20 inches.	0–6 6–16
Tv	Tivoli fine sand.	Windblown deposits of noncalcareous sands 6 to 50 feet high; in places the dunes are deposited over buried soils similar to Arch or Amarillo soils; occurs in a strip 2 to 6 miles wide that bisects the north-central part of the county from east to west.	0–72
ZfA ZfB	Zita fine sandy loam, 0 to 1 percent slopes. Zita fine sandy loam, 1 to 3 percent slopes.	Profile is deep and is well drained and noncalcareous in the top 15 to 20 inches; it grades to very strongly calcareous caliche in the parent material; soils occur in all parts of the county, generally in areas of less than 50 acres.	0–7 7–30 30–72
ZmA	Zita loam, 0 to 1 percent slopes.	Similar to Zita fine sandy loam but less sandy throughout the profile..	0–8 8–28 28–50
ZnB	Zita loamy fine sand, 0 to 3 percent slopes.	Similar to Zita fine sandy loam but the surface layer is a loamy fine sand..	0–14 14–24 24–50

Engineering Interpretations of the Soils

The soils are evaluated for engineering use in table 6. Specific features in the soil profile that may affect engineering work are pointed out. These features are estimated from actual test data available and from field experience with the performance of the soils.

The rating of the soil for road subgrade is based on the estimated classification of the soil materials. On flat terrain the rating applies to the soil materials in the A and B horizons. On steeper terrain (6 percent slopes or steeper), it applies primarily to the soil materials in the C horizon. Soils that have a plastic clay layer, such as Church clay loam and Randall clay, impede internal

TABLE 6.—*Engineering*

Map symbol	Soil	Suitability of soil for—			Soil characteristics affecting—	
		Road subgrade	Road fill	Topsoil	Dikes or levees	Farm ponds: Reservoir area
Ad	Active dunes	Poor to fair	Poor to fair	Poor	Rapid permeability; poor stability.	Excessive seepage.
AfA AfB AfC	Amarillo fine sandy loam, 0 to 1 percent slopes. Amarillo fine sandy loam, 1 to 3 percent slopes Amarillo fine sandy loam, 3 to 5 percent slopes.	Poor to fair	Fair	Fair	Moderate permeability; fair stability.	Moderate to excessive seepage.
AlA AlB	Amarillo loam, 0 to 1 percent slopes. Amarillo loam, 1 to 2 percent slopes.	Poor to fair	Poor to fair	Fair to good	Moderate permeability; fair stability.	Moderate to excessive seepage.
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes.	Fair	Fair	Poor to fair	Moderate permeability; fair stability in subsoil.	Moderate to excessive seepage.
An	Arch fine sandy loam	Poor to fair	Fair	Poor	Moderately rapid permeability; fair stability.	Excessive seepage.

physical properties significant to engineering—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Texture USDA	Unified	AASHO	No. 4	No. 10	No. 200				
						Inches per hour	*Inches per inch of depth*	*pH*	
Loam	CL	A-6	100	100	55–65	0.5–1.0	0.175	7.5–8.0	Moderate.
Clay loam	CL	A-6 or A-7-6	100	100	70–80		0.183	7.2–7.8	Moderate.
Fine sand	SP or SP-SM	A-3	100	99–100	2–6	1.0–4.0	0.066	7.0–7.5	Low.
Fine sandy loam	SM or SC	A-4 or A-6	100	100	40–50	1.0–2.5	0.133	7.5–8.0	Low.
Sandy clay loam	CL	A-6	100	100	50–60		0.150	7.5–8.0	Moderate.
Clay loam	CL	A-6	95–100	90–100	50–60		0.083	8.0–8.5	Moderate.
Loam	CL	A-6	100	100	55–65	1.0–2.0	0.166	7.5–8.0	Moderate.
Clay loam	CL	A-6	100	100	55–65		0.166	7.5–7.8	Moderate.
Clay loam	CL	A-6	95–100	95–100	50–60		0.083	8.0–8.5	Moderate.
Loamy fine sand	SM-SC	A-2	100	100	20–30	1.5–3.0	0.083	7.5–8.0	Low.
Sandy clay loam	CL	A-6	100	100	50–60		0.150	7.5–8.0	Moderate.
Clay loam	CL	A-6	95–100	90–95	50–60		0.083	8.0–8.5	Moderate.

drainage and have low stability when wet. Such soils are rated "Poor." This rating is based on their poor grading and general lack of stability unless they are properly confined. The coarser textured and better graded soils are rated as "Fair."

The suitability of the soil for road fill depends largely on its natural water content and texture. Plastic soils that have a high content of natural water, such as Church clay loam and Randall clay, are difficult to handle, to compact, and to dry to the desired content of water. They, therefore, are rated "Poor." The very sandy soils are difficult to place and compact because they do not contain enough binding material. These soils are rated "Poor to fair."

interpretation of the soils

Soil characteristics affecting—Continued					
Farm ponds—Con.	Irrigation		Land leveling	Field terraces and diversion terraces	Waterways
Embankment	Sprinkler system	Surface system			
Poor stability	Very low water-holding capacity.	Very high intake rate; dune topography.	Dune topography	Dune topography; very high wind erosion.	Not applicable.
Fair stability to good stability.	Moderately high water-holding capacity.	High intake rate; high seepage from earthen ditches.	Generally not practical on slopes above 3 percent.	Gully and sheet erosion.	Erodible.
Good stability	High water-holding capacity.	Moderate intake rate; moderate seepage from earthen ditches.	No problems	Gully and sheet erosion.	Erodible.
Fair stability in subsoil.	Moderately high water-holding capacity.	Very high intake rate; high seepage from earthen ditches.	High wind erosion	High wind erosion	Highly erodible.
Fair stability	Moderate water-holding capacity.	Very high intake rate; excessive seepage from earthen ditches.	High wind erosion	High wind erosion	Erodible.

TABLE 6.—*Engineering interpretation*

Map symbol	Soil	Suitability of soil for—			Soil characteristics affecting—	
		Road subgrade	Road fill	Topsoil	Dikes or levees	Farm ponds: Reservoir area
Ao	Arch loam	Poor to fair	Poor to fair	Poor	Moderately rapid permeability; fair stability.	Excessive seepage
AvA	Arvana fine sandy loam, 0 to 1 percent slopes.	Poor to fair	Fair	Fair	Moderate permeability; fair stability.	Moderate to excessive seepage.
AvB	Arvana fine sandy loam, 1 to 3 percent slopes.					
AxA	Arvana fine sandy loam, shallow, 0 to 1 percent slopes.	Poor to fair	Fair	Fair	Moderate permeability; good stability; hard caliche at depths of 10 to 20 inches.	Moderate seepage; hard caliche substratum.
AxB	Arvana fine sandy loam, shallow, 1 to 3 percent slopes.					
AyA	Arvana loam, 0 to 1 percent slopes.[1]	Poor to fair	Poor to fair	Fair to good	Moderate permeability; fair stability.	Moderate to excessive seepage.
AyB	Arvana loam, 1 to 2 percent slopes.[1]					
BeC	Berthoud fine sandy loam, 3 to 5 percent slopes.	Poor to fair	Fair	Fair	Moderately rapid permeability; fair stability.	Moderate seepage
BhB	Berthoud loam, 1 to 3 percent slopes.	Poor to fair	Poor to fair	Fair	Moderate permeability; fair stability.	Moderate seepage
BhD	Berthoud loam, 3 to 8 percent slopes.					
Br	Brownfield fine sand, thick surface.	Fair	Fair; poor to fair in the upper 1½ to 2½ feet.	Poor	Fair stability in subsoil.	Excessive seepage
Bs3	Brownfield soils, severely eroded.					
Ch	Church clay loam	Poor	Poor	Poor	Unstable	Low seepage
DrB	Drake soils, 1 to 3 percent slopes.	Poor to fair	Poor to fair	Poor	Fair stability; high wind erosion.	High seepage
DrC	Drake soils, 3 to 5 percent slopes.					
DrE	Drake soils, 5 to 20 percent slopes.					
Ga, Ga3	Gomez loamy fine sand[2]	Fair	Fair	Poor	Moderately rapid permeability; poor stability.	Excessive seepage
Km	Kimbrough soils	Poor to fair; very shallow to hard caliche.	Fair	Fair	Surface very shallow; hard substratum.	Moderately rapid permeability.
La	Likes fine sandy loam[3]	Poor to fair	Fair	Poor	Moderately rapid permeability; poor stability.	High seepage
Ld	Loamy alluvial land	Poor to fair	Poor to fair	Good	Moderate permeability; fair stability.	Moderate seepage

See footnotes at end of table.

of the soils—Continued

Soil characteristics affecting—Continued					
Farm ponds—Con.	Irrigation		Land leveling	Field terraces and diversion terraces	Waterways
Embankment	Sprinkler system	Surface system			
Fair stability	Moderately high water-holding capacity.	High intake rate; high seepage from earthen ditches.	High wind erosion	Moderate wind erosion.	Erodible.
Fair stability to good stability.	Low water-holding capacity.	High intake rate; high seepage from earthen ditches.	Cuts generally limited.	Gully and sheet erosion.	Erodible.
Good stability	Very low water-holding capacity.	High intake rate; use light applications of water.	Shallow	Shallow	Shallow; hard caliche at depths of 10 to 20 inches.
Good stability	High water-holding capacity.	Moderate intake rate; moderate seepage from earthen ditches.	Cuts generally limited.	No problems	Erodible.
Fair stability	Moderately high water-holding capacity.	High intake rate; short slopes.	Generally not practical on slopes of more than 3 percent.	Gully and sheet erosion.	Erodible.
Fair stability	Moderately high water-holding capacity.	Moderate intake rate; short slopes.	Generally not practical on slopes of more than 3 percent.	Gully and sheet erosion.	Erodible.
Fair stability in subsoil.	Moderate water-holding capacity.	Very high intake rate.	High wind erosion	High wind erosion	Highly erodible.
Poor stability	Low intake rate	Nearly level, uniform slopes.	Limited to shallow cuts.	Slight erosion	Slightly erodible.
Poor stability	Moderate water-holding capacity.	Moderate intake rate.	Generally not practical on slopes of more than 3 percent.	High wind erosion	High wind erosion.
Poor stability	Low water-holding capacity	Very high intake rate; earthen ditches unstable and have excessive seepage.	Very high wind erosion.	Very high wind erosion; poor stability.	Highly erodible.
Fair stability; very shallow, hard substratum.	Very shallow	Very shallow	Very shallow	Very shallow	Very shallow.
Poor stability	Low water-holding capacity.	Very high intake rate; undulating topography.	High wind erosion; undulating topography.	High wind erosion	Highly erodible.
Fair stability	High water-holding capacity.	Moderate intake rate.	Subject to occasional overflow.	Slight erosion	Slightly erodible.

TABLE 6.—*Engineering interpretation*

Map symbol	Soil	Suitability of soil for—			Soil characteristics affecting—	
		Road subgrade	Road fill	Topsoil	Dikes or levees	Farm ponds: Reservoir area
Lk	Lubbock loamy fine sand	Poor to fair	Poor to fair	Poor to fair	Moderately rapid permeability; poor stability.	Moderate seepage in substratum.
Lu	Lubbock fine sandy loam	Poor to fair	Fair	Fair to good	Slow permeability; fair stability.	Moderate seepage in substratum.
MfA MfB MfC BmD	Mansker fine sandy loam, 0 to 1 percent slopes. Mansker fine sandy loam, 1 to 3 percent slopes. Mansker fine sandy loam, 3 to 5 percent slopes. Mansker fine sandy loam, 5 to 8 percent slopes.[4]	Poor to fair	Fair	Fair	Moderately rapid permeability.	Excessive seepage.
MkA MkB	Mansker loam, 0 to 1 percent slopes. Mansker loam, 1 to 3 percent slopes.	Poor to fair	Fair	Fair to poor	Moderately rapid permeability; fair stability.	Excessive seepage.
OtA	Olton loam, 0 to 1 percent slopes.	Poor	Fair	Poor to fair	Slowly permeable	Permeable in substratum; will seal.
PfA PfB	Portales fine sandy loam, 0 to 1 percent slopes. Portales fine sandy loam, 1 to 3 percent slopes.	Poor to fair	Fair	Fair	Moderately rapid permeability; fair stability.	Moderate seepage.
PmA PmB	Portales loam, 0 to 1 percent slopes. Portales loam, 1 to 3 percent slopes.	Poor to fair	Fair	Poor to fair	Moderately rapid permeability; fair stability.	Moderate seepage.
Ps	Potter soils	Poor to fair	Fair	Poor	Very shallow; moderately rapid permeability.	Excessive seepage.
Ra	Randall clay	Poor	Poor	Poor	Very slow permeability; poor stability.	Practically impervious.
Rf	Randall fine sandy loam	Poor	Poor to fair	Fair	Very slow permeability; poor stability.	Practically impervious.
Sh Sf	Springer loamy fine sand, hummocky. Springer loamy fine sand, undulating.	Fair	Fair; poor to fair in the upper 1 to 2 feet.	Poor	Moderately rapid permeability; poor stability.	Excessive seepage.
StA StB	Stegall loam, 0 to 1 percent slopes. Stegall loam, 1 to 2 percent slopes.	Poor	Fair	Fair to good	Slow permeability	Hard caliche substratum.
SwA	Stegall loam, shallow, 0 to 1 percent slopes.	Poor	Fair	Fair to good	Slow permeability; hard caliche at depth of 10 to 20 inches.	Hard caliche substratum.

See footnotes at end of table.

of the soils—Continued

Soil characteristics affecting—Continued					
Farm ponds—Con.	Irrigation		Land leveling	Field terraces and diversion terraces	Waterways
Embankment	Sprinkler system	Surface system			
Poor stability	Moderate water-holding capacity.	Rapid permeability for light application.	High wind erosion	High wind erosion	Highly erodible.
Fair stability	Low intake rate	Moderate permeability for light applications.	No problems	No problems	Erodible.
Fair stability with flat side slopes.	Low water-holding capacity.	High intake rate	Shallow cuts not practical on slopes of more than 3 percent.	Shallow	Highly erodible.
Fair stability with flat side slopes.	Low water-holding capacity.	Moderately permeable.	Very shallow	Shallow	Erodible on flat slopes; hard to stabilize on steeper slopes.
Fair stability	Low intake rate	Fairly uniform slopes	No problems	No problems	Slightly erodible.
Fair stability	Moderate water-holding capacity.	Very high intake rate.	High wind erosion	High wind erosion	Highly erodible.
Fair stability	Permeable; moderate water-holding capacity.	Moderate intake rate.	No problems	Gully and sheet erosion.	Erodible.
Fair stability	Low water-holding capacity.	Very shallow	Very shallow	Very shallow	Very shallow.
Suitable for cores if compacted at proper moisture content.	Very low intake rate	Nearly level, uniform slopes.	Difficult to maintain uniform grade.	No water erosion	Not applicable.
Suitable for cores if compacted at proper moisture content.	Very low intake rate	Nearly level, iniform slopes.	Susceptible to wind erosion.	No water erosion	Not applicable.
Poor stability	Low water-holding capacity.	Undulating topography; very high intake rate.	Very high wind erosion.	Undulating topography; very high wind erosion.	Very high wind erosion.
Fair stability	Low intake rate	Fairly uniform slopes	No problems	No problems	Slightly erodible.
Fair stability	Low water-holding capacity.	Shallow; low water-holding capacity; use light applications of water.	Shallow	Shallow	Shallow; hard caliche at depth of 10 to 20 inches.

TABLE 6.—*Engineering interpretation*

Map symbol	Soil	Suitability of soil for—			Soil characteristics affecting—	
		Road subgrade	Road fill	Topsoil	Dikes or levees	Farm ponds: Reservoir area
Tv	Tivoli fine sand	Poor to fair	Poor to fair	Poor	Rapid permeability; poor stability.	Excessive seepage
ZfA ZfB	Zita fine sandy loam, 0 to 1 percent slopes. Zita fine sandy loam, 1 to 3 percent slopes.	Poor to fair	Fair	Fair	Moderate permeability; fair stability.	Moderate to excessive seepage.
ZmA	Zita loam, 0 to 1 percent slopes.	Poor to fair	Poor to fair	Good	Moderate permeability; fair stability.	Moderate seepage
ZnB	Zita loamy fine sand, 0 to 3 percent slopes.	Fair	Fair	Poor to fair	Moderate permeability; fair stability in subsoil.	Excessive seepage

[1] Mapped only in a complex with Amarillo loam.

[2] Mapped in Gomez-Arch complexes.

The soils in Bailey County are not a source of sand or gravel. The surface layer is generally suitable for topsoil. The Arvana, Kimbrough, Stegall, and Potter soils are a possible source of hard caliche for use in road construction and surfacing. Bedrock is not likely to be encountered.

The vertical alinement, or placement of the roadway, is affected by various factors. Cuts made in sand dunes, such as Tivoli fine sand and Springer loamy fine sand, expose material easily eroded by wind and water. Cut slopes in soils that have highly plastic clay layers, such as Church clay loam and Randall clay, are more susceptible to sloughing and sliding than other soils. Cuts in these soils, therefore, should be on flatter slopes. A layer of rocklike caliche occurs in soils such as the Arvana and Kimbrough soils and Stegall loam. Special equipment may be needed to excavate this rocklike material.

Embankments for impounding water can be safely constructed from practically all the soils, but they must be carefully placed and compacted. In places the reservoir area for ponds needs special practices to reduce excessive seepage.

The soils in this area are suited to the surface and sprinkler methods of irrigation. Sprinkler irrigation may be used on all the soils but is best suited to coarse-textured, sandy soils and more rolling topography. If the depth of the soil is 20 inches or more, surface irrigation may be used in preference to the sprinkler method on fine- and medium-textured soils with flat, uniform slopes.

Field terraces and diversion terraces constructed from coarse-textured soils are difficult to maintain. Wind and water erosion is a serious hazard in maintaining terrace ridges and channels at desired specifications.

Accumulations of windblown material in waterways on highly erodible soils create a difficult maintenance problem. If the permanent vegetation is covered, the water-carrying capacity of the waterway is reduced.

Winter grading and frost action are not considered problems, because the soils generally have a low moisture content during the winter, and subfreezing temperatures occur in fairly short periods.

Genesis, Classification, and Morphology of the Soils

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on material deposited or accumulated by geologic agencies. The important factors of soil formation are parent material, climate, living organisms, topography, and time.

The nature of the soil at any point on the earth depends upon the combination of the five major factors at that point. All five of these factors come into play in the genesis of every soil. The relative importance of each differs from place to place; sometimes one is more important and sometimes another. In extreme cases one factor may dominate the formation of the soil and fix most of its properties, as is common when the parent material consists of pure quartz sand. Little can happen to quartz sand, and the soils derived from it usually have faint horizons. Even in quartz sand, however, distinct profiles can be formed under certain types of vegetation where the topography is low and flat and a high water table is present. Thus, for every soil the past combination of the five major factors is of the first importance to its present character.

The interrelationships among the factors of soil formation are complex, and the effects of any one factor cannot be isolated and identified with certainty. It is convenient, however, to discuss the factors of soil formation separately and to indicate some of their probable effects. The reader should remember always that the factors interact contin-

of the soils—Continued

Soil characteristics affecting—Continued					
Farm ponds—Con.	Irrigation		Land leveling	Field terraces and diversion terraces	Waterways
Embankment	Sprinkler system	Surface system			
Poor stability	Very low water-holding capacity.	Very high intake rate; dune topography.	Dune topography	Dune topography; very high wind erosion.	Not applicable.
Fair stability to good stability.	Moderately high water-holding capacity.	High intake rate; excessive seepage from earthen ditches.	High wind erosion	High wind erosion	Highly erodible.
Fair stability	High water-holding capacity.	Moderate intake rate.	No problems	No problems	Slightly erodible.
Fair stability in subsoil.	Moderate water-holding capacity.	Very high intake rate; excessive seepage from earthen ditches.	High wind erosion	High wind erosion	Highly erodible.

[3] Mapped in Likes-Arch complex, hummocky.

[4] Mapped in a complex with Berthoud fine sandy loam.

ually in the processes of soil formation and that the interactions are important to the nature of every soil.

The purpose of this section is to present the outstanding morphological characteristics of the soils of Bailey County and to relate them to the factors of soil formation. Physical and chemical data are limited for these soils, and the discussion of soil genesis and morphology is correspondingly incomplete.

Most of the soils of Bailey County are neutral to alkaline. Most of them have a base saturation of 80 to 100 percent.

Parent material.—Most of the soils of Bailey County were developed from material deposited by the wind during the Illinoian age. A few of the soils were formed from recent deposits of alluvial or eolian materials.

The lime content in some areas has been increased by a high water table, as shown in Arch and Church soils. These soils are generally in shallow basins that receive lime from surrounding slopes. The parent materials are largely alkaline to calcareous, unconsolidated sandy and silty earths.

The texture of the parent materials greatly influences soil development. Olton soils were developed from silty and clayey materials and generally show distinct horizonation; Tivoli soils, in contrast, were developed from quartz sands and show little horizonation.

Climate.—Precipitation, temperature, and humidity have had a major part in the formation of soils in Bailey County. The humid climate of past geologic ages had an important effect on the deposition of the parent material. Later, zonal soils, such as Amarillo, and intrazonal soils, such as Mansker, formed under a limited rainfall that seldom wet them below the zone of living roots. As a result, these soils have accumulated a horizon of calcium carbonate. Because of low rainfall, leaching has not removed the free lime from the upper layers of the younger soils, such as Arch.

Wind has also affected the formation of soils in this area from the time it deposited sand over pre-existing alluvial materials in the Illinoian stage of the Pleistocene to its present shifting of coarse sands on the surface.[8] Tivoli and Springer soils are among the soils affected.

Living organisms.—Vegetation, micro-organisms, earthworms, and other forms of life that live on and in the soil contribute to its formation. The type and amount of vegetation are important. They are determined partly by the climate and the kind of parent material.

Climate limited the vegetation of Bailey County to grass. The parent material determined whether the grass would be tall, as on Brownfield fine sand, which has a sandy parent material, or short, as on Olton loam, which has a clayey parent material.

The mixed prairie type of native vegetation contributed large amounts of organic matter to the soil. Decaying grass leaves and stems distributed this organic matter on the soil surface. Decomposition of the fine roots distributed it throughout the solum. The network of tubes and pores left by these decaying roots hastened the passage of air and water through the soil and provided abundant food for bacteria, actinomycetes, and fungi.

Earthworms are the most noticeable animal life in the soil. Despite the low rainfall in this area and periods when the entire solum is dry, earthworms have had an important part in soil development. About 40 percent of some of the B_2 horizons of the Amarillo soils are worm casts. Worm casts add greatly to the movement of air, water, and plant roots in the soil.

Soil-dwelling rodents have had a part in the development of some soil areas. Farmers who occupied the land since it was in native grass know where large prairie-

[8] FRYE, JOHN C., and LEONARD, A. BYRON. STUDIES OF CENOZOIC GEOLOGY ALONG EASTERN MARGIN OF TEXAS HIGH PLAINS, ARMSTRONG TO HOWARD COUNTIES. Univ. Tex., Bur. Econ. Geol. Rept. 32: 60 pp., illus. 1957.

dog towns thrived. The burrowing of these animals did much to offset the leaching of free lime from the soil. It destroyed soil structure that was already formed. The areas of Portales soils within large areas of Amarillo soils are a good example of such rodent activity. Portales soils contrast with the Amarillo soils around them in being calcareous to the surface, in having weaker structure in the subsoil, and in having weaker C_{ca} horizons in many places.

The influence of men on the soil-forming factors should not be ignored. At first, they fenced the range, overgrazed it, and changed the vegetation. They then plowed the land to plant crops. By harvesting crops and allowing runoff and wind erosion, they reduced the amount of organic matter and the silt and clay particles in the plow layer. Through the use of heavy machinery and poorly timed tillage, men produced compacted areas that reduced infiltration of water and aeration. They have drastically changed the moisture regimes in some areas by irrigating. These things that have occurred in the past 50 years have shown marked effects on the soils of the county.

The way that men treat the soil in future generations will affect its further development.

Relief.—Relief influences soil development through its effect on drainage and runoff. If other factors of soil formation are equal, the degree of profile development depends mainly on the average amount of water that enters the soil. The soils on steep slopes, such as Berthoud or Mansker soils, absorb less moisture and normally have less well-developed profiles than soils on flats and in depressions, such as Amarillo and Lubbock soils. In addition, the soil-forming processes on steep slopes are retarded by continuous erosion.

Relief also affects the kind and amount of vegetation on a soil, but this is not so important in Bailey County. Slopes facing north receive less sunlight than those facing south; so they lose less moisture through evaporation. As a result, in many areas the soils on slopes facing north have dense vegetation and are generally more strongly developed. Slopes facing east have a good vegetative cover and are more developed in many places than those facing west. This is because soils on these slopes are exposed to sunlight for shorter periods and therefore lose less moisture by evaporation.

Time.—The characteristics of a soil are mainly determined by the length of time that the soil-forming factors have acted upon the soil. Some materials that have been in place for only a short time have not been influenced enough by climate and living organisms to develop well-defined and genetically related horizons. The bottom-land soils, such as Loamy alluvial land and the Drake soils bordering saline lakes, are examples of weakly developed profiles.

The Amarillo and Olton are soils that have been in place for a long time and have approached equilibrium with their environment. They are mature, or old, soils. These soils show marked horizon differentiation. They occupy the nearly level to gently sloping areas of Bailey County.

Classification of Soils by Higher Categories

Classification consists of an orderly grouping of defined kinds of soils into classes in a system designed to make it easier to remember soils, including their characteristics and interrelationships, and to organize and apply the results of experience and research to areas ranging in size from plots of several acres to large bodies of millions of square miles. The defined kinds of soils are placed in narrow classes for use in detailed soil surveys and in the application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories so that information can be applied to large geographic areas.

Classes of soils defined on a comparable basis and of the same rank in a classification system comprise what is called a category. A comprehensive system of soil classification, one which will be useful in dealing with the soils of a small field as well as with the soils of a continent, plus land areas of intermediate size, must therefore consist of a number of categories. The higher categories consist of fewer and broader classes than the lower categories.

The system of soil classification now being used in the United States consists of six categories, one above the other. Each successively higher category consists of a smaller total number of classes, and each of those classes has a broader range of characteristics. Thus, there are thousands of classes in the lowest category and no more than three in the highest category. The intermediate categories are also intermediate in number of classes and in permissible span or breadth of each class. Beginning at the top, the six categories in the system of soil classification are the order, suborder, great soil group, family, series, and type.

Four of the six categories have been widely used, and two have been used very little. Of the two higher categories, the order and great soil group have been widely used. Similarly, the two lowest categories, the soil series and soil type, have been widely used. On the other hand, the categories of the suborder and family have never been fully developed and are therefore of little value now. In soil classification and mapping, attention has been largely given to the recognition of soil types and series within counties or comparable areas and to the subsequent grouping of the series into great soil groups and orders. The two lowest categories have been used primarily for study of soils of small geographic areas, whereas the categories of the order and great soil group have been used for the study of soils of large geographic areas.

Differences in the breadth, or span, of individual classes in each category are indicated by the total number of classes in that category. All soils in the United States are included in three classes in the highest category, that of soil orders. These same soils are placed in some three dozen great soil groups, a category of somewhat lower rank. Going down the ladder to the next lower category in general use, approximately 6,000 soil series have been recognized in the United States. More series will be recognized as the study of soils continues, especially in areas where little work has been done in the past. The total number of soil types is not known exactly, inasmuch as records are not maintained for individual soil types as is done for individual soil series. The total number of soil types recognized in the country as a whole, however, would be at least twice as large as the number of series. From comparisons of the respective numbers of orders, great soil groups, series, and types, it is immediately obvious that the ranges permitted in the properties of soils within one class in a category of high rank are broad, where as ranges within individual classes in a category of low rank are relatively narrow.

The nature of each of the four categories of the order, great soil group, series, and type will not be described at length in this section. The soil series and the soil type are defined in the Glossary. The categories of the soil order and the great soil group are described briefly in the subsequent paragraphs.

The highest category in the present system of soil classification consists of three classes. known as the zonal, intrazonal, and azonal orders. The zonal order comprises soils with evident, genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. The intrazonal order comprises soils with evident, genetically related horizons that reflect the dominant influence of one or more local factors of parent materials, topography, and time over the effects of climate and living organisms. The azonal order comprises soils that lack distinct, genetically related horizons because of one or more of the following—youth of parent materials, resistance of parent materials to change, and steep topography. In the text of this report, these orders are often referred to as zonal soils, intrazonal soils, and azonal soils.

Because of the way in which the soil orders are defined, all three can usually be found within a single county, as is true in Bailey County. Two of the orders and sometimes all three of them may occur in a single field.

Classification of a soil series into one of the three orders does indicate something about the factors of major importance in the formation of that soil. The classification into orders also indicates something about the degree of expression of horizons in soils, or, in other words, the degree of horizonation. Even so, the ranges in properties are wide among the soils in any one order when all of them are considered collectively. Consequently, the total number of statements that can be made for any one order and which will be valid for all soils within that order are limited. Primarily, the orders indicate something about important factors of soil formation and something about degree of horizonation.

The great soil group is the next lower category beneath the order that has been widely used in this country. Classes in that category have been used to a very great extent because they indicate a number of relationships in the soil genesis and also indicate something of the fertility status, suitability for crops or trees, and the like.

Each great soil group consists of a large number of soil series with many internal features in common. Thus, all members of a single great soil group in either the zonal or intrazonal orders have the same number and kind of definitive horizons in their profiles. These definitive horizons need not be expressed to the same degree, nor do they need to be of the same thickness in all soils within one great soil group. Specific horizons must be recognizable, however, in every soil profile of a soil series representing a given great soil group.

Great soil groups in the azonal order are defined in part on the nature of the profile and also in part on history or origin of the soil. All members of a single great soil group have a number of internal features in common, but none of the great soil groups in the azonal order has distinct horizonation. Consequently, all of them still bear a strong imprint of the materials from which they are being formed. Definitions of the great soil groups in the azonal order are centered on the portion of the profile approximately comparable in thickness to the solum of associated great soil groups of the zonal and intrazonal orders.

The classification of soil series in Bailey County into great soil groups and orders follows. Each series recognized in the county has been classified on the basis of the current understanding of the soils and their formation.

Zonal Order:
- Brown soils:
  - Berthoud
- Chestnut soils:
  - Lubbock
  - Stegall
  - Zita
- Reddish Brown soils:
  - Brownfield
  - Springer
- Reddish Chestnut soils:
  - Amarillo
  - Arvana
  - Olton

Intrazonal Order:
- Calcisols:
  - Arch
  - Church
  - Gomez
  - Mansker
  - Portales
- Grumusols:
  - Randall

Azonal Order:
- Lithosols:
  - Kimbrough
  - Potter
- Regosols:
  - Drake
  - Likes
  - Tivoli

Morphology

The relationship of the outstanding morphological characteristics of the soils of Bailey County to the factors of soil formation is briefly discussed in this section.

In Bailey County the zonal order contains four great soil groups: Brown, Chestnut, Reddish Brown, and Reddish Chestnut.

The Brown soil group includes only the Berthoud series. The soils of this series have a brown, calcareous surface soil that grades to a pale-brown subsoil, which is underlain by light-colored, calcareous, unconsolidated substrata at a depth of 3 to 4 feet.

There are three series in the Chestnut group in the county. They are the Lubbock, Stegall, and Zita series. The Chestnut soils are dark brown or dark grayish brown and grade to whitish calcareous horizons at a depth of 1½ to 4 feet.

Two soil series are in the Reddish Brown group in this county. They are the Brownfield and Springer. The soils of these series have a reddish-brown surface soil that grades to a red subsoil.

The Reddish Chestnut group is the most extensive in Bailey County. It comprises the Amarillo, Arvana, and Olton series. The soils of these series are reddish brown and normally grade into white or pink caliche at a depth of 36 to 42 inches. The have distinct, genetically related horizons and other soil characteristics that show the predominant influence of climate and living organisms in their formation. These soils have a distinct A, B, C horizon sequence.

The intrazonal soils in Bailey County contain the Calcisol and Grumusol great soil groups. The Arch, Church, Gomez, Mansker, and Portales soils are Calcisols. The Randall soils are Grumusols.

Arch, Church, Gomez, Mansker, and Portales soils are considered Calcisols because of the thick accumulation of calcium carbonate, 10 to 36 inches below the soil surface.

Arch and Church soils have developed from highly calcified parent material. Until very recent geologic times, this material made up lakebeds. The Church soils developed in more clayey sediment than the Arch soils.

Portales soils have developed from much the same parent material as Arch soils. However, they have had a longer time to develop; or because of a more favorable microrelief, they have received extra water to speed up the leaching of lime.

The lack of development in Mansker soils may be caused by relief, age, or parent material. Theoretically, Arch soils should develop with time into soils resembling the Mansker series, then into soils like those of the Portales series, and then into Chestnut soils resembling those of the Zita series. Finally, they should develop into zonal Amarillo soils.

The soils of the Randall series, the only Grumusols in Bailey County, have developed in the playa beds from clayey materials. Because of relief, they developed under wet conditions.

The azonal order in this county contains two great soil groups. These are the Lithosol and Regosol groups. These soils usually show only a weak A_1 horizon.

The Lithosols in the azonal order are the Kimbrough and Potter soils. Kimbrough soils are very shallow, because they have developed over hard, rocklike caliche. Potter soils lack development because of geologic erosion on steep slopes.

The Regosols in the azonal order are the Drake, Likes, and Tivoli soils. Drake soils lack development because of youth and parent materials that are very high in lime. Likes soils much resemble Drake soils but have developed from much sandier material. Tivoli soils are young soils, and their parent material contains very little clay or minerals subject to weathering.

Characteristics of the Likes-Arch Complex, Hummocky

In Bailey County the Likes soils occur in a complex with Arch soils. Their parent material was apparently wind-deposited, moderately sandy material laid down in small dunes. The long axis of the dunes was generally north and south. This indicates that the dominant winds during the deposition and shifting of the material were from the west.

A profile of a Likes soil in the Likes-Arch complex, hummocky, is described under the Likes series.

The hummocks in this complex lie over a buried soil (in most places resembling Arch) that is at a depth of 2 to 6 feet.

Two transects were made across this soil complex, and a detailed study of the characteristics was made to determine the percentage of different soils in the complex, as shown in table 7. A diagram of the transects is shown in figure 17.

The two transects embrace eight hummocks and six intradune flats or valleys, as shown in the figure. These hummocks do not have a uniform slope to the apex but are rounded; each area of dunes may have several knobs or tops. The figure shows that soil horizons on each dune are fairly uniform in thickness, and that the height of the dune depends on the thickness of sandy material below the solum. The side slope of an individual dune ranges from 3 to 8 percent. The height ranges from 1.5 to 6.5 feet. The distance across the dunes ranges from 200 to 900 feet.

These areas of soil are referred to by some farmers as the knobby sands.

TABLE 7.—*Percentage of the different soils in the Likes-Arch complex, hummocky, as determined by two transects*

Transect	Likes fine sandy loam	Arch fine sandy loam	Gomez fine sandy loam	Area in hummocks	Area in interdune flats
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
No. 1: (2,150 feet long)	17	54	29	69	31
No. 2: (2,040 feet long)	68	6	26	100	0
Nos. 1 and 2 combined: (4,190 feet long)	42	30	28	84	16

Additional Facts About the County

In this section the geology, climate, and history of Bailey County are discussed. Information is also given about agricultural statistics, public facilities, farm improvements, transportation, industries, natural resources, and wildlife.

Geology

The outstanding geologic event in the history of Bailey County was the deposition of the Ogallala formation. This formation is the main source of irrigation water in the country. It was formed from materials deposited more than a million years ago, during the early Pliocene epoch. To understand how this underground formation developed, it is necessary to review the geologic history of the area (fig. 18).

About 180 million years ago (shortly before the uplift of the Appalachian Mountains), a shallow sea covered the area that is now western Texas. Marine sediments that were deposited during this period formed the Permian red beds. While the Appalachian Mountains were being formed, the High Plains rose above the level of the sea. Streams that flowed over the exposed Permian rocks eroded fine-textured materials and redeposited them along the flood plains. These materials formed the Triassic red beds, or the impervious stratum that underlies the Ogallala formation.

During the Cretaceous period, a shallow arm of the sea again partly covered the High Plains. Sand, clay, and limestone were deposited over much of the area.

The formation of the Rocky Mountains was the next significant development. Swift streams from the mountains cut valleys and canyons through the Cretaceous rock formed from the deposits of the Cretaceous period and

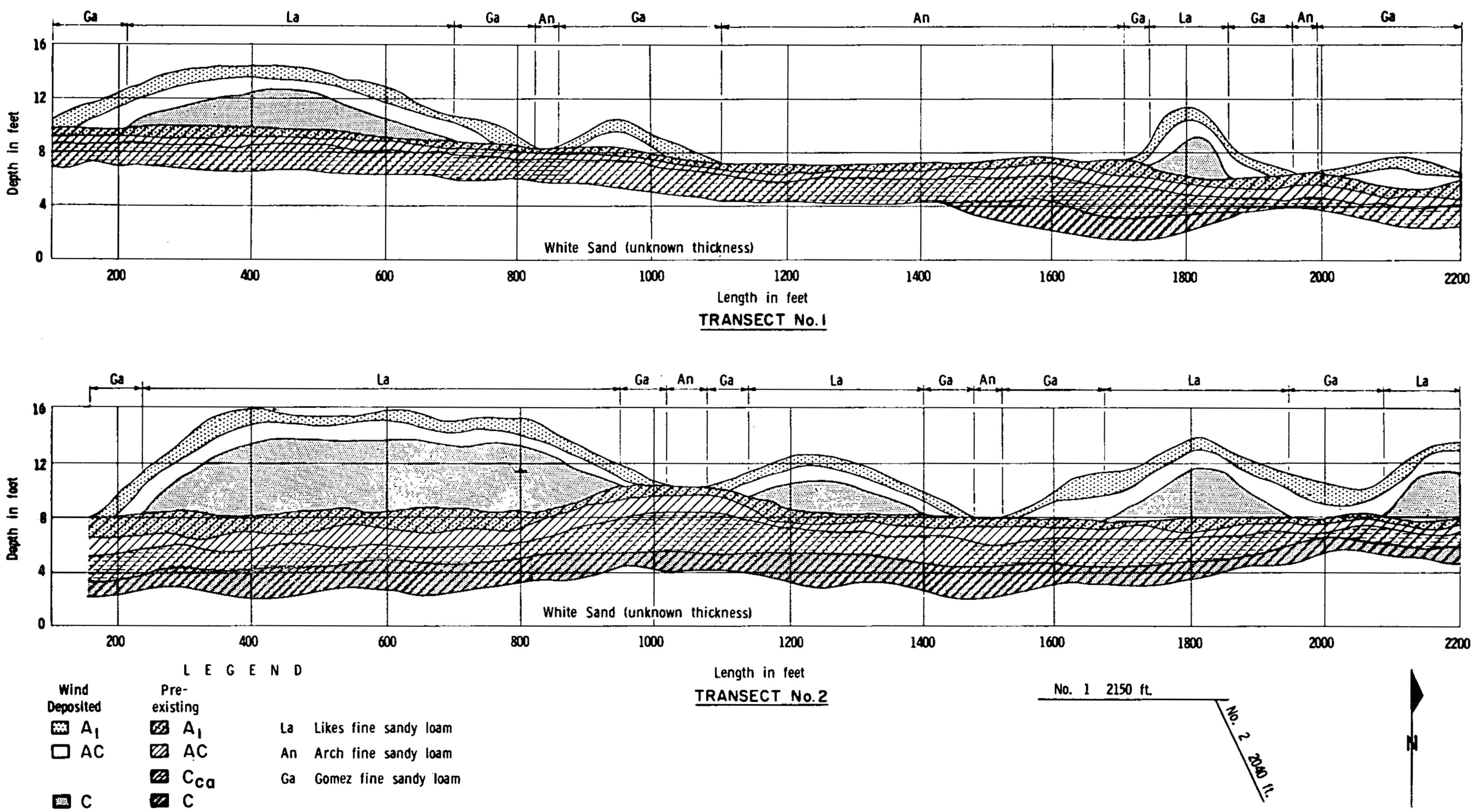

Figure 17.—**Transects on Likes-Arch complex, hummocky.**

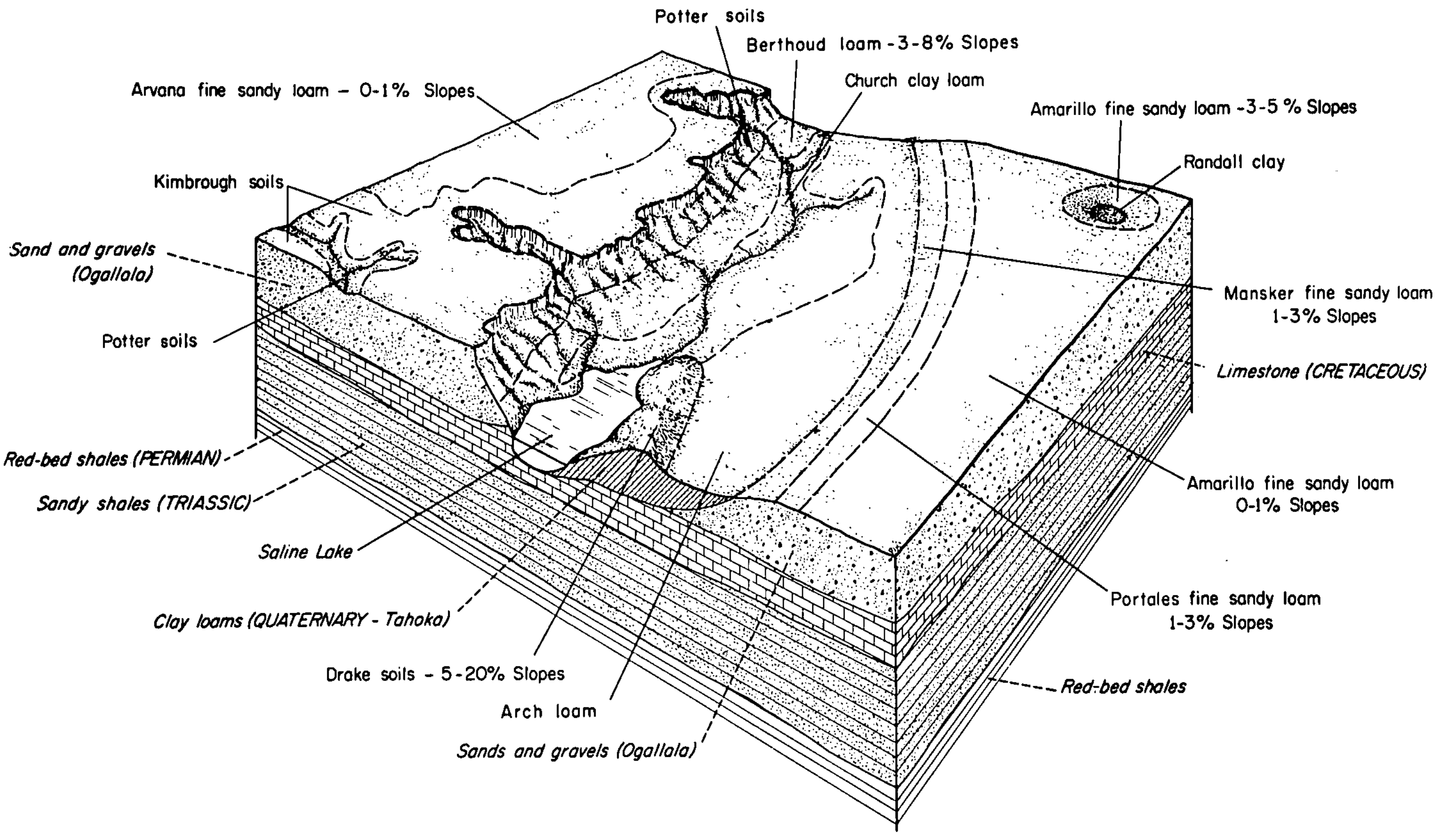

Figure 18.—**Soils and underlying formations associated with a saline lake in Bailey County.**

into the underlying Triassic red beds. Most of the Cretaceous material deposited on the High Plains was washed away. In Bailey County the Cretaceous formation is thin and discontinuous. There are local outcrops along the edges of some of the saline lakes.

When the Rocky Mountains reached their maximum height, they began to erode. Coarse, gravelly material was carried great distances by the swift streams. As the mountains were eroded, the streams became less swift and began to deposit gravel, sand, and silt near their sources. These deposits formed alluvial fans of gravelly, coarse material along the foot slopes of the mountains. The finer materials were transported and spread farther to the east. The Ogallala formation developed from these deposits of outwash more than a million years ago. This outwash was deposited just before the beginning of the ice age. The glaciers did not move as far south as Texas, but during the ice age a much moister climate prevailed in this area. Because of an increase in precipitation, streams formed and flowed across the Ogallala formation. The draws crossing Bailey County are probably the remains of these streams.

The source of underground water in Bailey County is the saturated beds of sand and gravel in the lower part of the Ogallala formation and not an underground rive or lake. The Triassic red beds underneath the Ogallala formation are relatively impervious, so it is not likely that water could be obtained from any of the lower strata. During the development of the Ogallala in a period of nearly a million years, water from the Rocky Mountains was stored in its water-bearing stratum. When the Ogallala formation was cut off from the mountains, its source of water was blocked. At present rain or snow that falls on the High Plains probably is the only source of water to replenish the underground supply.

The water table slopes gently to the southeast, and the water moves very slowly. The natural rate of flow is probably not more than 1 or 2 feet a day. Before wells were drilled for irrigation, the water was discharged mainly by springs along the caprock at about the same rate it was being replenished. At present water is being pumped for irrigation faster than it is being restored.

The amount of water available varies considerably in places because of variations in the thickness of the water-producing stratum and the depth to the red beds. Apparently, the red beds are undulating and in places they rise nearly to the static water table, or above it.[9] Some areas of Bailey County have no irrigation water, probably for this reason.

The materials from which the soils of the county developed were deposited during the Pleistocene epoch. Most of this material was deposited by wind during the Illinoian age. During this age, Bailey County was probably a prairie with low rainfall, and the wind shifted and sorted the surface materials.

As the glaciers moved southward into the United States, the climate of Texas became much wetter. During this

[9] THEIS, CHARLES V. REPORT ON THE GROUND WATER IN CURRY AND ROOSEVELT COUNTIES, NEW MEXICO. Tenth Bien. Rpt. of State Engin. of N. Mex., 1930–1932, 63 pp., illus. 1932.

time, Bailey County probably consisted of humid prairies and wooded areas along streams. When the glaciers receded, the climate became more arid, and the soils and vegetation developed as they now are.

Climate [10]

The climate of Bailey County is semiarid. The average annual precipitation is 17.44 inches, but more moisture is received than in the adjacent region of New Mexico on the west. Less moisture is received than in the low rolling plains some distance to the east.

Humidity is low compared to that of central and east Texas. The highest humidities are during the early morning hours, and the lowest during the warmest part of the afternoon. In summer the readings at 6:00 a.m. may be expected to average from 75 to 78 percent humidity; however, the readings at 6:00 p.m. are within a range of 35 to 39 percent. The humidity is lowest during the spring following warm, southwesterly winds.

A summary of the climate at Muleshoe, Tex., during the period 1931–60 is given in table 8.

Extreme variations are characteristic of monthly and annual precipitation, as shown in table 8 by the columns for wettest and driest years. In 1941 a total annual precipitation of 43.52 inches was recorded at Muleshoe. Only 7.75 inches fell during the drought year, 1954. During the 5-year drought from 1952 through 1956, the average annual rainfall was 10.75 inches. In the next 4-year period, 1957–1960, the average annual rainfall was 21.04 inches, almost twice as much. On the average, 1 year with less than 11.2 inches and 1 year with more than 25 inches can be expected during a 10-year period.

Greatest daily precipitation has exceeded that shown in table 8 in earlier years as follows: In March 1929 the greatest daily precipitation was 1.90 inches; in April 1930 it was 2.33 inches; and in July 1924 it was 3.38 inches.

Precipitation occurs most frequently as thunderstorms rather than as general rains. Because of these spotty showers, the amount of rainfall varies extremely. The maximum rainfall occurs during the months of May and June—months when thunderstorms are most frequent. In the 5-month period, May through September, 70 percent of the average annual rainfall occurs. Heavy thunderstorms cause excessive runoff and rapid erosion, so that little benefit is derived from much of the precipitation in very wet months or years.

Rain often may not fall for several weeks or more. All months of the year, except July and August, have had periods of 30 days or more without rain. On several occasions no rain was reported for 2 consecutive months. From December 1929 through March 1930, no rain fell for 4 consecutive months. In contrast, the late spring and early summer rainfall in 1941 was very heavy, and 24.55 inches fell during the 3-month period, May through July.

The precipitation during the winter months is rather limited, because the area is cut off from the moisture of the Gulf of Mexico by frequent cold fronts. Winter precipitation falls as rain or snow or as rain and snow mixed. Snowfalls are generally light, and the snow stays on the ground only a short time. But occasionally during the winter, the moisture from the Gulf is carried northward into deep, low-pressure centers over the Texas Panhandle. The result is heavy snows. A monthly snowfall of 17.0 inches was recorded in January 1936, and a fall of 12.0 inches was recorded in February 1956. The maximum monthly snowfall for March (10 inches), as shown in table 8, was exceeded in 1 year previous to those covered by table 8. This occurred in March 1924, when the snowfall was 10.7 inches.

The high, level to rolling terrain provides little resistance to wind, so that the average velocity is rather high. The strongest winds occur with the more severe thunderstorms of late spring and early summer, but such winds are of short duration. The strongest, continuous winds are during February, March, and April. These winds often cause severe duststorms; however, the increased efficiency of soil conservation practices on the sandy soils has reduced the effects of wind erosion. The prevailing winds vary from south to southwest.

Hailstorms are more frequent late in spring and early in summer. Hail may occur during any thunderstorm, but damaging hail is fairly rare and covers a small area. Crop losses vary considerably according to the stage of plant growth.

As shown by table 8, temperatures, like rainfall, show extreme variations, especially during the colder 6 months of the year, November through April. Fast-moving cold fronts from the northern plains cause rapid drops in temperature, whereas strong, southerly and southwesterly winds cause rapid rises. Wide fluctuations in temperature often occur daily late in fall, in winter, and in spring. After several weeks of mild weather, fairly severe cold fronts may push rapidly southward late in spring and freeze new spring vegetation. This weather pattern discourages the growing of fruit trees and tender early crops in the area. The dry air, high elevation, and generally clear skies are ideal for solar radiation. Consequently, there is a large range between maximum temperature during the afternoon and minimum temperature during the early morning. This daily range averages about 30° F. during all months of the year. Summer days are hot and have low humidity. Summer nights are relatively cool and have minimum temperatures in the low 60's.

Lower minimum temperatures than those shown in table 8 have occurred in the following years: In May 1929 the lowest temperature recorded was 26°; in July 1929, 50°; in August 1928, 44°, and in October 1929, 20°.

The chances of receiving freezes of 28° and 32° in the spring after the stated dates are as follows. The chances are that 1 year in 5 there will be a 28° freeze after April 24; 1 year in 10, after April 30, and 1 year in 20, after May 5. The chances are that 1 year in 5 there will be a 32° freeze after April 30; 1 year in 10, after May 5; and 1 year in 20, after May 8.

The chances of receiving freezes of 32° and 28° in the fall before the stated dates are as follows. The chances are 1 in 5 that a 32° freeze will occur before October 12; 1 in 10, before October 7; 1 year in 20, before October 4. The chances of a 28° freeze are 1 year in 5 before October 24; 1 year in 10 before October 19; and 1 year in 20 before October 16.

[10] This section by ROBERT B. ORTON, State climatologist, Weather Bureau, U.S. Department of Commerce.

TABLE 8.—*Summary of climate at Muleshoe,*

Month	Temperature [1]							Precipitation		
	Average			Extremes				Average monthly	Greatest daily	
	Daily maximum	Daily minimum	Monthly	Highest recorded		Lowest recorded				
	° F.	° F.	° F.	° F.	*Year*	° F.	*Year*	*Inches*	*Inches*	*Year*
January	52. 8	20. 6	36. 7	81	1950	−14	1947	0. 65	1. 45	1939
February	56. 8	23. 4	40. 1	82	1940	−21	1933	. 48	. 67	1948
March	64. 4	28. 8	46. 6	96	1946	0	1948	. 62	1. 38	1937
April	74. 1	39. 1	56. 6	96	[3] 1943	11	1945	1. 02	2. 12	1959
May	81. 7	49. 7	65. 7	103	[3] 1945	27	1938	2. 88	3. 66	1949
June	91. 6	59. 6	75. 6	109	1939	40	1946	2. 48	4. 02	1938
July	93. 2	63. 0	78. 1	110	1944	51	1939	2. 37	2. 47	1941
August	92. 0	61. 7	76. 9	110	1944	48	1944	2. 21	2. 18	1942
September	85. 1	54. 0	69. 6	106	1945	31	1936	1. 99	2. 35	1957
October	75. 0	42. 2	58. 6	96	1934	22	[3] 1949	1. 62	2. 62	1946
November	62. 5	27. 5	45. 0	89	1934	2	1938	. 55	1. 20	1935
December	54. 9	22. 4	38. 7	81	1939	−9	1939	. 65	1. 87	1943
Year	73. 7	41. 0	57. 4	110	1944	−21	1933	17. 44	4. 02	1938

[1] Temperature recordings were supplied by the U.S. Department of Commerce, Weather Bureau.

[2] Based on 5-year average, 1956–60 (inclusive).

[3] Also occurred on dates earlier than those covered by this table.

The growing season is fairly short. There are 181 days between the average date of the last occurrence of 32° in spring and the average date of first occurrence of 32° in fall. The average number of days between the last occurrence of 28° in spring and the first occurrence of 28° in fall is 202 days.

Bailey County has much sunshine the year around. Evaporation is high, as would be expected in a semiarid region. Average annual lake evaporation is approximately 69 inches. Maps of Weather Bureau pan evaporation give approximately 101 inches of annual evaporation from a free-water surface at ground level. Of this 101 inches, approximately 66 percent evaporates during the period May through October.

History

Bailey County was formed in 1876 from the Bexar Territory. It was organized in 1917. It was named for Peter James Bailey, who was killed in the Alamo.

As late as 1870, various tribes of Plains Indians hunted buffalo and camped in this area. The main watering and camping areas were along the Blackwater Draw, which was fed by springs. There is evidence of large camping grounds near most of the saline lakes and some playas.

The Spaniards were the first to explore this area. They called it Llano Estacado, which means staked plains. Buffalo hunters arrived in the early 1870's. The ranchers followed towards the end of the decade.

An early ranch in the county, operated by the Capitol Land Syndicate and known as the XIT Ranch, was located in the northern part of the county. The Muleshoe Ranch was one of the biggest ranches in the western part of the county. The I. C. Enochs Ranch, the Maple-Goodland Ranch, the YL Ranch, and other smaller ranches occupied most of the remainder of the county.

The city of Muleshoe was named after the Muleshoe Ranch and was incorporated as a town in 1926. It later became the county seat.

Agricultural Statistics

Although farmers and ranchers began to settle on the land about 1900, it was not until after the first World War that farming became widespread. Since 1940 the number of farms has increased, probably because of irrigation. Irrigated farms tend to be smaller than dryland farms. According to the United States census reports, the number of farms has increased from 758 in 1930 to 884 in 1954. It has been estimated by personnel of the Agricultural Conservation Program Service, the Soil Conservation Service, and the Extension Service that there were 884 farms in the county in 1959.

The total area cultivated is 370,797 acres. Of this, 221,321 acres are dry-farmed and 149,476 acres are irrigated. There are 149,490 acres used as rangeland, and 16,673 acres are used for roads, towns, farmsteads, and other miscellaneous uses.

Crops

Cotton and grain sorghum have been the main crops for many years. Large acreages of other crops could be grown if there were a market. Bailey County now produces more sesame than any other area in the United States. About 4,000 acres are planted each year.

Table 9 shows the acreage of principal crops in Bailey County, as reported by the United States census for stated years.

Tex., in 30-year period, 1931–60

Precipitation—Continued							Average number of days when maximum temperature is [2]		Average number of days when minimum temperature is [2]	
Driest year (1954)	Wettest year (1941)	Precipitation that can be expected 1 year in 10		Snowfall						
		Less than	More than	Average	Maximum		90° or above	32° or below	32° and below	0° and below
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Year*	*Days*	*Days*	*Days*	*Days*
0.01	0.24	0.1	1.8	3.2	17.0	1936	0	2	29	1
.48	.38	.1	1.2	2.1	12.0	1956	0	3	23	1
0	3.14	.1	1.7	1.5	10.0	1934	0	1	20	0
.32	1.99	.2	2.4	.4	3.0	[3] 1949	1	0	5	0
1.51	11.86	.7	6.8	(4)	3.0	1935	8	0	0	0
.45	5.77	.4	5.3	(5)	(5)	[3] 1951	20	0	0	0
.06	6.92	.7	6.0	0	----------	----------	23	0	0	0
2.82	2.09	.4	4.5	0	----------	----------	21	0	0	0
.31	3.46	.2	4.7	0	----------	----------	9	0	0	0
1.76	6.37	.2	4.9	.2	4.0	1941	1	0	2	0
0	.47	.1	1.6	1.0	6.0	1931	0	1	21	(4)
.03	.83	.1	1.5	2.5	9.0	1932	0	2	30	0
7.75	43.52	11.2	25.0	10.9	17.0	1936	83	9	130	2

[4] Less than one-half.

[5] Trace.

Table 9.—*Acreage of principal crops in stated years*

Crop	1939	1949	1954	[1] 1959
	Acres	*Acres*	*Acres*	*Acres*
Cotton harvested	43,604	115,117	75,415	104,776
Sorghum for all purposes except sirup:				
Harvested for grain	72,464	125,686	103,142	179,425
Cut for silage, hay, or fodder	35,927	4,466	10,701	2,500
Corn for all purposes	2,743	1,233	934	3,000
Wheat threshed or combined	3,807	12,963	5,591	11,300
Oats threshed or combined	75	165	64	100
Barley threshed or combined	434	690	461	3,000
Hay crops, total	2,563	4,564	9,451	6,550
Alfalfa cut for hay	247	4,499	8,134	6,500
Irish potatoes for home use or for sale	27	(2)	[3] 356	800
Sesame	--------	--------	--------	4,000

[1] Estimated by personnel of the Agricultural Conservation Program Service, the Soil Conservation Service, and the Extension Service.

[2] Reported in small fractions.

[3] Does not include acreage for farms with less than 20 bushels harvested.

Livestock

A large part of the total land area of the county is in range and is used mainly for cattle. Hogs and pigs and sheep and lambs are raised mainly by the few general farmers in the county.

Since the tractor has been used on the farm, and irrigation has been practiced, the number of horses and mules has decreased. Most of the horses are kept for herding cattle or for pleasure riding.

Table 10 shows the number of livestock in Bailey County in stated years, as reported by the United States census.

Table 10.—*Number of livestock on farms in stated years*

Livestock	1940	1945	1950	1954	[1] 1959
	Number	*Number*	*Number*	*Number*	*Number*
Cattle and calves	[2] 3,250	17,071	13,509	12,055	5,900
Hogs and pigs	[3] 6,682	5,794	5,066	1,969	4,300
Sheep and lambs	[4] 11,376	1,266	1,843	3,409	8,200
Horses and colts	[2] 1,579	739	290	266	(5)
Mules and mule colts	[2] 317	56	22	44	(5)
Chickens	[4] 70,562	[4] 101,253	[4] 53,128	[4] 45,513	------

[1] Figures furnished by Chamber of Commerce.

[2] Over 3 months old.

[3] Over 4 months old.

[4] Over 6 months old.

[5] No data available.

Size of farms

Table 11 shows the size of farms in Bailey County, as recorded by the United States census. The average size of farms in the county is 474 acres. As shown in table 11, farms less than 100 acres in size are increasing. Farms of this size are probably irrigated. Farms of 180 to 499 acres are decreasing. These farms have probably been divided, because under irrigation one man cannot handle a large acreage. Farms of 500 acres or larger are increasing. These are a combination of irrigation-dryland-livestock farms, or large blocks having a number of owners and several tenant farmers.

TABLE 11.—*Farms by size of farm*

Size of farm	1940	1954	[1] 1959
Acres	*Number*	*Number*	*Number*
Under 3	2	12	----------
3 to 9	12	25	25
10 to 49	43	93	60
50 to 99	40	81	80
100 to 179	233	155	189
180 to 259	73	47	50
260 to 499	284	246	260
500 to 999	94	154	155
1,000 +	39	71	65
Total	820	884	884

[1] Estimated by personnel of the Agricultural Conservation Program Service, the Soil Conservation Service, and the Extension Service.

Public Facilities and Farm Improvements

Public schools are located at Muleshoe, Bula, and Three Way. Churches of most denominations are throughout the county. There are about 150 miles of paved roads, and most farms are within 5 miles of at least one of them. The unpaved roads throughout the county are passable except during rare periods of very bad weather.

All rural sections have electricity. Many farms have several modern appliances. In 1954, telephones were reported on 105 farms. Most farmers have 2 tractors and the equipment to do all farming up to harvest. In 1954, 803 farms reported having 1,532 tractors. Latin-American labor is mainly depended on to irrigate, hoe, and help harvest crops.

Transportation

United States Highway No. 84 crosses Muleshoe in the northeastern part of the county from southeast to northwest. It parallels the Panhandle and Santa Fe Railway. All communities within the county are connected by paved road. Bus and truck lines on the main highways connect the county with all parts of Texas and New Mexico.

Agricultural Enterprises

The economy of Bailey County depends mainly on agriculture. There are 23 cotton gins that usually process more than 70,000 bales of cotton, and 7 elevators that receive more than 200,000,000 pounds of grain sorghum, wheat, corn, and other grain crops.

Other agricultural products are processed by three vegetable-packing and processing plants. There are also an alfalfa-dehydrating plant, a cannery, a cotton compress, a plant that delints cottonseed, and several smaller businesses that handle agricultural products for marketing.

Natural Resources

The soil is the greatest natural resource in Bailey County. Ranchers were first attracted by the good native grasses. Since the soil was fertile, it produced good yields of cotton, grain sorghum, and other products.

Abundant irrigation water, another important resource, encouraged new crops and farming methods. In 1912 there were about 10 irrigation wells that irrigated only a few hundred acres. The number of irrigation wells increased to about 2,000 in 1959 and irrigated nearly 150,000 acres. Irrigation water often more than doubles yields. Since the extensive irrigation that started after the second World War, however, the water table has dropped more than 40 feet in many places. This underground storage of water has little or no recharge. Care must be used to conserve the remaining water until other sources of water or an effective system of recharge is found.

Wildlife

Bailey County supports several types of wild animals, including rabbits, skunks, ground squirrels, coyotes, badgers, and prairie dogs. Birds of the upland include

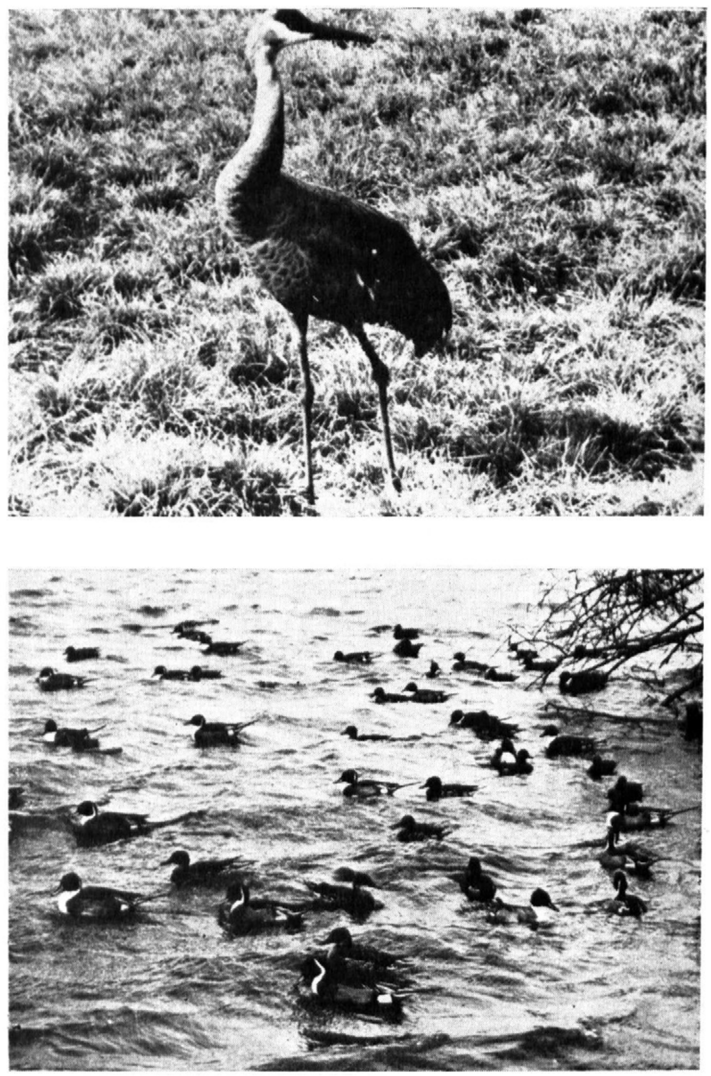

Figure 19.—Top: **Lesser sandhill crane.** ***Bottom:*** **Pintail ducks wintering on the game refuge of the U.S. Department of the Interior. (Courtesy of Frank Dufresne, U.S. Department of the Interior, Fish and Wildlife Service.)**

blue and bobwhite quail, prairie chickens, mourning doves, ring-necked pheasants, English sparrows, meadowlarks, robins, blackbirds, hawks, and many others. Migratory waterfowl include ducks, coots, gulls, killdeer, curlew, plover, and the largest single concentration of lesser sandhill crane in the United States (fig. 19). Rattlesnakes are the only poisonous snakes in the area.

The U.S. Department of the Interior maintains a game refuge in the south-central part of the county. This refuge is about 5,000 acres in size, and about 700,000 migratory waterfowl winter there. Picnic grounds, three lakes, and various forms of wildlife attract many tourists.

Representatives of the Blackwater Valley Soil Conservation District, the county agricultural extension agent, or personnel of the United States Department of the Interior will assist in developing habitats for wildlife.

Glossary

Aggregate (of soil). Many fine soil particles held in a single mass or cluster, such as a clod, crumb, block, or prism. Many properties of the aggregate differ from those of an equal mass of unaggregated soil.

Alkaline soil. Generally, a soil that is alkaline throughout most or all of the parts of it occupied by plant roots; although the term is commonly applied to only a specific layer or horizon of a soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

Base saturation. The relative degree to which soils have metallic cations adsorbed. The proportion of the cation-exchange capacity that is saturated with metallic cations. These cations are mainly calcium, potassium, magnesium, and sodium.

Calcareous soil. Soil that contains enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid. Soil that is alkaline in reaction because of the presence of free calcium carbonate. The pH is usually more than 7.8.

Caliche. A broad term for secondary calcareous material in layers near the surface. As the term is used, caliche may be soft and clearly recognized as the C_{ca} horizon of the soil, or it may exist in hard, thick beds beneath the solum or exposed at the surface.

Clay. (1) As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. (2) As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A coating or film of clay that has been deposited on the surface of a soil aggregate.

Complex, soil. An intricate mixture of areas of different kinds of soil that are too small to be shown separately on a publishable soil map. The whole group of soils must be shown together as a mapping unit and described as a pattern of soils.

Concretions. Hard grains, pellets, or nodules resulting from concentrations of compounds in the soil that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Concretions can be of various sizes, shapes, and colors.

Consistence, soil. The attributes of soil material that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture. Terms commonly used to describe consistence are *loose, soft,* or *hard* when dry; *loose, friable,* or *firm* when moist; and *sticky* or *plastic* when wet. *Friable* soil, for example, is easily crumbled by the fingers.

Dispersion, soil. The breaking down of soil aggregates to single grains. Ease of dispersion is an important factor influencing the erodibility of soils. Generally speaking, the more easily dispersed the soil, the more erodible it is.

Eolian deposits. Wind-deposited materials moved fairly short distances.

Indurated. Very strongly cemented. In Bailey County indurated refers to rocklike caliche.

Invaders. Invaders are weeds or less desirable grasses that become established after the climax vegetation has been reduced by grazing.

Lacustrine deposits. Materials deposited in the waters of lakes and exposed by lowering of the water level or by the elevation of the land. In Bailey County most of this material was deposited during Pleistocene times.

Liquid limit. The moisture content at which a soil passes from a plastic to a liquid state.

Lithosol. A soil having little or no evidence of soil development and consisting mainly of a partly weathered mass of rock fragments or of nearly barren rock.

Loam. Soil having approximately equal amounts of sand, silt, and clay. Loam contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Marine sediment. Material reworked by the sea and later exposed.

Miscellaneous land types. Rough, stony, and severely gullied land or fresh stream deposits of variable texture. They have little true soil and are not classified by soil types and series but are identified by descriptive names. An example is Active dunes.

Mohs' scale. A scale of hardness introduced by F. Mohs and expressed in terms as follows: (1) talc; (2) gypsum; (3) calcite; (4) fluorite; (5) apatite; (6) orthoclase; (7) quartz; (8) topaz; (9) sapphire; and (10) diamond.

Parent material. The unconsolidated mass of rock material (or peat) from which the soil profile develops.

Permeability. The readiness with which air, water, or plant roots penetrate into or pass through soil pores. The portion of the soil being discussed should be designated; for example, "the permeability of the A horizon."

pH. A term used to indicate the acidity and alkalinity of soils. A pH of 7.0 indicates precise neutrality; large numbers (up to 14.0), alkalinity; and smaller ones (down to 0.0), acidity.

Phase, soil. That subdivision of a soil type having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. The variations are chiefly in such external characteristics as relief, stoniness, or erosion. Thus Amarillo loam, 0 to 1 percent slopes, is a soil phase.

Plasticity index. The numerical difference between liquid limit and plastic limit. The range in moisture content within which a soil is in a plastic state.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Playas. Flat, generally dry, undrained basins that contain water for periods following rains.

Saline soil. A nonalkali soil containing soluble salts sufficient to impair its productivity.

Sand. Individual rock or mineral fragments having diameters ranging from 0.05 millimeter to 2.0 millimeters. Sand grains consist chiefly of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more of sand and not more than 10 percent of clay.

Series, soil. A group of soils that, except for the texture of the surface soil, have horizons similar as to differentiating characteristics and arrangement in the soil profile, and that developed from a particular type of parent material. A series may include two or more soil types that differ from one another in the texture of the surface soil.

Silt. (1) Individual mineral particles of soil that range in diameter between the upper size of clay, 0.002 millimeter, and the lower size of very fine sand, 0.05 millimeter. (2) Soil of the textural class silt contains 80 percent or more of silt and less than 12 percent of clay.

Solum. The upper part of the soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soils includes the A and B horizons.

Structure. The aggregation of primary soil particles into compound particles, or clusters of primary particles, which are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal types of soil structure are defined as follows:

Blocky.—Aggregates are shaped like blocks; they may have flat or rounded surfaces that join at sharp angles.

Blocky, subangular.—Aggregates have some rounded and some flat surfaces; upper sides are rounded.

Granular.—Roughly spherical, firm, small aggregates that may be either hard or soft but are generally more firm and less porous than crumb and without the distinct faces of blocky structure.

Prismatic.—Aggregates have flat, vertical surfaces, and their height is greater than their width.

Subsoil. The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness.

Tailwater. The water just downstream from a structure.

Texture, soil. The relative proportions of the various size groups of individual soil grains in a mass of soil. Specifically, it refers to the proportions of sand, silt, and clay.

Type, soil. A group of soils, within a given soil series, that have the same texture in the surface soil; have the same arrangement of horizons; and have the same parent material. A soil type may be subdivided into several soil phases. Thus Amarillo loam is a soil type within the Amarillo series.

Volumetric change. The volume change for a given moisture content, expressed as a percentage of the dry volume of the soil mass, when the moisture content is reduced from the stipulated percentage to the shrinkage limit.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 6, for approximate acreage and proportionate extent of the soils; table 3, p. 38, for estimated average yields for cultivated soils under two levels of management; and table 4, p. 40, for range sites]

			Capability unit				*Range site*
Map symbol	*Mapping unit*	*Page*	*Dryland or range*	*Page*	*Irrigated*	*Page*	*Name*
Ad	Active dunes	7	VIIIe-1	37	(1)		(2)
AfA	Amarillo fine sandy loam, 0 to 1 percent slopes	8	IIIe-2	33	IIe-2	33	Mixed Land.
AfB	Amarillo fine sandy loam, 1 to 3 percent slopes	8	IIIe-1	34	IIIe-1	34	Mixed Land.
AfC	Amarillo fine sandy loam, 3 to 5 percent slopes	8	IVe-3	35	IVe-3	35	Mixed Land.
AlA	Amarillo loam, 0 to 1 percent slopes	9	IIIce-1	33	IIe-1	33	Deep Hardland.
AlB	Amarillo loam, 1 to 2 percent slopes	10	IIIe-3	34	IIIe-3	34	Deep Hardland.
AmB	Amarillo loamy fine sand, 0 to 3 percent slopes	9	IVe-1	34	IIIe-4	34	Sandy Land.
An	Arch fine sandy loam	10	IVes-1	35	IIIes-1	35	High Lime.
Ao	Arch loam	10	IVes-1	35	IIIes-1	35	High Lime.
AvA	Arvana fine sandy loam, 0 to 1 percent slopes	11	IIIe-1	34	IIIe-1	34	Mixed Land.
AvB	Arvana fine sandy loam, 1 to 3 percent slopes	11	IIIe-1	34	IIIe-1	34	Mixed Land
AxA	Arvana fine sandy loam, shallow, 0 to 1 percent slopes	11	IVe-7	36	IVe-7	36	Mixed Land.
AxB	Arvana fine sandy loam, shallow, 1 to 3 percent slopes	11	IVe-7	36	IVe-7	36	Mixed Land.
AyA	Arvana-Amarillo loams, 0 to 1 percent slopes	12	IIIce-1	33	IIe-1	33	Deep Hardland.
AyB	Arvana-Amarillo loams, 1 to 2 percent slopes	12	IIIe-3	34	IIIe-3	34	Deep Hardland.
BeC	Berthoud fine sandy loam, 3 to 5 percent slopes	13	IVe-3	35	IVe-3	35	Mixed Land.
BhB	Berthoud loam, 1 to 3 percent slopes	12	IIIe-3	34	IIIe-3	34	Deep Hardland.
BhD	Berthoud loam, 3 to 8 percent slopes	12	VIe-7	37	(1)		Deep Hardland.
BmD	Berthoud-Mansker fine sandy loams, 5 to 8 percent slopes	13	VIe-3	36	(1)		Mixed Land.
Br	Brownfield fine sand, thick surface	13	VIe-1	36	IVe-5	36	Sandy Land.
Bs3	Brownfield soils, severely eroded	13	VIe-6	37	(1)		Sandy Land.
Ch	Church clay loam	14	IVes-1	35	IIIes-1	35	High Lime.
DrB	Drake soils, 1 to 3 percent slopes	15	IVes-1	35	IIIes-1	35	High Lime.
DrC	Drake soils, 3 to 5 percent slopes	15	VIe-4	37	IVe-4	36	High Lime.
DrE	Drake soils, 5 to 20 percent slopes	15	VIe-4	37	(1)		High Lime.
Ga	Gomez-Arch complex	15	VIe-1	36	IVe-5	36	Sandy Land.
Ga3	Gomez-Arch complex, severely eroded	15	VIe-6	37	(1)		Sandy Land.
Km	Kimbrough soils	16	VIIs-1	37	(1)		Shallow Land.
La	Likes-Arch complex, hummocky	16	VIe-2	36	IVe-6	36	Mixed Land.
Ld	Loamy alluvial land	17	IIIce-1	33	IIe-1	33	Mixed Land.
Lk	Lubbock loamy fine sand	18	IVe-1	34	IIIe-4	34	Sandy Land.
Lu	Lubbock fine sandy loam	17	IIIe-2	33	IIe-2	33	Mixed Land.
MfA	Mansker fine sandy loam, 0 to 1 percent slopes	18	IVe-2	35	IIIe-5	35	Mixed Land.
MfB	Mansker fine sandy loam, 1 to 3 percent slopes	19	IVe-7	36	IVe-7	36	Mixed Land.
MfC	Mansker fine sandy loam, 3 to 5 percent slopes	19	VIe-3	36	(1)		Mixed Land.
MkA	Mansker loam, 0 to 1 percent slopes	19	IVe-2	35	IIIe-5	35	Shallow Land.
MkB	Mansker loam, 1 to 3 percent slopes	19	IVe-7	36	IVe-7	36	Shallow Land.
OtA	Olton loam, 0 to 1 percent slopes	20	IIIce-1	33	IIe-1	33	Deep Hardland.
PfA	Portales fine sandy loam, 0 to 1 percent slopes	21	IIIe-2	33	IIe-2	33	Mixed Land.
PfB	Portales fine sandy loam, 1 to 3 percent slopes	21	IIIe-1	34	IIIe-1	34	Mixed Land.
PmA	Portales loam, 0 to 1 percent slopes	20	IIIce-1	33	IIe-1	33	Deep Hardland.
PmB	Portales loam, 1 to 3 percent slopes	20	IIIe-3	34	IIIe-3	34	Deep Hardland.
Ps	Potter soils	21	VIIs-1	37	(1)		Shallow Land.
Ra	Randall clay	22	VIw-1	37	VIw-1	37	(2)
Rf	Randall fine sandy loam	22	IVw-1	36	IVw-1	36	(2)
Sf	Springer loamy fine sand, undulating	23	VIe-1	36	IVe-5	36	Sandy Land.
Sh	Springer loamy fine sand, hummocky	23	VIe-5	37	(1)		Sandy Land.
StA	Stegall loam, 0 to 1 percent slopes	23	IIIce-1	33	IIe-1	33	Deep Hardland.
StB	Stegall loam, 1 to 2 percent slopes	23	IIIe-3	34	IIIe-3	34	Deep Hardland.
SwA	Stegall loam, shallow, 0 to 1 percent slopes	24	IVe-7	36	IVe-7	36	Shallow Land.
Tv	Tivoli fine sand	24	VIIe-1	37	(1)		Sandy Land.
ZfA	Zita fine sandy loam, 0 to 1 percent slopes	25	IIIe-2	33	IIe-2	33	Mixed Land.
ZfB	Zita fine sandy loam, 1 to 3 percent slopes	25	IIIe-1	34	IIIe-1	34	Mixed Land.
ZmA	Zita loam, 0 to 1 percent slopes	25	IIIce-1	33	IIe-1	33	Deep Hardland.
ZnB	Zita loamy fine sand, 0 to 3 percent slopes	26	IVe-1	34	IIIe-4	34	Sandy Land.

[1] Not suitable for irrigation. [2] Not assigned a range site.

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If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).