Issued March 1971

SOIL SURVEY

Arapahoe County, Colorado

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
COLORADO AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1958–63. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the West Arapahoe, Agate, Kiowa, and Deer Trail Soil Conservation Districts. Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

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

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

Community planners and others can read about soil properties that affect the choice of sites for homes, small industrial buildings, and other nonfarm uses in the section "Nonfarm Uses of Soils."

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

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

Community planners and others concerned with recreational development can find in the section "Use of Soils for Recreation" information about limitations of the soils as sites for recreational and vacation facilities.

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

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

Newcomers in Arapahoe County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the sections "Climate of Arapahoe County" and "Additional Facts About the County."

Cover picture: **Contour stripcropping on Fondis silt loam, 3 to 5 percent slopes.**

U S GOVERNMENT PRINTING OFFICE 1971

For sale by the Superintendent of Documents, U S. Government Printing Office
Washington, D C. 20402

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SOIL SURVEY OF ARAPAHOE COUNTY, COLORADO

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

ARAPAHOE COUNTY is in the northeastern part of Colorado (fig. 1). It has a land area of 520,960 acres, or 814 square miles. The county is about 72 miles long and about 12 miles wide.

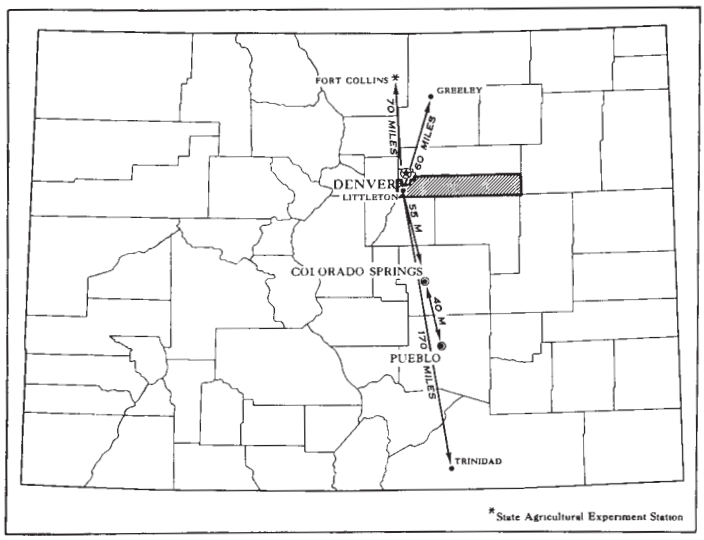

Figure 1.—**Location of Arapahoe County in Colorado.**

This county has a warm, semiarid climate, which is cooler and slightly more moist in the western part than in other parts. The altitude ranges from 6,200 feet above sea level in the extreme southwestern part of the county to 4,750 feet at the northeastern edge. Average altitude is about a mile.

The county is drained by the South Platte River and its tributaries. The South Platte River flows northward across the extreme western edge of the county. Some of its tributaries originate in or east of the Black Forest, flow northward across the county, and join the river outside the county. The South Platte River and Cherry Creek are the only streams in the county that flow continuously. The other streams seldom flow for more than two weeks, generally in March or April and during heavy storms in summer. Flash floods are common in summer.

The western one-fourth of this county is part of the expanding metropolitan area of Denver, and the eastern three-fourths is used mostly for farming. Almost half of this acreage is used for cultivated crops, mainly winter wheat. Most of the remaining acreage is in native grass that is grazed by cattle and sheep.

The irrigated acreage in the county decreased from about 23,000 acres in 1940 to about 2,200 acres in 1961, and it continues to decrease. This decrease is due to community development near the western edge of the county and to use of water from the South Platte River for domestic purposes. The generally small areas that are now irrigated are used to grow supplemental winter feed for livestock. Water for irrigation is not available in sufficient quantities to irrigate other areas.

How This Survey Was Made

This survey was made to learn what kinds of soils are in Arapahoe County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

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

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. Bresser and Fondis, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Bresser loamy sand, terrace, 0 to 3 percent slopes, is one of several phases within the Bresser series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Arapahoe County: the soil complex and the undifferentiated soil group.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Bresser-Stapleton sandy loams, 3 to 9 percent slopes, is an example.

An undifferentiated soil group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated soil group consists of the names of the dominant soils, joined by "and." Bresser and Truckton soils, 3 to 9 percent slopes, eroded, is an example.

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

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

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

General Soil Map

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

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

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

1. Alluvial Land-Nunn Association

Deep, nearly level, mainly loamy and sandy soils; on flood plains and terraces

This soil association consists of deep, nearly level, mainly loamy and sandy soils along major streams. About half the acreage is subject to flooding.

This association occupies about 13 percent of the county. About 26 percent is made up of Loamy alluvial land, 23 percent of Sandy alluvial land, 18 percent of Nunn soils, and the remaining 33 percent of minor soils.

Loamy alluvial land is nearly level and subject to occasional flooding. It consists of deep, dark-colored, stratified loam and sandy loam that recently have been deposited. In some places the range in texture is wide within short distances. Sandy alluvial land occurs next to the major stream channels and is frequently flooded. It consists of nearly level, deep, light-colored sand.

Nunn soils occur on terraces and are not subject to flooding. These soils are deep and have a loamy surface layer and a clay loam or clay subsoil. They are cultivated in most places.

Minor soils in this association are in the Bresser, Bijou, Beckton, Fort Collins, and Heldt series. The Bresser, Bijou, and Fort Collins soils occur on terraces and are

not subject to flooding. Beckton and Heldt soils also occur on terraces and normally contain excessive salts. They are not subject to frequent flooding.

About half of this association is cultivated to small grains, mainly wheat. Crops grow better on the Nunn, Fort Collins, Bresser, and Bijou soils than on the other soils in this association. Only those soils are irrigated, because water for irrigation is available only along streams. The Beckton and Heldt soils are in native grass. They are not suited to dryland cultivation, because they contain excessive salts. Loamy alluvial land is well suited to crops, but protection from or control of flooding is needed to control water erosion and gullying. Sandy alluvial land is mostly in cottonwood trees and grasses. The hazards of soil blowing and water erosion are so severe on this land that cultivation is prevented, but the trees growing on it protect livestock in winter.

2. Litle-Samsil Association

Rolling soils that are clayey except in the upper few inches; moderately deep to shallow over shale; on uplands

This association is in the southeastern part of the county. It consists of moderately deep to shallow soils that formed in material weathered from saline Pierre shale. In most places these soils are rolling and have slopes ranging from 3 to 9 percent, but moderately steep soils occur next to drainageways and are moderately to severely eroded.

This association occupies about 5 percent of the county. About 63 percent is made up of Litle soils, 25 percent of Samsil soils, and the remaining 12 percent of minor soils.

The Litle soils have a silty clay loam surface layer about 6 inches thick. The subsoil, about 18 inches thick, is pale-brown silty clay to clay that, in the lower part, contains visible salts, mostly gypsum.

The Samsil soils have a clay loam surface layer about 5 inches thick. Much visible gypsum occurs between this layer and the underlying shale. Depth to shale normally is less than 18 inches.

Both Litle and Samsil soils take in water slowly. The Litle soils have moderate to high available water holding capacity. Because they are shallow and saline, the Samsil soils have only moderate or low available water holding capacity. Both soils are alkaline and are suited to alkali sacaton and other plants tolerant of alkali.

Also in this association are closely intermingled Adena and Colby soils and, in small drainageways, areas of frequently flooded, clayey alluvium. The Colby soils occupy the crests of ridges, and the Adena soils occur just below them on east-facing slopes. In almost all places the Adena soils occur on slopes facing east or southeast.

This association is in native grass that is used to pasture sheep and cattle. Roads are few and gravel is scarce.

3. Weld-Adena-Colby Association

Deep, nearly level to sloping, loamy soils that have a clayey to loamy subsoil; formed in silty, wind-deposited material; on high-lying divides between creeks

This association occupies high areas between creeks throughout the eastern half of the county. The landscape is one of tables and flats, areas bordering drainageways, and ridgetops.

This association occupies about 18 percent of the county. About 43 percent is made up of Weld soils, 28 percent of Adena soils, 15 percent of Colby soils, and the remaining 14 percent of minor soils.

The Weld soils are nearly level and occupy the tables and flats. They have a silt loam surface layer about 5 inches thick. Their subsoil of brownish clay loam, silty clay, and clay typically contains lime at a depth of about 14 inches.

The Adena soils border the drainageways and in most places have slopes of 3 to 5 percent. They have a grayish-brown silt loam surface layer about 2 inches thick. Their subsoil is brownish silty clay loam and silt loam in which lime has accumulated in the lower part.

Colby soils occur on ridgetops and in other high areas. They have a surface layer of light brownish-gray, limy silt loam about 5 inches thick. The next layer contains much lime and slightly more clay than the surface layer.

The Weld, Adena, and Colby soils have moderate intake of water and high available water holding capacity. They are, however, highly susceptible to water erosion and to soil blowing.

Also in this association are the Deertrail, Renohill, Buick, and Thedalund soils of the uplands and Loamy alluvial land along drainageways. The Deertrail soils generally are in areas less than 1 acre in size and are closely intermingled with Weld soils. The Renohill and Buick soils are gently sloping to moderately steep. Thedalund soils are next to drainageways and small rough areas.

The Weld soils are among the soils most suitable for cultivation in the county. The Adena and Colby soils are suited to cultivated crops, though not so well suited as the Weld. All of these soils need protection against soil blowing and water erosion. The Weld soils are especially susceptible to soil blowing.

4. Thedalund-Baca Association

Mainly gently sloping to rolling soils that are loamy throughout; moderately deep and deep over interbedded shale and sandstone; on uplands

This association is on uplands in the eastern part of the county. It consists of soils that have a layer of loess deposited over interbedded shale and sandstone. In most places these soils have slopes ranging from 3 to 9 percent, but steep soils occur next to drainageways. A few deep gullies have vertical banks more than 15 feet high.

This association occupies about 4 percent of the county. About 60 percent is made up of Thedalund soils, 30 percent of Baca soils, and the remaining 10 percent of minor soils.

The Thedalund soils are light olive-brown clay loam to a depth of about 9 inches. Below this is light yellowish-brown silty clay loam underlain, at a depth of about 30 inches, by consolidated shale that contains crystals and seams of gypsum and strata of sandstone and siltstone.

The Baca soils have a grayish-brown loamy surface layer about 3 inches thick and a grayish-brown and light olive-brown clay loam subsoil. Interbedded, soft sandstone and shale generally occur at a depth ranging from 3 to 5 feet.

The Thedalund and Baca soils generally are alkaline and contain moderate amounts of free lime. Thedalund soils have a moderate to rapid rate of water intake and

low available water holding capacity. Baca soils have a moderate rate of water intake and high available water holding capacity.

Also in this association are areas of Rock outcrop, Colby soils, and Loamy alluvial land. Outcrops of sandstone, less than 50 feet in diameter, are common. The Colby soils generally occur as bands, about 100 feet wide, on the ridgetops. Loamy alluvial land is along the drainageways in areas less than 100 feet wide.

Most of this association is used to pasture sheep and cattle, but limited water is available for livestock and domestic use. The main native plants are blue grama, side-oats grama, western wheatgrass, and pricklypear cactus. More grass grows on Loamy alluvial land than on the other soils in this association. Because of steepness, shallowness, and the severe hazard of erosion, less than 10 percent of this soil association is used for cultivated crops. Wheat, the main cultivated crop, grows fairly well.

5. Terry-Olney-Thedalund Association

Sloping soils that are loamy throughout; moderately deep and deep over sandstone and shale; on uplands

This association is on uplands in the eastern part of the county. It consists of soils that formed in loamy, wind-deposited material mixed with material weathered from sandstone and from interbedded sandstone and shale. In most places slopes range from 5 to 9 percent, but areas next to drainageways are steep (fig. 2).

This association occupies about 7 percent of the county. About 45 percent is made up of Terry soils, 33 percent of Olney soils, 12 percent of Thedalund soils, and the remaining 10 percent of minor soils.

The Terry soils have a grayish-brown fine sandy loam surface layer about 8 inches thick. Their subsoil is light yellowish-brown fine sandy loam. Soft sandstone occurs at a depth of about 26 inches. Typically, accumulated lime occurs at a depth of about 20 inches.

The Olney soils have a grayish-brown fine sandy loam surface layer about 6 inches thick. Their subsoil is brown and pale-brown fine sandy loam about 12 inches thick. Lime typically is at a depth of about 18 inches. Underlying the subsoil is a mixture of material deposited by the wind and material weathered from fine-grained sandstone.

The Thedalund soils have a light olive-brown clay loam surface layer that is about 9 inches thick and is noncalcareous in the uppermost 5 inches. Below this is light yellowish-brown silty clay loam underlain, at a depth of about 30 inches, by consolidated shale that contains crystals and seams of gypsum and strata of sandstone and siltstone.

Figure 2.—Typical landscape in the Terry-Olney Thedalund soil association.

The Terry, Olney, and Thedalund soils take in water at a moderate to rapid rate, and they have low to high available water holding capacity.

Also in this association are areas where sandstone crops out in narrow ledges and a few small areas of Colby and Baca soils. The Colby soils are on ridgetops in bands about 100 feet wide. The Baca soils are just below the Colby soils on east-facing slopes. Thick, sandy, and loamy alluvium occurs on the bottom of draws.

Almost all of this association is in native grass that is grazed by cattle and sheep. Water for livestock and domestic use generally is available from wells, about 200 feet deep, that yield 10 gallons or more per minute. In most areas the soils are not suitable for cultivation, because they are too steep, shallow, and susceptible to erosion.

6. Renohill-Buick-Litle Association

Sloping to steep, loamy soils that have a loamy to clayey subsoil; moderately deep and deep over shale or sandstone; on uplands

This association is on uplands, mainly in the western half of the county (fig. 3). In most places slopes range from 5 to 25 percent. Most of the association is in the Lowry Air Force Base Bombing Range.

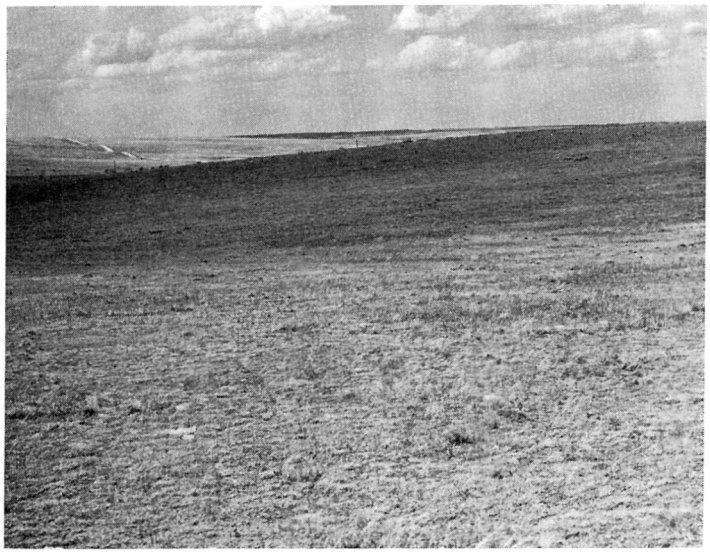

***Figure 3.*—Typical landscape in the Renohill-Buick-Litle association.**

This association occupies about 15 percent of the county. About 50 percent is made up of Renohill soils, 23 percent of Buick soils, 13 percent of Litle soils, and the remaining 14 percent of minor soils.

The Renohill soils have a grayish-brown loam surface layer about 5 inches thick and a brown and light olive-brown clay loam subsoil. Depth to shale is about 26 inches. Lime generally occurs between the subsoil and shale, but in some places these soils are limy throughout.

The Buick soils have a brown loam surface layer about 3 inches thick. The next layer also consists of 3 inches of brown loam. The subsoil, to a depth of about 22 inches, is brown and light yellowish-brown clay loam, and below that depth is very pale brown sandy clay loam. Lime occurs at a depth of about 12 inches.

The Litle soils have a light brownish-gray silty clay loam, generally limy, surface layer about 3 inches thick. Their subsoil, about 13 inches thick, is limy, pale-brown clay or silty clay in the upper part and is clay in the lower part. Beds of partly consolidated, clayey shale occur at a depth of about 39 inches.

The major soils in this association are slowly to moderately permeable. Runoff generally is moderate to rapid. Erosion normally is slight to moderate, but it is severe in some cultivated areas.

Minor parts of this association are the Thedalund, Samsil, and Fondis soils on uplands and Loamy alluvial land along streams.

Most of this association is used to pasture cattle or as wildlife habitat. The native grasses are western wheatgrass, blue grama, plains bluegrass, and pricklypear cactus. Where the soils are cultivated, wheat is the principal crop. Stubble mulching, terracing, contour stripcropping, and other intensive conservation practices are needed to help control erosion, conserve moisture, and maintain or increase the growth of crops. Many homes are in this association in the western part of the county. Gravel roads are about 2 to 3 miles apart through most of the association. One improved road crosses the middle of the Lowry Bombing Range from west to east.

7. Nunn-Bresser-Ascalon Association

Deep, nearly level and undulating, loamy soils that have a clayey to loamy subsoil; developed in outwash; on uplands and terraces

This association is on uplands in the western and central parts of the county. Most areas are undulating and have slopes ranging from 0 to 4 percent. The soils are deep and have a clayey to loamy subsoil.

This association occupies about 13 percent of the county. About 60 percent is made up of Nunn soils, 15 percent of Bresser soils, 15 percent of Ascalon soils, and the remaining 10 percent of minor soils.

The Nunn soils occur in the more nearly level areas of this association. They have a grayish-brown loam surface layer about 3 inches thick. Their subsoil is brownish clay loam, light clay, and sandy clay loam about 19 inches thick. Lime occurs at a depth of about 22 inches.

The Bresser soils occur on knobs and in rolling areas. Their surface layer is dark grayish-brown sandy loam about 5 inches thick. The subsoil extends to a depth of about 28 inches. It is hard or very hard when dry. It is dark-brown sandy loam in the upper part, brown sandy clay loam in the middle part, and light-brown sandy loam in the lower part.

The Ascalon soils are similar to the Bresser soils but have a slightly grayer subsoil and lime at a depth of about 17 inches.

The major soils in this association take in water readily and have moderate to high available water holding capacity.

Also in this association are Truckton soils on the crests of knobs and low-lying areas called wet weather lakes. The low areas are near the Nunn soils and generally are less than 5 acres in size. They are ponded after heavy rains, for there is a dense clayey layer below the surface.

Most of this association is used for cultivated crops. All crops commonly grown in the county grow well, but wheat is the principal crop. In many places soil blowing is severe on the crest of knobs, but it, and water erosion as well, is reduced if crop residue is left on the surface.

8. Truckton-Bresser Association

Deep, rolling, loamy and sandy soils that have a loamy subsoil; on uplands

This association is on uplands. It occupies small areas on the eastern side of major drainageways throughout the western and central parts of the county. It consists of deep soils that formed in nonlimy, sandy material deposited by wind. The topography is rolling; most slopes are between 3 and 8 percent, but some are as much as 15 percent.

This association occupies about 14 percent of the county. About 50 percent is made up of Truckton soils, 27 percent of Bresser soils, and the remaining 23 percent of minor soils.

Truckton soils have a dark grayish-brown loamy sand surface layer about 6 inches thick. Their subsoil is brownish sandy loam that extends to a depth of 30 inches. It is hard or very hard when dry. These soils do not contain a limy layer but have streaks of lime in the underlying material.

The Bresser soils occur on the lower parts of slopes. They have a dark grayish-brown sandy loam surface layer about 5 inches thick. Their subsoil is dark-brown and light-brown sandy loam in the upper and lower parts and is brown sandy clay loam in the middle part. Like Truckton soils, Bresser soils do not contain a limy layer, but they have streaks of lime in the underlying material.

Except in bare areas, water is taken into the Truckton soils rapidly, but water is taken into the Bresser soils at a moderate to rapid rate. Both kinds of soils have moderate available water holding capacity.

Also in the association are the Blakeland, Ascalon, and Nunn soils and low, wet areas called wet weather lakes. The low wet areas generally are not more than 2 acres in size. Blakeland soils normally occur in small areas on ridgetops near Truckton soils. The Nunn soils are in small areas next to the wet weather lakes. Sandstone and shale crop out in small areas at the base of steep slopes next to the major drainageways.

About one-fourth of this association is used for cultivated crops, and the rest is in grass and is used for grazing. Among the native grasses are blue grama, needle-and-thread, sandreed, and little bluestem. Cultivated crops grow fairly well on the soils of this association, but soil blowing is severe in cultivated areas on the crest of knobs and rolling areas. Stubble mulching and stripcropping are among the practices needed for controlling soil blowing and conserving moisture.

9. Stapleton-Bresser Association

Moderately steep soils that are loamy throughout; moderately deep and deep over arkosic sandstone; on foothills

This association is on foothills at the highest elevations in the county. Slopes generally range from 8 to 25 percent. The association consists of moderately deep and deep, loamy soils on poorly consolidated beds of sand and silt mixed with windblown sandy deposits.

This association occupies about 3 percent of the county. About 42 percent is made up of Stapleton soils, 30 percent of Bresser soils, and the remaining 28 percent of minor soils.

The Stapleton soils are moderately deep. Their surface layer, about 8 inches thick, is grayish-brown sandy loam that contains a noticeable amount of mica and fine gravel. Below this layer is light brownish-gray and pale-yellow sandy loam that contains much fine gravel. Poorly consolidated beds of fine gravel and siltstone occur at a depth of about 16 inches.

The Bresser soils are deep. They have a dark grayish-brown sandy loam surface layer about 5 inches thick. The subsoil, about 23 inches thick, is dark-brown, brown, and light-brown sandy loam and sandy clay loam that is hard or very hard when dry. Interbedded shale and fine gravel or wind-deposited sand occurs below a depth of 3 feet.

Both Stapleton and Bresser soils have a moderate to rapid rate of water intake. Available water holding capacity is low in the Stapleton soils and moderate in the Bresser soils. Both kinds of soils generally are free of lime. They are susceptible to soil blowing and water erosion.

Also in this association are the Buick, Litle, and Renohill soils and, in draws, areas of frequently flooded loamy and sandy alluvium. Cobblestones, as much as 12 inches in diameter, occur on the surface of the Litle soils, and many gullies have formed in the areas consisting of loamy and sandy alluvium.

Most of this association is in native grass and western yellow pine. Cattle grazing is the main use. The pine trees have little or no commercial value, but they provide shade for livestock and areas where the trees grow can be developed for recreational uses. Because of the slope, water erosion generally is a severe hazard in cultivated areas.

10. Fondis-Weld Association

Deep, nearly level and gently sloping, loamy soils that have a clayey layer in the subsoil; formed mainly in silty, wind-deposited material; on foothills

This association is on uplands in the western part of the county. It consists of deep soils that formed mainly in silty material deposited by the wind. Slopes range from 1 to 5 percent in most places, but next to drainageways they are as much as 9 percent.

This association occupies about 8 percent of the county, About 70 percent is made up of Fondis soils, 22 percent of Weld soils, and the remaining 8 percent of minor soils.

The Fondis soils have a surface layer of dark grayish-brown silt loam to silty clay loam about 8 inches thick. The subsoil, to a depth of about 32 inches, is dark-brown clay and pale-brown silty clay loam. Below that depth are

layers of older buried soils. These layers are light yellowish-brown and dark-brown loam, silt loam, and clay loam; they contain much lime.

The Weld soils have a grayish-brown silt loam surface layer about 5 inches thick. Their subsoil, about 21 inches thick, is brown, grayish-brown, and light yellowish-brown clay loam, silty clay, and silty clay loam. These soils are limy at a depth of about 14 inches.

The Fondis and Weld soils take in water at a moderate rate, and they have high available water holding capacity.

The minor soils in this association are in the Heldt and Buick series. The Heldt soils occur on uplands and terraces and are nearly level to gently sloping. The Buick soils occur on uplands and are gently sloping to moderately steep.

Most of this association is cultivated. Crops grow well and also respond well to irrigation. Most of the farms are of the cash-grain type, and wheat is the principal crop. Much of this association is being diverted to residential and industrial use.

Descriptions of the Soils

This section describes the soil series and mapping units in Arapahoe County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series and then the mapping units in the series. Thus, to get full information on any one mapping unit, it is necessary to read the description of the unit and also the description of the soil series to which it belongs. The description of a soil series mentions features that apply to all the soils in

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

Mapping unit	Acres	Percent
Adena-Colby fine sandy loams, 1 to 5 percent slopes	1, 780	0 3
Adena-Colby fine sandy loams, 5 to 9 percent slopes	830	2
Adena-Colby silt loams, 1 to 5 percent slopes	30, 750	5 9
Adena-Colby silt loams, 5 to 9 percent slopes	4, 450	.9
Ascalon sandy loam, 5 to 9 percent slopes	1, 746	3
Baca loam, 3 to 5 percent slopes	920	2
Baca loam, 5 to 9 percent slopes	1, 220	2
Baca-Thedalund loams, 3 to 9 percent slopes	7, 500	1 4
Beckton loam, 0 to 3 percent slopes	5, 160	1 0
Bijou sandy loam, 0 to 3 percent slopes	3, 330	6
Bijou sandy loam, wet, 0 to 3 percent slopes	2, 000	4
Blakeland loamy sand, 1 to 9 percent slopes, eroded	820	2
Blakeland loamy sand, 1 to 20 percent slopes	1, 040	.2
Bresser loamy sand, terrace, 0 to 3 percent slopes	490	1
Bresser sandy loam, terrace, 0 to 3 percent slopes	4, 280	8
Bresser loam, gravelly subsoil variant, 1 to 3 percent slopes	914	2
Bresser-Stapleton sandy loams, 3 to 9 percent slopes	1, 070	2
Bresser-Stapleton sandy loams, 9 to 20 percent slopes	10, 380	2 0
Bresser-Truckton sandy loams, 3 to 5 percent slopes	31, 350	6 0
Bresser-Truckton sandy loams, 5 to 20 percent slopes	18, 004	3 5
Bresser and Truckton soils, 3 to 9 percent slopes, eroded	8, 350	1 6
Buick loam, 3 to 5 percent slopes	7, 020	1 4
Buick loam, 5 to 9 percent slopes	8, 250	1 6
Clayey alluvial land	1, 345	3
Colby silt loam, 1 to 5 percent slopes	2, 430	5
Colby silt loam, 5 to 20 percent slopes	2, 710	5
Colby and Adena soils, 1 to 9 percent slopes, eroded	1, 910	.4
Edgewater loam, 0 to 3 percent slopes	1, 202	2
Fondis silt loam, 1 to 3 percent slopes	21, 393	4 1
Fondis silt loam, 3 to 5 percent slopes	12, 620	2 4
Fondis-Ascalon, gravelly subsoil variant, complex, 1 to 9 percent slopes	760	2
Fondis-Colby silt loams, 3 to 5 percent slopes	9, 450	1 8
Fort Collins loam, 0 to 3 percent slopes	1, 440	3
Gravelly land	2, 640	5
Heldt clay, 0 to 3 percent slopes	3, 290	6
Heldt clay, saline, 0 to 3 percent slopes	680	1
Litle silty clay loam, 1 to 9 percent slopes	9, 400	1 8
Litle-Samsil, gypsum, silty clay loams, 3 to 9 percent slopes	6, 290	1 2
Loamy alluvial land	16, 289	3 1
Nunn loam, 0 to 3 percent slopes	26, 888	5 2
Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes	54, 390	10 4
Olney fine sandy loam, 5 to 9 percent slopes	1, 670	.3
Renohill loam, 3 to 9 percent slopes	2, 210	4
Renohill loam, reddish variant, 5 to 20 percent slopes	240	(1)
Renohill-Buick loams, 3 to 9 percent slopes	31, 500	6 1
Renohill-Buick loams, 9 to 20 percent slopes	8, 925	1 7
Renohill-Buick complex, 5 to 20 percent slopes, eroded	440	1
Renohill-Litle clay loams, 3 to 9 percent slopes	1, 320	3
Renohill-Litle-Thedalund complex, 9 to 30 percent slopes	17, 398	3 3
Rock outcrop	360	.1
Samsil clay, gypsum, 5 to 20 percent slopes	4, 220	8
Samsil-Litle stony clays, 20 to 50 percent slopes	840	2
Samsil-Renohill clay loams, 3 to 20 percent slopes	6, 130	1 2
Samsil-Shale outcrop complex	4, 200	8
Sand pits	330	1
Sandy alluvial land	7, 919	1 5
Shale outcrop	2, 700	5
Stapleton sandy loam, 9 to 30 percent slopes	1, 100	2
Tassel-Rock outcrop complex	1, 560	3
Terrace escarpments	4, 340	8
Terry fine sandy loam, 5 to 20 percent slopes	4, 560	.9
Terry-Olney-Thedalund sandy loams, 5 to 20 percent slopes	21, 530	4 1
Thedalund clay loam, 9 to 20 percent slopes	2, 470	5
Thedalund clay loam, 9 to 20 percent slopes, eroded	2, 620	5
Truckton loamy sand, 1 to 5 percent slopes	3, 360	6
Truckton loamy sand, 5 to 20 percent slopes	9, 360	1 8
Weld fine sandy loam, 1 to 5 percent slopes	760	1
Weld silt loam, 0 to 3 percent slopes	16, 670	3 2
Weld silt loam, 3 to 5 percent slopes	2, 150	4
Weld-Deertrail silt loams, 0 to 3 percent slopes	26, 150	5 0
Wet alluvial land	2, 167	.4
Water and stream channels	4, 980	1 0
Total	520, 960	100 0

[1] Less than 0 1 percent

the series. Differences among the soils of one series are pointed out in the descriptions of the individual soils or are indicated in the soil name. Unless otherwise stated, the descriptions of all mapping units in this section are for dry soils. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. For example, Clayey alluvial land is a miscellaneous land type and does not belong to a soil series, nevertheless, it is listed in alphabetic order along with the series.

An essential part of each soil series is the description of the soil profile, the sequence of layers beginning at the surface and continuing downward to the depth beyond which roots of most plants do not penetrate. Each soil series contains a short description of a typical soil profile and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, the range site, and the tree planting suitability group in which the mapping unit has been placed. The pages on which each of these groups is described can be found by referring to the "Guide to Mapping Units" at the back of this soil survey. Many terms used in the soil descriptions and other sections of this survey are defined in the Glossary at the back of this soil survey and in the "Soil Survey Manual" (*5*).[1]

Adena Series

The Adena series consists of well-drained, deep, undulating to rolling soils that occur mainly in the eastern three-fourths of the county. These soils developed in material deposited by the wind.

In a typical profile the surface layer is grayish-brown silt loam that is free of lime and about 2 inches thick. The subsoil, about 17 inches thick, is brown silty clay loam in the upper part and is pale-brown, limy silt loam or silty clay loam in the lower part. The underlying material is very pale brown and pale-brown, limy silt loam that extends to a depth of 60 inches and is easily penetrated by roots and water.

The Adena soils have moderate to moderately slow permeability, medium internal drainage, and high available water holding capacity. They are moderate to high in natural fertility but are highly susceptible to soil blowing and to water erosion.

These soils are well suited to grasses and to wheat and other nonirrigated crops. Most of the acreage is used for cultivated crops, mainly winter wheat.

Typical profile of an Adena silt loam, 900 feet north and 1,600 feet west of the southeast corner of section 16, T. 4 S., R. 59 W.; native grassland:

A1—0 to 2 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure, soft when dry, very friable when moist; abrupt, smooth boundary.

B2t—2 to 6 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to strong, fine, angular blocky structure; hard when dry, friable when moist; noncalcareous; thin, patchy clay films on ped surfaces; clear, smooth boundary.

B3ca—6 to 19 inches, pale-brown (10YR 6/3) silt loam or silty clay loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure that breaks to moderate, fine, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; thin, patchy clay films on ped surfaces; clear, smooth boundary.

C1ca—19 to 32 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 5 5/3) when moist; weak, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure; very strongly calcareous; few medium concretions and fine seams of lime; clear, smooth boundary.

C2—32 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive (structureless); soft when dry, very friable when moist; very strongly calcareous.

The A horizon is silt loam or fine sandy loam. It ranges from 1 to 4 inches in thickness and from grayish brown to very dark grayish brown in color. The B2t horizon ranges from 2 to 6 inches in thickness and is silty clay loam or clay loam in texture. Depth to lime ranges from 4 to 10 inches.

The Adena soils have thinner layers and lime closer to the surface then the Weld soils. In contrast to Colby soils, which are calcareous throughout and lack a B horizon, the Adena soils are noncalcareous in the upper few inches and have a distinct B horizon.

Adena-Colby fine sandy loams, 1 to 5 percent slopes (AcC).—This complex occurs in large areas along Deer Trail Creek in the eastern part of the county. The soils are undulating.

Adena fine sandy loam makes up about 60 to 80 percent of this complex, and Colby fine sandy loam, 20 to 40 percent. Included with these soils in mapping were small areas of Olney fine sandy loam. Also included were some areas of dark-colored alluvium in drainageways and in small depressions called wet weather lakes.

The Adena soil occurs on side slopes and in more nearly level areas. Its surface layer is grayish brown and about 4 inches thick. In the subsoil, which is clay loam about 17 inches thick, lime is about 10 inches from the soil surface. The underlying material ranges from 2 to many feet in thickness and is limy, loose, and loamy.

The Colby soil is on ridgetops or knolls. Its brown, limy surface layer is about 4 inches thick and is underlain by about 10 inches of limy loam. As in the Adena soil, the underlying material ranges from 2 to many feet in thickness and is limy, loose, and loamy.

Most of this complex is either in native grass or has been reseeded to grass. In addition to grass, the soils are suited to grain sorghum and to wheat, barley, and other small grains. If not protected, these soils are susceptible to severe soil blowing. (Capability unit IVe-6; Loamy Plains range site; tree planting suitability group 1)

Adena-Colby fine sandy loams, 5 to 9 percent slopes (AcD).—These soils occur in small, scattered areas along Deer Trail Creek in the eastern part of the county. Drainageways are well established.

Adena fine sandy loam makes up 50 to 70 percent of this complex, and Colby fine sandy loam, 30 to 50 percent. Included with these soils in mapping were small areas of Olney fine sandy loam and of Terry fine sandy loam. Also included were areas of loamy alluvium in drainageways that generally are less than 100 feet wide.

[1] Italicized numbers in parentheses refer to Literature Cited, p 76

The Adena soil occurs on side slopes. It has a grayish-brown surface layer about 3 inches thick and a clay loam subsoil about 12 inches thick. Depth to lime is about 8 inches. The underlying material ranges from 2 to many feet in thickness and is limy, loose, and loamy.

The Colby soil is on ridgetops and on slopes facing north or west. It has a limy, brown surface layer about 4 inches thick. Below this is a layer of limy silt loam about 6 inches thick. The underlying material ranges from 2 to many feet in thickness and is limy, loose, and loamy.

Most of this complex is in native grass and is used for grazing. Because soil blowing and water erosion are severe hazards, the soils in this complex are not suited to cultivated crops. Good range management is needed to prevent overgrazing and to control erosion. (Capability unit VIe–1; Loamy Plains range site; tree planting suitability group 1)

Adena-Colby silt loams, 1 to 5 percent slopes (AdC).—This complex of undulating soils occurs in the eastern three-fourths of the county, mainly in the northern part. Areas have a few broad drainageways.

Adena silt loam makes up 60 to 80 percent of this complex, and Colby silt loam, 20 to 40 percent. Included with these soils in mapping were small areas of Weld silt loam and of Loamy alluvial land.

The Adena soil occurs on side slopes. It has the profile described as typical for the series. Lime occurs at a depth of 6 to 9 inches.

The Colby soil, called white caps, has a limy surface layer about 4 inches thick that is underlain by about 9 inches of limy silt loam.

Most of the acreage of this complex is cultivated. Wheat and other small grains are suitable crops, but management is needed that controls erosion. Practices that help to control erosion are terracing, stripcropping, stubble mulching, and the use of close-growing crops. (Capability unit IVe–1; Loamy Plains range site; tree planting suitability group 1)

Adena-Colby silt loams, 5 to 9 percent slopes (AdD).—These soils occur in small, scattered areas in the eastern three-fourths of the county, mainly in the northern part.

Adena silt loam makes up 60 to 70 percent of this complex, and Colby silt loam, 30 to 40 percent. Included with these soils in mapping were small areas of Renohill soils that are next to drainageways in some places. Also included were areas of loamy alluvium in drainageways as much as 100 feet wide. Included in the extreme eastern part of the county were small areas of Litle silty clay loam.

The Adena soil occurs on side slopes. It has a grayish-brown silt loam surface layer about 3 inches thick and a silty clay loam subsoil about 14 inches thick. Lime occurs at a depth of about 7 inches.

The Colby soil occurs on ridgetops and on slopes facing north or west. It has a limy surface layer about 4 inches thick. The next layer is limy silt loam about 6 inches thick.

Because soil blowing and water erosion are hazards, the soils in this complex are not suited to cultivated crops. Most areas are in native grass. (Capability unit VIe–1; Loamy Plains range site; tree planting suitability group 1)

Ascalon Series

The Ascalon series consists of deep, undulating to rolling soils that occur on uplands in the western three-fourths of the county. These soils developed in outwash material that has been reworked by the wind.

In a typical profile the surface layer is brown sandy loam that is free of lime and about 6 inches thick. The subsoil, about 11 inches thick, is brown sandy clay loam and is also free of lime. Below the subsoil is a layer of light-gray sandy loam that is about 13 inches thick and contains lime. This layer is underlain by very strongly calcareous, light yellowish-brown loamy sand.

The Ascalon soils have a rapid rate of water intake and generally moderate available water holding capacity. If they are cultivated, however, they tend to crust and become slick. This reduces the water intake rate and increases the hazard of erosion. These soils are easily penetrated by plant roots and are moderate to high in natural fertility. Unprotected areas are susceptible to severe soil blowing.

These soils are suited to grasses and to wheat and other nonirrigated crops. Most of the acreage is used for cultivated crops, mainly winter wheat. A few small areas are irrigated and are used mainly for corn and alfalfa.

Typical profile of Ascalon sandy loam, 600 feet east and 400 feet north of the southwest corner of section 5, T. 5 S., R. 62 W.:

A1—0 to 6 inches, brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist, weak, fine, crumb structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B2t—6 to 17 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) when moist and crushed; moderate, medium, angular blocky structure; hard when dry, firm when moist; thin, patchy clay films, noncalcareous; vertical streaks that are dark brown (10YR 3/3) when moist in about the upper one-third of this horizon; clear, smooth boundary.

C1ca—17 to 30 inches, light-gray (10YR 7/2) sandy loam, light brownish gray (10YR 6/2) when moist; weak, coarse, prismatic structure, very hard when dry, very friable when moist; very strongly calcareous; gradual boundary.

C2—30 to 60 inches +, light yellowish-brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) when moist; massive (structureless) slightly hard when dry, friable when moist; very strongly calcareous

The A horizon ranges from sandy loam to loam in texture and from 3 to 8 inches in thickness The B2t horizon is 8 to 18 inches thick The horizons are thinnest on steep slopes and on ridges that face west or north; they are thickest in swales and in areas near the low-lying areas called wet weather lakes In the more nearly level areas, layers of buried soils commonly occur below a depth of 3 feet Depth to lime is 12 to 30 inches. In some places gravel and cobblestones occur at a depth of 18 to 40 inches

The Ascalon soils have a less clayey subsoil and less distinct horizons than the Nunn soils Unlike the Bresser and Truckton soils, Ascalon soils contain lime in the lower part of the subsoil Ascalon soils have a more clayey subsoil than Truckton soils The C horizon of Ascalon soils is more mixed than that of Bresser soils and is less sandy than that of Truckton soils.

Ascalon sandy loam, 5 to 9 percent slopes (AsD).—This soil occurs on uplands in the western three-fourths of the county. Included with this soil in mapping were a few small areas of Bresser and Truckton sandy loams and of Renohill loam.

Most of this soil is in native grass, but cultivated crops are grown in the more gently sloping areas. Wheat is the main crop. Because of slope, the hazard of erosion is severe. Practices that help to control erosion are terracing, stubble mulching, and the use of close-growing crops. (Capability unit IVe–4; Sandy Plains range site; tree planting suitability group 1)

Baca Series

The Baca series consists of deep, gently sloping to strongly sloping soils that occur in the eastern part of the county.

In a typical profile the surface layer is grayish-brown loam that is free of lime and about 3 inches thick. The subsoil, about 9 inches thick, is grayish-brown and light olive-brown clay loam that contains lime at a depth of 9 inches. The subsoil is underlain by light yellowish-brown and light olive-gray, limy silty clay loam about 34 inches thick. Below this is olive-gray, limy fine sandy loam.

The Baca soils have a moderate rate of water intake and high available water holding capacity. They are moderate to high in natural fertility but are susceptible to soil blowing and to water erosion.

These soils are better suited to native grasses than to cultivated crops. Most of the acreage is used for range, but winter wheat and other nonirrigated crops are grown in some areas.

Typical profile of a Baca loam, 650 feet east and 200 feet north of the southwest corner of section 24, T. 4 S., R. 57 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—3 to 6 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; thin, patchy clay skins; noncalcareous; clear, smooth boundary

B2t—6 to 9 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure that breaks to moderate, fine, subangular blocky structure; slightly hard when dry, firm when moist; thin, continuous clay skins; noncalcareous; clear, smooth boundary.

B3ca—9 to 12 inches, light olive-brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure; slightly hard when dry, firm when moist; thin, patchy clay skins; strongly calcareous; clear, smooth boundary.

C1ca—12 to 25 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; very strongly calcareous; clear, smooth boundary.

C2—25 to 35 inches, light olive-gray (5Y 6/2) silty clay loam, olive gray (5Y 5/2) when moist; massive (structureless); slightly hard when dry, firm when moist; contains concretions of lime and iron; very strongly calcareous; clear, smooth boundary.

C3—35 to 46 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) when moist; massive (structureless); slightly hard when dry, firm when moist; contains concretions of lime and iron; very strongly calcareous; clear, smooth boundary.

C4—46 inches, olive-gray (5Y 5/2) fine sandy loam, olive gray (5Y 4/2) when moist; massive and slightly consolidated fine-grained sandstone; very strongly calcareous.

The A horizon ranges from 2 to 5 inches in thickness and from loam to very fine sandy loam in texture. The B2t horizon is clay loam to clay 3 to 8 inches thick. Hard shale or sandstone generally occurs at a depth of more than 3 feet. Flat fragments of sandstone, 2 to 10 millimeters across, generally are scattered throughout the profile, but in some places they do not occur in the uppermost 12 inches.

The Baca soils are darker colored, have more distinct horizons, and are deeper to sandstone or shale than the associated Thedalund soils. Baca soils are similar to the Weld soils but formed in a mixture of wind-deposited material and material derived from sandstone and shale instead of silty material deposited by the wind.

Baca loam, 3 to 5 percent slopes (BcC).—This soil occurs in scattered areas in the eastern part of the county. The surface layer is friable loam about 5 inches thick, and the subsoil is silty clay loam to clay about 11 inches thick. Lime occurs at a depth of 10 to 12 inches. Sandstone and shale generally are at a depth of 4 to 5 feet.

Included with this soil in mapping were a few small areas in which the subsoil is exposed and the surface layer is limy clay loam. Also included were small areas of Colby silt loam and of Weld silt loam.

This soil is easy to work. Surface runoff is medium, and the available water holding capacity is high. Erosion is a severe hazard following a year of crop failure. Practices that help to control soil blowing and water erosion are stripcropping, stubble mulching, contour farming, and terracing.

Most of this soil is in native grass, but a few areas are used for cultivated crops, mainly wheat. Cultivated crops grow fairly well. (Capability unit IVe–1; Loamy Plains range site; tree planting suitability group 1)

Baca loam, 5 to 9 percent slopes (BcD).—This soil occurs in scattered areas in the eastern part of the county. It has the profile described as typical for the series. Lime occurs at a depth of about 8 or 9 inches. Surface runoff is medium to rapid, and the hazard of erosion is slight to moderate.

Included with this soil in mapping were small areas of Thedalund loam and of Colby silt loam. Also included were a few outcrops of barren, hard sandstone that are less than 50 feet in diameter.

Because tillage encourages erosion and loss of moisture, this soil is not suited to cultivated crops. Most of the acreage is in native range, mainly of blue grama and western wheatgrass. (Capability unit VIe–1; Loamy Plains range site; tree planting suitability group 1)

Baca-Thedalund loams, 3 to 9 percent slopes (BhD).—These soils occur in the eastern part of the county. Baca loam makes up about 50 to 60 percent of this complex, and Thedalund loam, 30 to 40 percent.

Included with these soils in mapping were some areas of Colby silt loam along ridgetops and some areas of Loamy alluvial land in drainageways. Also included were a few barren outcrops of hard sandstone less than 50 feet in diameter and 5 feet high. The Thedalund soils occur next to these outcrops, which are near drainageways.

The Baca soil is moderately deep and loamy throughout. The Thedalund soil is calcareous, moderately deep over interbedded sandstone and shale, and loamy throughout.

Most of this complex is native range and has only a moderate hazard of erosion, though runoff is medium to rapid. Cultivated crops are not suited because of the underlying bedrock and the severe hazard of erosion. (Capability unit VIe-1; Loamy Plains range site; tree planting suitability group 4)

Beckton Series

The Beckton series consists of deep, moderately well drained and somewhat poorly drained, level to gently sloping soils that occur on terraces along most of the major drainageways in the eastern three-fourths of the county. These soils developed in material deposited by water.

In a typical profile the surface layer is grayish-brown and light brownish-gray loam that is free of lime and about 6 inches thick. The subsoil is about 17 inches thick and contains spots of gypsum in the lower 13 inches. It consists of dark grayish-brown clay loam or clay in the upper part, light brownish-gray clay loam in the middle part, and grayish-brown silty clay loam in the lower part. Underlying the subsoil is a layer of calcareous, grayish-brown clay loam that contains spots of gypsum.

The Beckton soils take in water slowly but have high available water holding capacity. In many places the water table is below a depth of 8 feet. These soils are droughty because of the salt content. They are subject to flooding and to water erosion in some places. Slickspots, or barren areas, as much as one-fourth acre in size, are common. These areas are highly susceptible to soil blowing, and in some places the surface soil has blown away.

Most areas of Beckton soils are not suited to cultivated crops and should remain in grass. Where water is available, these soils can be leached of salts and used for cultivated crops under intensive management.

Typical profile of Beckton loam, 0 to 3 percent slopes, 300 feet west of bridge across Deer Trail Creek on the south side of U.S. Highway No. 36, section 4, T. 4 S., R. 59 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; soft when dry, friable when moist; noncalcareous; clear, smooth boundary

A2—3 to 6 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, crumb structure; soft when dry, friable when moist; noncalcareous; abrupt, smooth boundary

B21t—6 to 10 inches, dark grayish-brown (10YR 4/2) heavy clay loam or clay, very dark grayish brown (10YR 3/2) when moist; weak, medium, columnar structure that breaks to moderate, fine, subangular blocky structure; hard when dry, firm when moist; calcareous spots in lower part of horizon; clear, smooth boundary.

B22tca—10 to 14 inches, light brownish-gray (10YR 6/2) heavy clay loam, grayish brown (10YR 5/2) when moist, weak to moderate, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure; hard when dry, firm when moist; calcareous; spots of gypsum, clear, smooth boundary

B3ca—14 to 23 inches, grayish-brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure to massive (structureless); hard when dry, firm when moist; calcareous; spots of gypsum; clear, smooth boundary.

C—23 to 60 inches, grayish-brown (2.5Y 5/2) heavy clay loam, dark grayish brown (25Y 4/2) when moist, massive (structureless); hard when dry, firm when moist; calcareous; spots of gypsum; somewhat stratified

The A horizon ranges from fine sandy loam to clay loam in texture and from 1 to 6 inches in thickness. The B2t horizon ranges from clay loam to clay in texture and from 4 to 12 inches in thickness. In the B2t horizon, bleached grains of sand are visible in the upper 2 inches, and lime is visible only in the lower part, though it may occur throughout this horizon. The C horizon ranges from 10YR to 2.5Y in hue.

The Beckton soils are more strongly developed and are less clayey than the Heldt soils. Unlike the Nunn and Fort Collins soils, the Beckton soils have an A2 horizon. In contrast to Fort Collins soils, Beckton soils are more clayey in the B2t horizon and have a more strongly developed profile.

Beckton loam, 0 to 3 percent slopes (BkB).—This soil occurs on terraces, mainly in the eastern three-fourths of the county. The upper 3 or 4 inches of the surface layer ranges from grayish brown to dark grayish brown in color. The subsoil, about 15 to 17 inches thick, ranges from clay loam to clay, contains salt throughout, and is slightly calcareous, at least in the lower part.

Included with this soil in mapping were small areas of the saline Heldt clay and of Nunn loam. Also included were small areas of loamy alluvial land in drainageways.

This soil is used mainly for pasture. It is not suited to cultivated crops. The native vegetation includes alkali sacaton, western wheatgrass, and blue grama. (Capability unit VIs-2; Salt Flat range site; tree planting suitability group 5)

Bijou Series

The Bijou series consists of deep, level to gently sloping soils along major streams. These soils developed in material that washed from the Dawson formation in the Black Forest. This material contains sand and feldspar. The topography is smooth to slightly undulating; most slopes are less than 2 percent.

In a typical profile the surface layer and the subsoil consist of grayish-brown sandy loam that is free of lime. The surface layer is about 6 inches thick, and the subsoil is about 18 inches thick and contains a few clay films. The underlying material is light yellowish-brown loamy sand in the upper part and pale-brown silt loam stratified with sand in the lower part.

The Bijou soils take in water rapidly. Internal drainage is generally rapid, and available water holding capacity is moderate. In some areas a less permeable layer restricts the downward movement of water and the soil is poorly drained. Bijou soils are moderate in natural fertility, but if cultivated and not protected against erosion, they lose their fertility rapidly. They are highly susceptible to soil blowing. Surface crusting is likely in cultivated areas.

These soils are suited to grasses and to wheat and other nonirrigated crops. About half of the acreage is used for cultivated crops, mainly winter wheat. Some areas along Bijou Creek and Cherry Creek are irrigated, and alfalfa and corn grow well in these areas. Hay, native grasses, or alfalfa is grown in poorly drained areas.

Typical profile of Bijou sandy loam, 0 to 3 percent slopes, about 1,600 feet east and 1,400 feet north of the southwest corner of section 30, T. 5 S., R. 61 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; very weak, thin, platy structure that breaks to weak, fine, granular structure, hard when dry, loose when moist; noncalcareous; abrupt, smooth boundary.

B2t—6 to 12 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure, hard when dry, very friable when moist; noncalcareous; few patchy clay films; clear, smooth boundary.

B3—12 to 24 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium to coarse, subangular blocky structure; hard when dry, loose when moist; noncalcareous; few patchy clay films; gradual, smooth boundary

C1—24 to 44 inches, light yellowish-brown (2.5Y 6/4) loamy sand, light olive brown (2.5Y 5/4) when moist, massive (structureless) or single grain (structureless); hard when dry, loose when moist; noncalcareous

IIC2—44 to 60 inches, pale-brown (10YR 6/3) silt loam stratified with sand; strata are ½ inch to 5 inches thick; some strata are calcareous

The A horizon ranges from loamy sand to sandy loam in texture and from 4 to 12 inches in thickness. The B2t horizon is 5 to 15 inches thick and generally is as dark as the surface layer. In the poorly drained areas, the B horizon contains gray and reddish mottles, is very hard when dry, and a clayey layer generally occurs below a depth of 4 feet and slows penetration of water.

Like the Truckton soils, the Bijou soils are much harder when dry than most sandy soils Bijou soils have a sandier subsoil and less distinct horizons than the nearby Bresser soils They have more distinct horizons and are less sandy throughout than the Blakeland soils The Bijou soils are sandier throughout than the Fort Collins soils, but unlike those soils, Bijou soils do not contain lime

Bijou sandy loam, 0 to 3 percent slopes (BlB).—This soil occurs in the western two-thirds of the county, mainly along the major streams. Slopes generally are less than 2 percent. This soil has the profile described as typical for the series.

Included with this soil in mapping were small areas of Blakeland loamy sand, of Bresser sandy loam on terraces, and of the wet Bijou sandy loam.

About one-half of the acreage of this soil is used for cultivated crops. Because soil blowing is a moderate to severe hazard, it is essential that enough crop residue is left on the surface to control soil blowing. (Capability unit IIIe–1; Sandy Foothill range site; tree planting suitability group 2)

Bijou sandy loam, wet, 0 to 3 percent slopes (BmB).—This poorly drained soil occurs in the western two-thirds of the county. The largest areas are east of West Bijou Creek and Cherry Creek, but small areas are scattered throughout the county.

The surface layer is dark-colored sandy loam to loamy sand about 10 inches thick. The subsoil is sandy loam about 24 inches thick. Gray and brown mottles occur at a depth of 8 to 24 inches. During dry periods salts are visible on the surface in some spots. The water table is high at least part of the year and is usually within 5 feet of the surface most of the time.

Included with this soil in mapping were a few small areas of Bijou sandy loam that are not wet, of Beckton loam, and of Blakeland loamy sand.

About one-half of the acreage of this soil is cultivated. Alfalfa is the most common crop. If this soil is cultivated, a cover must be maintained at all times to control soil blowing. Soil blowing on pasture or hay meadow is controlled by not grazing or cutting the grass closely in fall. Then, there is enough cover for protection in spring. (Capability unit IVw–1; Wet Meadow range site; tree planting suitability group 3)

Blakeland Series

The Blakeland series consists of nearly level to steep soils that occur as small, scattered areas throughout the western half of the county. These soils developed in wind-deposited material that was derived from the Dawson formation. The topography is undulating to hilly.

In a typical profile the surface layer is grayish-brown loamy sand that is free of lime and about 14 inches thick. The next layer consists of noncalcareous, brown sand about 7 inches thick. The underlying material is noncalcareous, yellowish-brown sand that extends to a depth of 60 inches. Below a depth of 6 inches, the soil material is very hard when dry.

The Blakeland soils are droughty. They have a rapid rate of water intake and low available water holding capacity. Unprotected areas are susceptible to water erosion and to severe soil blowing.

Most of the acreage is in native grass and is used for grazing cattle and horses. The dominant grasses include sand bluestem, sandreed, little bluestem, and needle-and-thread. These soils are also suitable for community development. They are a good source of material for road fill.

Typical profile of Blakeland loamy sand, 1 to 20 percent slopes, about 2,240 feet east and 600 feet south of the northwest corner of section 26, T. 4 S., R. 64 W.:

A11—0 to 6 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; single grain (structureless); loose when dry or moist; noncalcareous; clear, smooth boundary.

A12—6 to 14 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, coarse or very coarse, prismatic structure that breaks to weak, coarse or very coarse, subangular blocky structure; very hard when dry, loose when moist; noncalcareous; gradual, wavy boundary.

AC—14 to 21 inches, brown (10YR 5/3) sand, brown or dark brown (10YR 4/3) when moist; single grain (structureless); very hard when dry, loose when moist; noncalcareous; gradual, wavy boundary.

C—21 to 60 inches, yellowish-brown (10YR 5/4) sand; single grain (structureless); hard when dry, loose when moist; noncalcareous

The A horizon ranges from 4 to 15 inches in thickness The AC horizon ranges from loamy sand to sand Feldspar minerals generally occur throughout the profile In places some dark streaks extend to a depth of 25 inches. In some places small balls of clay, 5 to 10 millimeters in diameter, occur in the AC horizon and in the C horizon Blakeland soils are very hard and stand in vertical banks as much as 10 feet high Depth to bedrock ranges from a few feet to many feet

The Blakeland soils are more sandy than the Truckton soils, and unlike them, do not have a B horizon They are calcareous and are less silty and darker colored than Colby soils, which are limy

Blakeland loamy sand, 1 to 9 percent slopes, eroded (BoD2).—This soil occurs in the western three-fourths of the county where topography is rolling. The surface layer is dark-brown loamy sand about 5 inches thick. It grades to lighter colored loamy sand or sand that extends to a depth of more than 5 feet.

Included with this soil in mapping were small areas of Truckton loamy sand. Also included, in areas as much as one-half acre in size, were blowouts on north- and west-facing slopes. In these areas the yellowish-brown underlying material is exposed.

This soil has been cultivated, but most of the acreage is now in grass. Because of the severe hazard of erosion, this soil should not be used for cultivated crops. (Capability unit VIe–4; Deep Sand range site; tree planting suitability group 2)

Blakeland loamy sand, 1 to 20 percent slopes (BoE).—This undulating to hilly soil occurs mainly in the western three-fourths of the county, generally in areas less than 160 acres in size. This soil has the profile described as typical for the series. Even though this soil is sandy, it is hard enough to resist digging when dry.

Included with this soil in mapping were small areas of Truckton loamy sand.

This soil is used mainly for native range. Under good management, it produces an excellent stand of forage plants, mainly mid grasses and tall grasses. This soil is not suited to cultivated crops because it is droughty and is highly susceptible to soil blowing if left without a vegetative cover. (Capability unit VIe–4; Deep Sand range site; tree planting suitability group 2)

Bresser Series

The Bresser series consists of deep, level to steep soils that occur on stream terraces and on uplands in the western three-fourths of the county. These soils developed in noncalcareous, sandy material deposited by wind and water.

In a typical profile the surface layer is dark grayish-brown sandy loam about 5 inches thick. The subsoil, about 23 inches thick, is dark-brown sandy loam in the upper part, brown sandy clay loam in the middle part, and light-brown sandy loam that contains small balls of clay in the lower part. The underlying material is light yellowish-brown loamy sand that contains a few small balls of clay.

In areas in crops or grass, the Bresser soils have a moderate to rapid rate of water intake. In bare areas, however, crusting is likely, and the intake rate is moderate or slow. The available water holding capacity is moderate. These soils are easily penetrated by roots and generally are moderate in natural fertility, but unprotected areas are highly susceptible to water erosion and to soil blowing.

These soils are used mainly for cultivated crops. Winter wheat is the principal crop, but barley and sorghums are also grown. A few small areas are irrigated, and corn and alfalfa grow well in these areas.

Typical profile of a Bresser sandy loam, 600 feet west and 100 feet south of the northeast corner of section 21, T. 5 S., R. 61 W.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark gray brown (10YR 3/2) when moist; weak, fine, granular structure; hard when dry, loose when moist, noncalcareous; clear, slightly wavy boundary.

B2t—9 to 16 inches, brown (7.5YR 4/3) sandy clay loam, brown brown (10YR 3/3) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; hard when dry, very friable when moist; thin, patchy clay films on some peds; noncalcareous; clear, wavy boundary.

B2t—9 to 16 inches, brown (7.5YR 4/3) sandy clay loam, brown (7.5YR 4/3) when moist and crushed; moderate, medium and fine, prismatic structure that breaks to moderate, medium, angular blocky structure; very hard when dry, firm when moist; thin, nearly continuous clay films on peds; nodules or spots of heavy clay; dark stains on outside of peds, noncalcareous; clear, wavy boundary

B3—16 to 28 inches, light-brown (7.5YR 6/3) sandy loam, brown (7.5YR 5/3) when moist; weak to moderate, coarse, prismatic structure that breaks to weak to moderate, coarse, angular blocky structure; very hard when dry, very friable when moist, thin, patchy clay films on vertical faces of peds; balls of clay that are 5 to 15 millimeters in diameter; noncalcareous; gradual, wavy boundary

C—28 to 50 inches, light yellowish-brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure that breaks to massive (structureless); hard when dry, loose when moist; few balls of clay that are 5 to 10 millimeters in diameter; noncalcareous

The A horizon generally is sandy loam but ranges from loam to loamy sand. It is 4 to 12 inches thick. The B2t horizon is sandy clay loam or clay loam and is 5 to 16 inches thick. In some places thin streaks of lime occur in the C horizon.

The Bresser soils have a more clayey subsoil and thicker and more distinct horizons than the Truckton soils. Unlike the Ascalon and Nunn soils, Bresser soils do not contain lime in their subsoil. They are harder when dry than the Ascalon soils, and their subsoil is less clayey and silty than that of Nunn soils.

Bresser loamy sand, terrace, 0 to 3 percent slopes (BrB).—This soil occurs mainly along Kiowa Creek in the central part of the county. Its loamy sand surface layer is 6 to 12 inches thick and was deposited during the flood in 1935. The subsoil is sandy clay loam about 18 inches thick. Below this is stratified loamy sand and sandy loam that extend to a depth of 60 inches or more.

Included with this soil in mapping were some small areas of Bresser sandy loam on terraces and of wet Bijou sandy loam. Also included were areas where the loamy sand surface layer is 20 inches thick.

This soil has moderate available water holding capacity and is easily penetrated by plant roots. The water table is at a depth of about 10 feet most of the year. In many areas the soil material is moist below a depth of 4 feet.

Most of this soil is cultivated, but crops are hard to establish. Alfalfa and other deep-rooted crops grow well after they are established. This soil blows easily and is low in fertility. Soil blowing can be controlled by keeping a plant cover on the surface and by stubble mulching where summer fallow is used. (Capability unit IVe–7; Sandy Foothill range site; tree planting suitability group 2)

Bresser sandy loam, terrace, 0 to 3 percent slopes (BsB).—This soil occurs along major drainageways in the western three-fourths of the county. It has a dark-colored sandy loam surface layer about 6 inches thick and a sandy clay loam subsoil about 15 inches thick. A zone of lime accumulation does not occur, but there are spots of lime below the subsoil in some places.

Included with this soil in mapping were small areas of Nunn loam, of Bijou sandy loam, and of the wet Bijou sandy loam.

This soil is used mostly for cultivated crops, mainly wheat. It is easy to work and is readily permeable to roots, air, and moisture. Runoff is slow, but soil blowing is a hazard unless enough crop residue is kept on the surface for protection. (Capability unit IIIe–1; Sandy Foothill range site; tree planting suitability group 2)

Bresser loam, gravelly subsoil variant, 1 to 3 percent slopes (BtB).—This soil occurs primarily on the terrace on the eastern side of the South Platte River. Its surface layer is very dark grayish-brown loam that is about 8

inches thick and contains some gravel. The subsoil is brown clay loam about 16 inches thick. It grades into clean sands and gravel at a depth of about 30 inches. In some places lime occurs in the lower part of the subsoil.

Included with this soil in mapping were small areas of Nunn clay loam and of Edgewater loam.

This soil is suited to the crops commonly grown in the county. Water for irrigation generally is available from streams or wells. Nearly all of the acreage is used as residential or commercial sites, for which the soil is well suited. (Capability unit IIIc–1; Loamy Foothill range site; tree planting suitability group 1)

Bresser-Stapleton sandy loams, 3 to 9 percent slopes (BuD).—This complex occurs in the southwestern part of the county, generally in areas of less than 100 acres in size. Elevations are more than 6,000 feet.

Bresser sandy loam makes up about 60 to 70 percent of this complex, and Stapleton sandy loam, 20 to 30 percent. Included in mapping were areas of Buick loam, of Renohill loam, and of sandy alluvium in drainageways. The included areas make up 10 to 20 percent of some mapped areas.

The Bresser soil occurs on side slopes and foot slopes. This soil is deep and has a surface layer about 10 inches thick. It is fertile, easy to work, and takes in and holds water well. The subsoil is sandy clay loam about 24 inches thick.

The Stapleton soil occurs on knobs and next to drainageways. It is moderately deep, and its surface layer is 4 to 8 inches thick. The next layer is sandy to gravelly loam about 6 to 12 inches thick.

Most of this complex is in grass, but a few pine and mountain-mahogany trees grow in some places. These soils can be used for cultivated crops, but the hazard of erosion is severe. Terracing, stripcropping, and other intensive conservation practices help to control erosion. (Capability unit IVe-4; Sandy Foothill range site; tree planting suitability group 2)

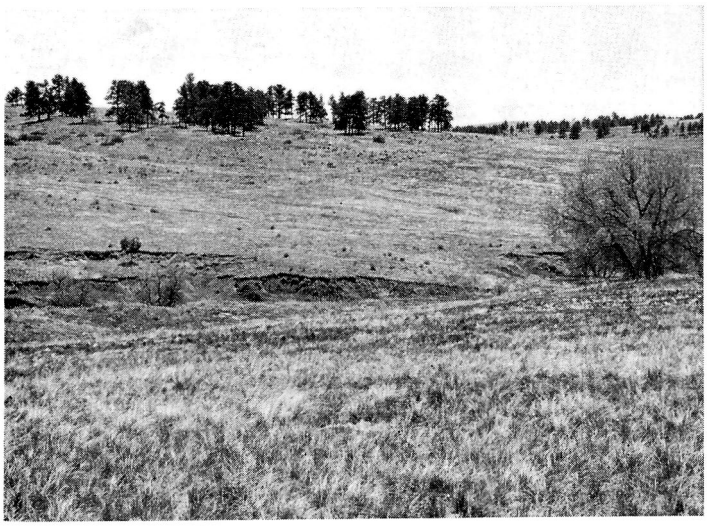

Figure 4.—**An area of Bresser-Stapleton sandy loams, 9 to 20 percent slopes. The pine trees in the background are growing on the Stapleton soil. An excellent stand of intermediate wheatgrass on the Bresser soil is in the foreground.**

Bresser-Stapleton sandy loams, 9 to 20 percent slopes (BuE).—This complex occurs in the southwestern part of the county at elevations above 5,900 feet. Many areas are more than 100 acres in size (fig. 4).

The Bresser and Stapleton soils are about equal in extent in this complex. Included with these soils in mapping were areas of Renohill loam, of Litle silty clay loam, and of Buick loam. Also included were areas of sandy alluvium in drainageways.

The Bresser soil occupies the higher slopes and ridgetops. It is deep and has a sandy clay loam subsoil. Shale or partly consolidated gravelly material occurs between depths of 30 and 60 inches in some places.

The Stapleton soil is on the steeper slopes next to the drainageways. It is shallow and has a surface layer 4 to 10 inches thick. Partly consolidated gravelly material is at a depth of 12 to 24 inches.

Almost all of this complex is in native grass and is used for grazing livestock or as wildlife and recreational areas. A few ponderosa pine and mountain-mahogany trees grow in some places. Because of the slope and the severe hazard of erosion, these soils are not suited to cultivated crops. Good range management is needed to prevent overgrazing and to control erosion. (Capability unit VIe–3; Sandy Foothill range site; tree planting suitability group 4)

Bresser-Truckton sandy loams, 3 to 5 percent slopes (BvC).—This complex occupies large areas throughout the western three-fourths of the county. The topography is gently sloping to rolling.

Bresser sandy loam makes up 50 to 70 percent of this complex, and Truckton sandy loam, 20 to 40 percent. Included with these soils in mapping were areas of Nunn loam and of low-lying areas called wet weather lakes. Also included were a few small areas of Truckton loamy sand and of the Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes.

The Bresser soil occupies the slopes. It has a surface layer about 6 inches thick and a sandy clay loam subsoil about 20 inches thick.

The Truckton soil occurs on ridgetops and is susceptible to soil blowing. Its surface layer is about 5 inches thick. The subsoil contains more clay than the surface layer and is sandy loam about 15 inches thick.

Most of this complex is in native grass, but a few areas are used for cultivated crops. Wheat is the main crop, but sorghums and barley are also grown. Because soil blowing is a severe hazard, these soils are better suited to grass than to cultivated crops. (Capability unit IVe–3; Sandy Foothill range site; tree planting suitability group 2)

Bresser-Truckton sandy loams, 5 to 20 percent slopes (BvE).—This complex occurs mainly in the southern part of the county. It occupies large areas that extend eastward from Cherry Creek to East Bijou Creek. These areas generally are more than 100 acres in size and are dominant on the eastern side of streams.

Bresser and Truckton soils are about equal in extent in this complex. Included with these soils in mapping were small areas of Ascalon sandy loam. Also included were some areas in which outcrops of shale and sandstone occur along streams and drainageways.

The Bresser soil is on side slopes. It has the profile described as typical for the series.

The Truckton soil occurs in the higher areas. Its surface layer is about 5 inches thick. The subsoil, about 12 inches thick, is sandy loam and contains more clay than the surface layer.

Almost all of this complex is in native grass. Because of the slope, droughtiness, and a severe hazard of erosion, these soils are not suited to cultivated crops. Careful control of grazing is needed to maintain a good grass cover and to help control erosion. (Capability unit VIe–3; Sandy Foothill range site; tree planting suitability group 4)

Bresser and Truckton soils, 3 to 9 percent slopes, eroded (BwD2).—This mapping unit occurs mainly in the western three-fourths of the county. The Bresser soils make up about 50 to 70 percent of this mapping unit, and the Truckton soils, 20 to 40 percent. Included with these soils in mapping were small areas of Blakeland, Ascalon, and Stapleton soils.

The Bresser soils have a sandy loam or sandy clay loam surface layer about 4 inches thick. In most places the surface layer is light colored because soil blowing has removed organic matter from the surface soil and plowing has mixed material from the subsoil with the original surface soil. The subsoil is sandy clay loam.

The Truckton soils have a surface layer of brown sandy loam about 4 inches thick. In some places erosion has removed the original surface soil and the subsoil is exposed.

Although most areas of these soils are cultivated, cultivated crops are not suited because the hazard of soil blowing is severe. Blowouts are common on the ridgetops where slopes face west and north. In these areas most of the surface soil has been removed and the subsoil or the underlying material is exposed. Sandy loam or loamy sand several inches thick have been deposited over the original soil material where slopes face east.

A permanent plant cover is needed for the control of erosion on these soils. Diversions also help to control runoff and erosion. (Capability unit VIe–3; Sandy Foothill range site; tree planting suitability group 2)

Buick Series

The Buick series consists of deep, gently sloping to sloping soils that occur on uplands in the western three-fourths of the county. These soils developed in material deposited by wind and water.

In a typical profile the surface layer is brown loam that is free of lime and about 6 inches thick. The subsoil, about 50 inches thick, is brown and light yellowish-brown clay loam in the upper part and is very pale brown and pale-olive sandy clay loam in the lower part. The subsoil contains lime below a depth of about 12 inches. Horizons of an old buried soil occur below a depth of about 22 inches.

The Buick soils have a moderate rate of water intake and high available water holding capacity. They are moderately high in natural fertility.

These soils are suited to native grasses and to wheat and other nonirrigated crops. Most of the acreage is in native grasses. Winter wheat is the main crop.

Typical profile of Buick loam, 3 to 5 percent slopes, about 200 feet east and 1,000 feet south of the northwest corner of section 2, T. 4 S., R. 60 W.:

A1—0 to 3 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; weak to moderate, fine, granular structure, soft when dry, very friable when moist; medium and fine, rounded concretions, less than 5 percent by volume, of feldspar and quartz are scattered on surface and throughout horizon; noncalcareous; clear, smooth boundary

AB—3 to 6 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure, soft when dry, friable when moist; thin, patchy clay skins in lower inch; noncalcareous, clear, smooth boundary.

B2t—6 to 12 inches, brown (10YR 5/3) clay loam, brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to moderate or strong, fine, subangular and angular blocky structure; slightly hard when dry, friable when moist, thin, patchy clay skins; clear, smooth boundary

B3ca—12 to 22 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) when moist; moderate, medium, prismatic structure that breaks to moderate, medium or fine, subangular blocky structure, slightly hard when dry, friable when moist; thin, patchy clay skins, very strongly calcareous; clear, smooth boundary.

B21cab—22 to 40 inches, very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) when moist; weak to moderate, coarse, prismatic structure; hard when dry, firm when moist; common, medium, distinct concretions of lime, very strongly calcareous; gradual, wavy boundary.

B22cab—40 to 56 inches, pale-olive (5Y 6/3) sandy clay loam, olive (5Y 5/3) when moist; vertical cleavage but no apparent structure, hard when dry, firm when moist; moderately to very strongly calcareous.

The A horizon ranges from sandy loam to loam or silt loam in texture and from 2 to 6 inches in thickness The B2t horizon is clay loam, loam, or silt loam 5 to 15 inches thick Depth to lime generally is about 12 inches but ranges from 5 to 16 inches. In some places the buried layers are more red and the structural peds are larger and more distinct than in the rest of the subsoil The buried soil ranges from loam to clay and generally is gritty Depth to shale or sandstone ranges from 4 to 6 feet.

The Buick soils are deeper to bedrock than the associated Renohill soils The subsoil of Buick soils is less clayey and more compact in the lower part than that of the Weld soils Buick soils have a thinner, less clayey subsoil than Fondis soils, but both kinds of soils have layers of buried soils.

Buick loam, 3 to 5 percent slopes (BxC).—This soil occurs in small, scattered areas on uplands in the western three-fourths of the county. It has the profile described as typical for the series.

Included with this soil in mapping were a few small areas of Weld silt loam, of Colby silt loam, and of Renohill loam. The Weld and Colby soils are on the crests or the highest parts of the slope, and the Renohill soils are next to drainageways.

Most of this soil is in native grass, but some of it is used for small grains. Cropping is hazardous because of the slope, low precipitation, and the hazard of soil blowing. Following winter wheat by summer fallow is a common practice. Stubble mulching and terracing help to control erosion. (Capability unit IIIe–2; Loamy Foothill range site; tree planting suitability group 1)

Buick loam, 5 to 9 percent slopes (BxD).—This soil is on uplands throughout the western three-fourths of the county. Its surface layer consists of about 5 inches of loam or silt loam. The upper part of the subsoil, about 14 inches thick, is clay loam. Lime is 5 to 12 inches below the soil surface. In many cultivated areas, material from the sub-

soil is mixed with the topsoil, and in these areas the plow layer and the subsoil are clay loam in texture. In some places small blocks of limy soil material are on the surface. Loamy to clayey, calcareous soil material extends to a depth of 4 feet or more.

Included with this soil in mapping were a few small areas of Weld silt loam, of Colby silt loam, and of Renohill loam. Also included were small areas of a loamy soil that is limy throughout the subsoil; these areas occupy the crests of hills that face north or west.

Most of this soil is in native grass, but some areas are cultivated. In cultivated areas susceptibility to soil blowing and water erosion is severe. The slope, low precipitation, and soil blowing are the major hazards. Surface runoff is moderate to rapid, and the available water holding capacity is high. Practices that help to control erosion and conserve moisture are summer fallowing and stubble-mulch tillage. (Capability unit IVe–2; Loamy Foothill range site; tree planting suitability group 1)

Clayey Alluvial Land

Clayey alluvial land (Ca) occurs throughout the county in narrow drainageways and along streams and is subject to flooding every year. It generally occupies areas that are less than 500 feet wide and less than 1 mile long.

Included with this land in mapping were small areas of Loamy alluvial land and of Heldt clay.

Clayey alluvial land is variable, but commonly it has a surface layer of very dark grayish-brown, clayey soil material that has been recently deposited. This layer is about 6 inches thick and is generally calcareous. Below the surface layer is dark-brown, calcareous, stratified clay and loam that is generally thick and is lighter in color and higher in lime as depth increases. This material is easily penetrated by roots and water.

This land type is mostly in native grass. It is not suited to cultivated crops, because of the hazards of flooding and erosion. It is well drained, has high available water holding capacity, and is high in fertility. Where water spreaders are installed in the drainageways, western wheatgrass grows well, and it can be grazed or cut for hay. The water must be carefully controlled to keep gullies from forming. (Capability unit VIw–2; Overflow range site; tree planting suitability group 5)

Colby Series

The Colby series consists of deep, well-drained, gently sloping to steep soils that occur on ridgetops and on a few short steep slopes in the eastern three-fourths of the county. Most areas are less than 300 feet wide and 1 mile long.

In a typical profile the surface layer is light brownish-gray, limy silt loam about 5 inches thick. The next layer, about 7 inches thick, is pale-brown silt loam that contains much lime and is easily penetrated by roots and water. The underlying material is very pale brown and pale-brown, limy silt loam to a depth of 60 inches.

The Colby soils have a moderate rate of water intake, moderate permeability, and high available water holding capacity. They are moderate in natural fertility, but are highly susceptible to soil blowing and water erosion unless a vegetative cover is maintained. The hazard of erosion is increased in bare areas because they tend to slicken.

These soils are suited to wheat and other nonirrigated crops if protected against soil blowing and water erosion.

Typical profile of Colby silt loam, 1 to 5 percent slopes, about 900 feet north and 1,600 feet west of the southeast corner of section 16, T. 4 S., R. 59 W.:

A1—0 to 5 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; soft when dry, very friable when moist; very strongly calcareous; clear, smooth boundary

AC—5 to 12 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous, gradual, slightly wavy boundary.

C1ca—12 to 36 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous; diffuse, wavy boundary.

C2—36 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist, massive (structureless); loose when dry, very friable when moist, very strongly calcareous.

The A1 horizon is silt loam or loam and is 3 to 6 inches thick. It is generally limy at the surface but in places is free of lime to a depth of 2 inches. The AC horizon ranges from 7 to 20 inches in thickness and from loam to silt loam in texture. More visible lime occurs in this layer than in the underlying material.

In contrast to the Weld and Buick soils, which are noncalcareous in the upper part and have a distinct B horizon, the Colby soils are calcareous throughout and lack a B horizon. Colby soils are lighter colored than Weld soils, and they are not so compact in the lower part as Buick soils.

Colby silt loam, 1 to 5 percent slopes (CoC).—This soil occurs on ridgetops, less than 300 feet wide, mainly in the eastern three-fourths of the county. The areas are generally long and scattered. This soil has the profile described as typical for the series. Erosion, primarily soil blowing, has removed part of the surface layer.

Included with this soil in mapping were a few small areas of Weld silt loam. Also included, on the east side of Deer Trail Creek in the northern part of the county, were a few small areas of a Colby soil that has a limy, light-colored fine sandy loam surface layer about 4 inches thick.

About one-half of the acreage of this Colby silt loam is in native grass, but winter wheat is grown in some places and is commonly followed by summer fallow. This soil is easy to work, but it needs protection against soil blowing. Soil blowing is reduced by leaving crop residue on the surface to provide a protective cover. Stubble mulching helps to conserve moisture and to control soil blowing. (Capability unit IVe–1; Loamy Plains range site; tree planting suitability group 1)

Colby silt loam, 5 to 20 percent slopes (CoE).—This soil occupies small areas on side slopes that are generally less than 500 feet long and are in the eastern half of the county. Its light-colored, limy surface layer is about 4 inches thick, and it is underlain by limy silt loam.

Included with this soil in mapping were a few small areas of Baca loam and of Thedalund clay loam. These soils occur in the lowest areas in the landscape or in areas next to drainageways.

This soil is in native range. Because of the slope and the severe hazard of erosion, it is not suited to cultivated crops. Runoff is moderate to high. Unless a plant cover is maintained, this soil erodes easily and deep gullies form. Good management is needed to prevent overgrazing and to maintain a good grass cover. (Capability unit VIe–1; Loamy Slopes range site; tree planting suitability group 4)

Colby and Adena soils, 1 to 9 percent slopes, eroded (CyD2).—These soils occupy small areas that are scattered throughout the eastern three-fourths of the county. They have been eroded by both wind and water and have been cut by gullies that generally are 100 feet or less apart, 3 to 10 feet wide, and 6 to 18 inches deep. Soil blowing has been more severe on the ridgetops, but there are some blowouts, or small, limy, circular depressions, on the side slopes.

Colby soils make up 50 to 60 percent of this mapping unit, and Adena soils, 40 to 50 percent.

The Colby soils occur on small ridges. They have a limy silt loam surface layer about 4 inches thick. In some places the surface layer is underlain by a transitional layer that consists of limy silt loam or loam about 7 inches thick. Where this layer is missing, the surface layer lies directly on the loose, silty underlying material.

The Adena soils occur between the ridges and on slopes that face east. Their surface layer, about 4 inches thick, is brown silt loam that is spotted with lime. The subsoil is limy silty clay loam about 10 inches thick.

The soils in this mapping unit have been or are now cultivated, but they should be reseeded to grass where practical. Grazing should be avoided in reseeded areas until a good stand of grass has been established. Then it is essential to regulate grazing so as to control erosion. (Capability unit VIe–1; Loamy Plains range site; tree planting suitability group 1)

Deertrail Series

The Deertrail series consists of deep, level or nearly level soils that occur mainly in the eastern part of the county. These soils developed in material deposited by the wind.

In a typical profile the surface layer is light brownish-gray, lime-free silt loam about 2 inches thick. The subsoil, about 30 inches thick, is dark-brown, noncalcareous clay in the upper part, pale-brown, strongly calcareous silty clay in the middle part, and very pale brown and pale-brown, very strongly calcareous silty clay loam in the lower part. The underlying material is pale-brown, very strongly calcareous silt loam that extends to a depth of 55 inches.

The Deertrail soils have slow runoff and very slow water intake. Because of the high sodium content of the subsoil, the available water holding capacity is low. These soils are moderate in natural fertility but are droughty and susceptible to soil blowing.

These soils are suited to grasses and to wheat and other nonirrigated crops. Most of the acreage is used for cultivated crops, mainly winter wheat.

In Arapahoe County the Deertrail soils were mapped only with the Weld soils in a complex. For a description of this complex, see the Weld Series.

Typical profile of a Deertrail silt loam, 520 feet east, 250 feet north of the southwest corner of section 25, T. 5 S., R. 59 W.:

A2—0 to 2 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; strong, fine, granular structure in upper part; soft when dry, very friable when moist, strong, thin, platy silty clay loam in lower one-half inch; noncalcareous; abrupt, smooth boundary.

B21t—2 to 9 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 4/3) when moist and crushed; moderate, medium, columnar structure that breaks to strong, fine, angular blocky structure; very hard when dry, very firm when moist; thin, nearly continuous clay films, dark stains on upper 2 inches of peds; grains of bleached sand on columns; noncalcareous; abrupt, slightly wavy boundary.

B22tca—9 to 12 inches, pale-brown (10YR 6/3) silty clay, brown (10YR 5/3) when moist; moderate, medium, prismatic structure that breaks to moderate, fine, angular blocky structure, hard when dry, firm when moist, thin, patchy clay films on ped surfaces; strongly calcareous; clear, smooth boundary.

B31ca—12 to 23 inches, very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure that breaks to moderate, fine, angular blocky structure; hard when dry, firm when moist; thin, patchy clay films on ped surfaces; very strongly calcareous; common, medium, faint concretions of lime; vesicular; clear, smooth boundary.

B32ca—23 to 32 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; few, thin clay films on some ped faces; very strongly calcareous; few, medium, faint concretions of lime; vesicular; gradual boundary.

C—32 to 55 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive (structureless); soft when dry, very friable when moist, vesicular; very strongly calcareous.

The A horizon ranges from silt loam to silty clay loam in texture and from 1 to 4 inches in thickness. The surface is shiny and slick after a rain because the soil runs together and forms plates an inch or more thick. The B horizon ranges from 20 to 30 inches in thickness and has lime in it 6 to 14 inches from the soil surface. The B2t horizon is dense clay or silty clay that has dark stains in the upper part. In a road cut or pit, the B horizon appears as joints about a half-inch square or as columns several inches long. If the soil is disturbed, the columns break into blocks a half-inch square.

The Deertrail soils are lighter colored than the closely associated Weld soils and have a thinner surface layer and a more clayey subsoil. They have more distinct horizons, are deeper to lime, and are more clayey below the surface layer than nearby Colby soils. The Deertrail soils have a thinner, lighter colored surface layer than the Fondis soils, which contain buried layers of an older soil.

Edgewater Series

The Edgewater series consists of poorly drained soils that occur on bottom lands of the South Platte River. These soils are moderately deep over gravel. They developed in loamy material deposited by water.

In a typical profile the surface layer is dark grayish-brown loam that is free of lime and about 18 inches thick. It is underlain by about 10 inches of grayish-brown, noncalcareous sandy clay loam that is streaked with iron. Below this layer is a layer consisting of waterworn gravel, mainly of feldspar and granite, and some sand and fine mica.

The Edgewater soils take in water well and have moderate available water holding capacity. They are likely to be flooded when the major streams are at flood stage. Free water usually is within 4 feet of the surface, and sometimes it is much higher.

These soils are suited to cultivated crops, but most areas are now used for housing or commercial development.

They are also a source of gravel. Most areas have been irrigated and are used for the crops commonly grown in the county.

Typical profile of Edgewater loam, 0 to 3 percent slopes, 200 feet west and 200 feet south of the northeast corner of section 31, T. 5 S., R. 68 W.:

A1—0 to 18 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; moderate, fine, subangular blocky structure; slightly hard when dry, firm when moist; much mica; wormholes are common, noncalcareous; abrupt, smooth boundary

A1g—18 to 28 inches, grayish-brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist, weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist, few streaks of iron; noncalcareous; gradual boundary

IIC1—28 to 60 inches, waterworn gravel, mainly of feldspar and granite, but some sand and fine mica; water table at a depth of 60 inches

The A1 horizon ranges from 6 to 20 inches in thickness A few, medium, distinct mottles occur in the lower part of the A horizon. Worm casts and wormholes are numerous in the A horizon The A1g horizon ranges from 8 to 12 inches in thickness and from sandy clay loam to clay in texture; mottles range from common to many This horizon contains lime in some places

The Edgewater soils are darker colored to a greater depth than the Fort Collins soils and, unlike them, show effects of wetness Edgewater soils have more distinct layers than Wet alluvial land and are flooded less frequently.

Edgewater loam, 0 to 3 percent slopes (EdB).—This soil occupies areas along the South Platte River. Included in mapping were small areas of Wet alluvial land and of Nunn loam.

This soil is suited to the crops commonly grown in the county. Crops grow well in irrigated fields. Water for irrigation is available from wells that yield about 400 gallons or more per minute. Vegetable crops have been grown on this soil, but most of the acreage is now used as residential and commercial sites. This soil is a good source of gravel and of water. (Capability unit IVw-1; Wet Meadow range site; tree planting suitability group 3)

Fondis Series

In the Fondis series are deep, well-drained, gently sloping to sloping soils on uplands in the western half of the county (fig. 5).

In a typical profile the surface layer is about 8 inches thick and is free of lime. It is dark grayish-brown silt loam in the upper part and is dark grayish-brown silty clay loam in the lower part. The subsoil is about 84 inches thick and contains layers of an older buried soil. In the upper 24 inches is a layer of dark-brown, noncalcareous clay and a layer of pale-brown, very strongly calcareous silty clay loam. Below a depth of 32 inches are layers of an older buried soil that extend to a depth of 92 inches and contain concretions of lime. These layers are light yellowish-brown and dark-brown loam, silt loam, clay loam, and gravelly clay loam.

The Fondis soils have moderately slow permeability, slow internal drainage, and high available water holding capacity. They are high in natural fertility but are susceptible to soil blowing and to water erosion.

These soils are suited to native grasses and to wheat and other nonirrigated crops. Most of the acreage is used for cultivated crops, mainly winter wheat, and for residential sites. Some areas are irrigated and are used mainly for corn and alfalfa.

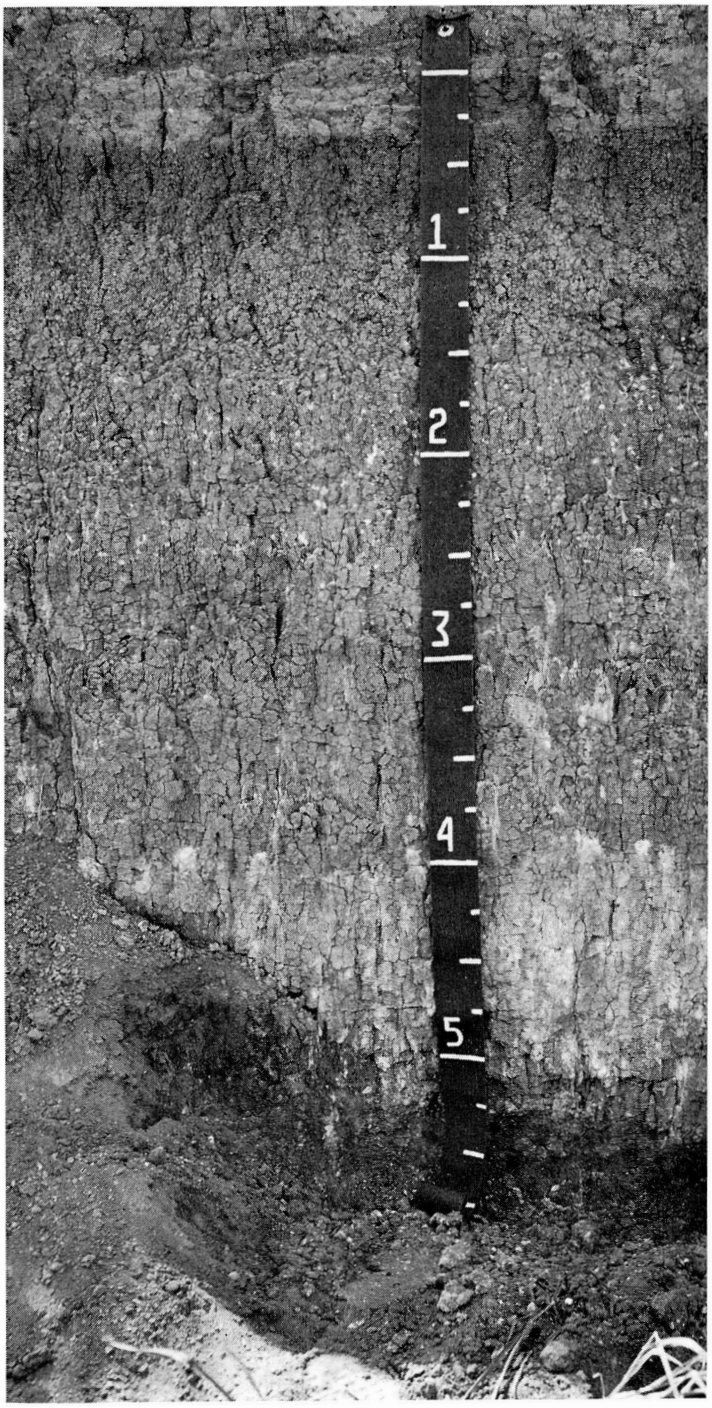

Figure 5.—**Profile of a Fondis silt loam.**

Typical profile of a Fondis silt loam, 2,490 feet south and 100 feet east of the southwest corner of section 30, T. 4 S., R. 63 W.:

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist, few fine pebbles on surface; fine

pebbles make up less than 5 percent of horizon, by volume, noncalcareous; clear, smooth boundary.

A3—4 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky structure that breaks to strong, fine to very fine, subangular blocky structure; slightly hard when dry, friable when moist, thin, patchy clay skins; grains of bleached sand; noncalcareous; clear, smooth boundary

B21t—8 to 17 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to strong, fine, angular blocky structure in which blocks are nearly cubes, very hard when dry, very firm when moist, thin, nearly continuous clay skins; few grains of bleached sand in upper 3 inches; noncalcareous; clear, smooth boundary.

B22tca—17 to 32 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; moderate, medium, prismatic structure that breaks to moderate, medium and fine, angular blocky structure; hard when dry, friable when moist; thin patchy clay skins; very strongly calcareous; gradual, smooth boundary.

B23cab—32 to 46 inches, light yellowish-brown (10YR 6/4) heavy loam or silt loam, yellowish brown (10YR 5/4) when moist; moderate, medium to coarse, prismatic structure that breaks to moderate, medium, angular blocky structure; hard when dry, very friable when moist; few thin clay skins; moderate, fine, distinct concretions of lime; very strongly calcareous; gradual, smooth boundary.

B24cab—46 to 84 inches, dark-brown (7.5YR 4/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, angular and subangular blocky structure; hard when dry, friable when moist; thin, patchy clay skins; medium, coarse, distinct concretions of lime and nodules of gypsum; very strongly calcareous; clear, smooth boundary.

B3cab—84 to 92 inches, light yellowish-brown (10YR 6/4) gravelly clay loam, yellowish brown (10YR 5/4) when moist; weak, coarse, prismatic structure; very hard when dry, firm when moist, patchy clay skins on vertical faces of peds; very strongly calcareous

The A horizon ranges from silt loam and silty clay loam to clay loam in texture and from 5 to 9 inches in thickness. The B21t and B22t horizons range from 12 to 28 inches in thickness and from clay to silty clay loam in texture. Depth to lime is 12 to 20 inches.

The Fondis soils are darker colored, more clayey in the subsoil, and deeper to lime than the Buick soils. They are darker colored, deeper to lime, and have more distinct horizons than the Litle soils. Fondis soils are a little darker and are more clayey than Weld soils. Unlike Weld soils, they contain horizons of an older buried soil.

Fondis silt loam, 1 to 3 percent slopes (FdB).—This soil occurs on uplands in the western part of the county. Many areas are 100 acres or more in size. The surface layer of this soil is about 7 inches thick and is abruptly over the subsoil. The upper part of the subsoil is dense clay about 20 inches thick. In the lower part of the subsoil are layers of a buried soil that consist of yellowish-brown clay loam. Depth to lime is 14 to 20 inches. This soil has moderate runoff and slow water intake. The hazards of soil blowing and water erosion are slight to moderate.

Included with this soil in mapping were a few small areas of Weld silt loam and of Fondis silt loam, 3 to 5 percent slopes. Also included were a few moderately eroded areas.

About one-half of the acreage of this soil is cultivated. The rest is in native grass or is used as residential areas. Wheat is the main crop. Summer fallowing after each crop is a common practice. If this soil is cultivated, a tillage pan forms easily. The use of crop residue helps to control soil blowing and water erosion. (Capability unit IIIc–1; Loamy Foothill range site; tree planting suitability group 1)

Fondis silt loam, 3 to 5 percent slopes (FdC).—This soil is on uplands in the western part of the county. Its surface layer is about 6 inches thick and rests abruptly on the subsoil, which consists of dense clay about 18 inches thick. Lime is nearer the surface than in Fondis silt loam, 1 to 3 percent slopes.

Included with this soil in mapping were a few small areas of Litle silty clay loam and of Colby silt loam. Also included were areas of Loamy alluvial land in drainageways that generally are less than 100 feet wide.

This soil is suited to cultivated crops. The acreage in cultivated crops and that used for native range and residential areas is about equal. Because of the slope, the dry climate, and the hazard of soil blowing, practices that help to conserve moisture and to control erosion are essential; effective practices include stubble mulching, terracing, and stripcropping. (Capability unit IIIe–2; Loamy Foothill range site; tree planting suitability group 1)

Fondis-Ascalon, gravelly subsoil variant, complex, 1 to 9 percent slopes (FgD).—This complex occupies small areas west of the South Platte River in the extreme western part of the county.

The Fondis soil makes up 50 to 70 percent of this complex, and the Ascalon soil, 30 to 50 percent. Included with these soils in mapping were small areas of Heldt clay and of Litle silty clay loam.

The Fondis soil occurs on the smoother parts of side slopes. It has a profile similar to the one described as typical for the Fondis series, but its surface layer is loam instead of silt loam.

The Ascalon soil occurs on knobs and small humps. Its profile is similar to the one described as typical for the Ascalon series, but its surface layer is loam instead of sandy loam and pebbles and cobblestones generally occur at a depth of 18 to 40 inches. In places the layer of pebbles and cobblestones is only about a foot thick, and it rests directly on beds of shale.

Most of the acreage of this complex is used as residential sites. Because of medium to rapid runoff and the hazard of erosion, these soils are not suited to cultivated crops. The Ascalon soil generally has low available water holding capacity because it is shallow to gravel. (Capability unit VIe–1; Loamy Foothill range site; tree planting suitability group 1)

Fondis-Colby silt loams, 3 to 5 percent slopes (FoC).—This complex is in the western part of the county. It occurs as bands, 700 feet wide and a half mile or more long, around ridgetops.

Fondis silt loam makes up about 60 to 80 percent of this complex, and Colby silt loam, 20 to 40 percent. Included with these soils in mapping were small areas of Weld silt loam.

The Fondis soil has a surface layer of dark-colored, lime-free silt loam about 5 inches thick. In the subsoil, which is brown clay about 12 inches thick, lime is about 12 inches from the soil surface. The underlying material extends to a depth of 4 feet or more and is limy clay loam.

The Colby soil has a grayish-brown, limy silt loam surface layer about 4 inches thick. Below this layer is limy silt loam about 12 inches thick. The underlying material is loose, limy silt.

About one-half of the acreage of this complex is in native grass. The soils are suited to the crops commonly grown in the county, but a protective cover of growing plants or of crop residue is needed at all times. Wheat and barley are the main crops. Runoff is moderate, and the available water holding capacity is high. Practices that help to control erosion and to conserve moisture are stubble mulching, terracing, and stripcropping. (Capability unit IIIe–2; Loamy Foothill range site; tree planting suitability group 1)

Fort Collins Series

In the Fort Collins series are deep, well-drained, level to gently sloping soils that occur on terraces and fans in the eastern part of the county. These soils developed in recent alluvium.

In a typical profile the surface layer is dark grayish-brown loam that is free of lime, is about 5 inches thick, and is easily worked. The subsoil, about 9 inches thick, is grayish-brown and light brownish-gray clay loam in the upper part and is pale-brown, limy loam in the lower part. The underlying material is pale-brown, limy, stratified fine sandy loam to clay loam that extends to a depth of 60 inches and is easily penetrated by roots.

The Fort Collins soils have moderate permeability, medium internal drainage, and high available water holding capacity. They are high in natural fertility but are susceptible to soil blowing if not protected.

These soils are well suited to the crops commonly grown in the county.

Typical profile of Fort Collins loam, 0 to 3 percent slopes, about 200 feet south and 200 feet west of the northeast corner of section 4, T. 4 S., R. 60 W.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B21t—5 to 8 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak to moderate, medium, prismatic structure that breaks to weak to moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; thin, patchy clay skins; slightly calcareous; clear, smooth boundary.

B22tca—8 to 10 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; weak to moderate, medium, prismatic structure that breaks to weak to moderate, medium, subangular blocky structure, slightly hard when dry, friable when moist; thin, patchy clay skins; strongly calcareous; clear, smooth boundary

B3ca—10 to 14 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, medium to coarse, prismatic structure that breaks to weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; very strongly calcareous; diffuse, smooth boundary.

C—14 to 60 inches, pale-brown (10YR 6/3) stratified fine sandy loam to clay loam, brown (10YR 5/3) when moist; massive (structureless); soft to slightly hard when dry, very friable when moist; very strongly calcareous

The A horizon is loam or sandy loam from 2 to 6 inches thick The B horizon ranges from 5 to 15 inches in thickness Depth to visible lime is between 8 and 30 inches and averages 14 inches

The Fort Collins soils are less clayey in the subsoil and have less distinct horizons than the Nunn soils They are more silty, contain more lime, and are lighter colored than Bresser soils.

Fort Collins loam, 0 to 3 percent slopes (FrB).—This soil occurs along drainageways in the eastern three-fourths of the county. Included with this soil in mapping were small areas of Bresser sandy loam and of Nunn loam. Also included were a few small areas of a Fort Collins soil that has a sandy loam surface layer about 4 inches thick.

This soil is suited to the crops commonly grown in the county. Water erosion is a slight to moderate hazard, and soil blowing is a severe hazard in unprotected areas. Stubble-mulch tillage and stripcropping are practices that help to conserve moisture and control erosion. (Capability unit IIIc–1; Loamy Plains range site; tree planting suitability group 1)

Gravelly Land

Gravelly land (Gr) occurs on side slopes above the major drainageways in the western three-fourths of the county. Slopes range from 6 to 50 percent.

The profile is variable, but commonly the surface layer is sandy loam or gravelly loam 2 to 4 inches thick. It is underlain by 10 to 20 inches of material that is sandy loam or gravelly clay loam in most places. Gravel mixed with some silt and sand occur below a depth of 3 feet. In many places shale and sandstone crop out on the lower parts of these side slopes.

Included with this land in mapping were small areas of Ascalon sandy loam and of Thedalund clay loam.

This land type is in native grass or is used as a source of gravel. It is not suited to cultivated crops, because it is shallow, droughty, and generally steep. (Capability unit VIIs–1; tree planting suitability group 5; no range site assigned)

Heldt Series

The Heldt series consists of deep, nearly level to gently sloping soils that occur on uplands and stream terraces throughout most of the county. These soils developed in material deposited by wind and water.

In a typical profile the surface layer is grayish-brown, lime-free clay about 4 inches thick. The subsoil, about 19 inches thick, is grayish-brown clay or silty clay that is very hard when dry. This layer contains lime in most places. It is not easily penetrated by roots. The underlying material is light olive-brown, stratified sandy loam to clay that contains lime and extends to a depth of more than 54 inches.

The Heldt soils take water in slowly and release it slowly to plants. The available water holding capacity ranges from low to moderate. Runoff is rapid because water intake is slow. These soils are droughty and are hard to work. A seedbed is difficult to prepare because the soil surface tends to seal. Flooding is a hazard in some places, and water erosion is likely in unprotected areas.

These soils are better suited to grass than to cultivated crops, but cultivated crops can be grown if management is good.

Typical profile of Heldt clay, 0 to 3 percent slopes, 1,400 feet east and 100 feet south of the northwest corner of section 30, T. 5 S., R. 61 W.:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) when moist; moderate, fine, granular structure; soft when dry, firm when moist; noncalcareous; clear, smooth boundary

B21—4 to 6 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; thin, patchy clay films; slightly calcareous; clear, smooth boundary

B22—6 to 19 inches, grayish-brown (10YR 5/2) clay or silty clay, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure that breaks to moderate, fine, angular blocky structure; extremely hard when dry, very firm when moist; slightly calcareous; thin, patchy clay films or slickensides, clear, smooth boundary.

B3ca—19 to 23 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure that breaks to moderate, medium, angular blocky structure; hard when dry, firm when moist; strongly calcareous; some concretions of lime and gypsum; thin, patchy clay films or slickensides; gradual boundary

C—23 to 54 inches +, light olive-brown (2.5Y 5/3) stratified sandy loam to clay, olive brown (2.5 4/3) when moist; massive (structureless); hard when dry, friable when moist, slightly calcareous to very strongly calcareous; strata range from one-half inch to 6 inches in thickness.

The A horizon ranges from 2 to 6 inches in thickness and is limy in some places. The B horizon ranges from 4 to 24 inches in thickness.

The Heldt soils are more clayey, have lime closer to the surface, and have less distinct horizons than the Nunn soils They also are more clayey and have less distinct horizons than the Beckton soils The boundary between the A and B horizons of the Beckton soils is abrupt instead of smooth, as it is in the Heldt soils.

Heldt clay, 0 to 3 percent slopes (HtB).—This soil occurs along the major drainageways in the county. It has the profile described as typical for the series. This soil takes in water slowly and is hard to work. Depth to lime ranges from about 4 to 8 inches.

Included with this soil in mapping were small areas of Beckton loam and of Nunn loam. Also included were a few small areas of Clayey alluvial land in small drainageways.

This soil is cultivated to small grains, mainly wheat and barley. It is hard to work, and seedbeds are difficult to prepare. Water erosion is a slight to moderate hazard. (Capability unit IVs–1; Clayey Foothill range site in the western part of the county; Clayey Plains range site in the eastern part; tree planting suitability group 4)

Heldt clay, saline, 0 to 3 percent slopes (HsB).—This soil occurs along the major drainageways in the eastern part of the county. The surface layer is heavy clay about 3 inches thick. In places, salts have accumulated in this layer and the surface is white when dry. The subsoil is heavy coarse clay about 10 inches thick. It commonly contains crystals of gypsum and spots of lime, particularly in the lower part. Barren, salty spots make up 20 to 60 percent of each area mapped.

Included with this soil in mapping were a few small areas of Heldt clay, of Beckton loam, and of Clayey alluvial land.

This soil is suited mainly to grass. Because the high salt content of the surface layer restricts plant growth, this soil supports only a poor stand of salt-tolerant plants. The surface soil tends to crust and seal, and this reduces the intake of water. Reclamation for cropping is not practical. (Capability unit VIs–1; Alkaline Plains range site; tree planting suitability group 5)

Litle Series

The Litle series consists of moderately deep, well-drained, gently sloping to sloping soils on uplands.

In a typical profile the surface layer is light brownish-gray silty clay loam about 3 inches thick. The subsoil, about 15 inches thick, is pale-brown clay or silty clay that contains lime. The underlying material is light yellowish-brown clay that extends to a depth of 39 inches and contains lime and some gypsum. Below this are olive to light olive-brown, partly consolidated clayey beds of shale that are very strongly calcareous.

The Litle soils have a slow rate of water intake and moderate to high available water holding capacity. Runoff is moderate to rapid, and the hazards of water erosion and of soil blowing are moderate.

These soils are used for grazing, for cultivated crops, and as homesites. Most of the acreage is in native range.

Typical profile of Litle silty clay loam, 1 to 9 percent slopes, 1,200 feet west and 1,000 feet north of the southeast corner of section 32, T. 5 S., R. 63 W.:

A1—0 to 3 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate to strong, fine, granular structure: soft when dry, friable when moist; slightly calcareous: clear, smooth boundary.

B2—3 to 8 inches, pale-brown (10YR 6/3) clay or silty clay, brown (10YR 5/3) when moist; weak, medium, prismatic structure that breaks to moderate, medium, angular blocky structure; hard when dry, firm when moist; few thin, patchy clay films on vertical surfaces of peds; very strongly calcareous; clear, smooth boundary

B3—8 to 18 inches, pale-brown (10YR 6/3) clay, brown (10YR 5/3) when moist, weak, fine, angular blocky structure; hard when dry, firm when moist; visible clay films on pressure faces; very strongly calcareous; few fine, distinct concretions of lime; clear, smooth boundary

C1ca—18 to 27 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; weak, medium, angular blocky structure; very hard when dry, very firm when moist; very strongly calcareous; few fine, distinct concretions of lime, clear, smooth boundary.

C2ca—27 to 33 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; weak, medium, angular blocky structure; very hard when dry, very firm when moist; very strongly calcareous; fine, common, distinct concretions of lime and gypsum; gradual boundary

C3—33 to 39 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) when moist; weak, coarse, subangular blocky structure; very hard when dry, very firm when moist; very strongly calcareous; many hard fragments of shale; gradual boundary

R—39 to 54 inches, olive to light olive-brown, partly consolidated beds of clayey shale; many fractures; very strongly calcareous

The A horizon is silty clay loam or clay loam that ranges from 2 to 6 inches in thickness The B2 horizon ranges from 4 to 10 inches in thickness, from heavy clay loam to clay in texture, and from brown to olive in color Depth to calcareous shale is 20 to 40 inches

The Litle soils have a thinner, lighter colored surface layer than the Fondis soils They have lime closer to the surface than the Fondis and Buick soils The Litle soils are more clayey and have less well-defined horizons than the Buick soils They are similar to Heldt soils but are shallower to shale

Litle silty clay loam, 1 to 9 percent slopes (LcD).—This soil occurs on uplands, mainly in the southwestern and southeastern parts of the county. It has the profile described as typical for the series.

Included with this soil in mapping were small areas of Renohill loam, of Buick loam, and of Samsil clay, gypsum. Also included were areas of Clayey alluvial land.

Nearly all of this Litle soil is in native grass. Because of the slope, rapid runoff, and slow intake of water, this soil is not suited to cultivated crops. It also erodes easily. (Capability unit VIs–1; Alkaline Plains range site in the eastern part of the county, Clayey Foothill range site in the western part; tree planting suitability group 4)

Litle-Samsil, gypsum, silty clay loams, 3 to 9 percent slopes (LsD).—This complex is on uplands in the extreme eastern part of the county. Slopes generally are less than 400 feet long.

Litle silty clay loam makes up about 50 to 60 percent of this complex, and Samsil clay, gypsum, 30 to 40 percent. Included with these soils in mapping were areas of Colby silt loam and small areas of Clayey alluvial land.

The Litle soil is on the upper part of slopes, and the Samsil soil occupies areas closer to the drainageways. The Colby soil is in small areas on the side slopes or ridgetops in some places.

This complex is in native grass. Because of shallowness, droughtiness, rapid runoff, and the hazard of erosion, the soils in this complex are not suited to cultivated crops. During dry years more grass grows in the drainageways than in other areas. In wet years native western wheatgrass that grows in the drainageways can be cut for hay. (Capability unit VIs–1; Alkaline Plains range site; tree planting suitability group 5)

Loamy Alluvial Land

Loamy alluvial land (Lv) occurs along narrow drainageways and major streams throughout the county and is subject to flooding (fig. 6). It occupies areas that generally are less than 500 feet wide and more than a mile long.

The profile is variable, but commonly the surface layer is very dark grayish-brown, generally noncalcareous, stratified loam and sandy loam about 6 inches thick. Below this layer is dark-brown, stratified sandy loam and clay loam that ranges from 1 foot to many feet in thickness and generally is calcareous.

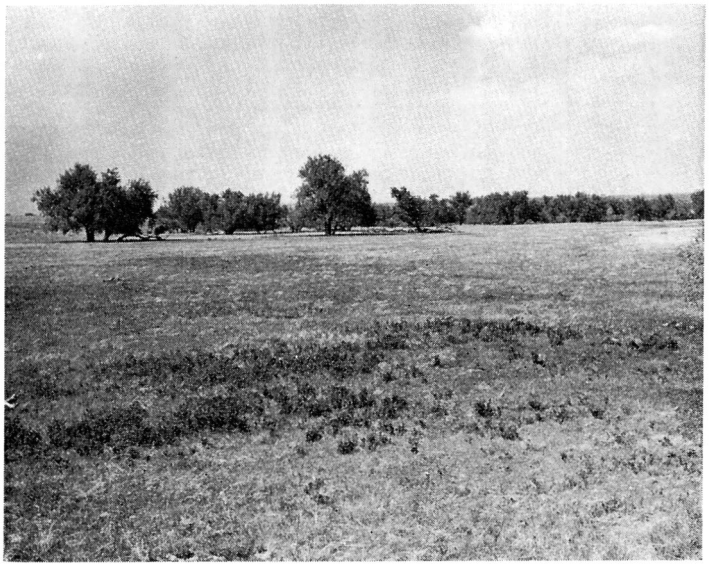

Figure 6.—Typical landscape of Loamy alluvial land.

Included with this land in mapping were small areas of Clayey alluvial land, of Sandy alluvial land, and of Wet alluvial land.

Loamy alluvial land is not suited to cultivated crops unless it is protected from flooding. Most of the acreage is in native grass. Pasture and hay are excellent where water spreading is used and the water is carefully controlled to prevent gullying. Loamy alluvial land has moderate to high available water holding capacity and generally is well drained. It is high in natural fertility and is easily penetrated by plant roots. (Capability unit VIw–2; Overflow range site; tree planting suitability group 1)

Nunn Series

In the Nunn series are deep, well-drained, level or nearly level soils that occur on uplands and on terraces along most of the major streams in the county. These soils developed in material deposited by wind and water.

In a typical profile the surface is grayish-brown, noncalcareous loam about 3 inches thick. The subsoil is about 19 inches thick. It is noncalcareous and is dark grayish-brown clay loam in the upper part, is grayish-brown light clay in the middle part, and is grayish-brown sandy clay loam in the lower part. The underlying material is light brownish-gray sandy loam and stratified sand and loam that extends to a depth of 60 inches and is slightly calcareous to very strongly calcareous.

The Nunn soils have moderate permeability and high available water holding capacity. Crops on them respond well to irrigation, and in irrigated areas, to additions of phosphorus and nitrogen. Unprotected areas are susceptible to soil blowing. In some areas these soils are subject to occasional flooding if not protected.

These soils are well suited to most of the crops commonly grown in the county. Some areas are irrigated and are used mainly for corn and alfalfa.

Typical profile of Nunn loam, 0 to 3 percent slopes, one-half mile south of the northeast corner of section 16, T. 5 S., R. 64 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, blocky structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B1—3 to 5 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that breaks to moderate, very fine, angular blocky structure; slightly hard when dry, friable when moist; thin, patchy clay films; noncalcareous; clear, smooth boundary.

B2t—5 to 18 inches, grayish-brown (10YR 5/2) light clay, dark grayish brown (10YR 4/2) when moist; moderate, fine to medium, prismatic structure that breaks to moderate to strong, fine to medium, angular blocky structure; hard when dry, firm when moist; thin, nearly continuous clay films; noncalcareous; gradual, smooth boundary.

B3—18 to 22 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2)) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, angular blocky structure; hard when dry, friable when moist; thin, patchy clay films; noncalcareous; clear, smooth boundary.

C1ca—22 to 30 inches, light brownish-gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; much visible lime; clear, smooth boundary.

C2—30 to 60 inches, light brownish-gray (10YR 6/2) stratified sand and loam, light grayish brown (10YR 5/2) when moist; massive (structureless), slightly hard when dry, very friable to loose when moist; slightly calcareous to strongly calcareous.

The A horizon is 3 to 8 inches thick. The B2t horizon ranges from clay loam to clay in texture and from 6 to 20 inches in thickness.

The Nunn soils are less clayey and are deeper to lime than the Heldt soils and have stronger structure. Nunn soils are slightly more clayey and have more distinct horizons than Fort Collins soils.

Nunn loam, 0 to 3 percent slopes (NlB).—This soil is on terraces. It has the profile described as typical for the series. Included with this soil in mapping were small areas of Beckton loam and of Fort Collins loam. Also included were a few small areas of Loamy alluvial land.

Most areas of this soil are cultivated. Some areas are used as residential sites. Under good management, suitable crops grow well on this soil. A few areas are irrigated and are used for corn and alfalfa. This soil takes in water at a moderate rate and has high available water holding capacity. Runoff is slow, and erosion is slight. (Capability unit IIIc–1; Loamy Plains range site in the eastern part of the county, and Loamy Foothill range site in the western part; tree planting suitability group 1)

Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes (NrB).—This complex of undulating soils occurs mainly in the central part of the county. It is the most extensive mapping unit in the county.

The Nunn soil makes up about 50 to 70 percent of this complex, and Ascalon and Bresser soils, 25 to 45 percent. Included with these soils in mapping were low-lying areas called wet weather lakes that make up 5 percent of the area mapped.

The Nunn soil occurs on the lower parts of slopes and in the more level areas of this complex. It has a loam surface layer about 8 inches thick and a clay loam subsoil about 20 inches thick. Lime generally occurs at a depth of 18 to 24 inches.

The Ascalon and Bresser soils are intermingled and occupy the higher areas of this complex. The Bresser soil is dominant in the southern part of the county and near the streams; the Ascalon soil occurs mainly in the northern part of the county. Ascalon and Bresser soils have a sandy loam surface layer about 6 inches thick. Their subsoil is sandy clay loam about 20 inches thick. Depth to lime is 14 to 30 inches in the Ascalon soil and is more than 60 inches in the Bresser soil.

Nearly all of the acreage of this complex is cultivated. The soils in this complex are well suited to crops. They are easy to work, and they have a moderate rate of water intake. The Nunn soils have high available water holding capacity, and the Bresser and Ascalon soils have moderate available water holding capacity. Erosion is slight to moderate. The Ascalon and Bresser soils are more susceptible to soil blowing than the Nunn soil. Stripcropping and stubble mulching help to conserve moisture and to control erosion. (Capability unit IIIc–1; Loamy Foothill range site; tree planting suitability group 1)

Olney Series

The Olney series consists of deep, gently sloping to rolling soils that occur in the eastern part of the county.

In a typical profile the surface layer is grayish-brown fine sandy loam that is free of lime and about 6 inches thick. The subsoil, about 12 inches thick, also is free of lime and is brown fine sandy clay loam in the upper part and pale-brown fine sandy loam in the lower part. The underlying material is light yellowish-brown and pale-brown, very strongly calcareous and strongly calcareous fine sandy loam that extends to a depth of 42 inches.

The Olney soils have a moderate rate of water intake and moderate available water holding capacity. They are susceptible to severe water erosion and soil blowing.

These soils are suited to native grass and to wheat and other nonirrigated crops. Most of the acreage is in native grass.

Typical profile of Olney fine sandy loam, 5 to 9 percent slopes, 2,500 feet west and 350 feet south of the northeast corner of section 1, T. 4 S., R. 59 W.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, crumb structure; soft when dry, very friable when moist, noncalcareous; clear, smooth boundary.

A3—4 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, blocky structure that breaks to moderate, fine, angular blocky structure; thin, patchy clay skins; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B2t—6 to 12 inches, brown (10YR 5/3) fine sandy clay loam, brown (10YR 4/3) when moist, moderate, fine, prismatic structure that breaks to moderate to strong, medium, subangular blocky structure; thin, nearly continuous clay skins; hard when dry, friable when moist; noncalcareous; gradual, wavy boundary

B3—12 to 18 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure: thin, patchy clay skins; slightly hard when dry, very friable when moist; noncalcareous; gradual boundary

C1ca—18 to 27 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) when moist; weak, medium, prismatic structure that breaks to weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous

C2—27 to 42 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive (structureless); soft when dry, loose when moist; strongly calcareous

The A horizon ranges from 4 to 8 inches in thickness. The B2t horizon is fine sandy clay loam or clay loam and ranges from 5 to 15 inches in thickness. Depth to lime is 10 to 30 inches. Soft sandstone is at a depth of about 50 inches.

The Olney soils are more clayey in the subsoil and have more distinct horizons than the Terry soils, which are nearby. They are less silty and more sandy than the Baca and Weld soils. Olney soils have finer sand with less feldspar than the Bresser soils.

Olney fine sandy loam, 5 to 9 percent slopes (OnD).—This gently sloping to rolling soil occurs on uplands in the eastern half of the county, mainly in the southern part. This soil has medium runoff, moderate to rapid water intake, and moderate available water holding capacity.

Included with this soil in mapping were a few small areas of Weld fine sandy loam and of Terry fine sandy loam. Also included were some areas of Loamy alluvial land in drainageways.

Most of this soil is in native grass, but a part of it is cultivated. Wheat and sorghum are the main crops. Where cultivated crops are grown, stubble-mulch tillage helps to conserve moisture and to control erosion, but this soil is better protected by reseeding it to grass. Regulating grazing and other good practices of range management are needed on range. (Capability unit VIe–3; Sandy Plains range site; tree planting suitability group 1)

Renohill Series

The Renohill series consists of moderately deep, well-drained, gently sloping to steep soils that occur on uplands, mainly in the western three-fourths of the county.

In a typical profile the surface layer is grayish-brown, noncalcareous loam about 5 inches thick. The subsoil, about 14 inches thick, is brown and light olive-brown, calcareous clay loam. The underlying material is light grayish-brown clay loam. Brown to olive-gray fractured shale is below a depth of about 26 inches.

The Renohill soils have medium internal drainage, moderately slow to slow permeability, and moderate available water holding capacity. They are moderate in natural fertility, but are susceptible to soil blowing and to water erosion.

Most of the acreage of Renohill soils is in native grass. Because of the slope and of shallowness of the rooting zone, these soils are not suited to cultivated crops.

Typical profile of Renohill loam, 3 to 9 percent slopes, 1,800 feet north and 1,100 feet west of the southeast corner of section 11, T. 5 S., R. 59 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, friable when moist; noncalcareous; clear, smooth boundary.

A12—3 to 5 inches, grayish-brown (10YR 5/2) loam, dark, grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B2t—5 to 10 inches, brown (10YR 5/33) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to moderate to strong, fine, angular blocky structure; hard when dry, firm when moist; patchy clay skins on ped surfaces; mildly calcareous, clear smooth boundary.

B3ca—10 to 19 inches, light olive-brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) when moist; moderate, medium, prismatic structure that breaks to strong, medium to fine, angular blocky structure, hard when dry, firm when moist; patchy clay skins on ped surfaces; strongly calcareous, gradual, smooth boundary

C1ca—19 to 26 inches, light grayish-brown (2.5Y 6/2) clay loam, gravish brown (2.5Y 5/2) when moist and crushed; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; hard when dry, firm when moist; few fine concretions of lime; gradual, smooth boundary.

C2—26 to 36 inches, brown (7.5YR 5/4) to olive-gray (5Y 5/2) fractured shale of clay loam texture, dark brown (7.5YR 4/4) to olive gray (5Y 4/2) when moist; structureless; slightly calcareous to very strongly calcareous.

The A horizon is loam or clay and is 2 to 6 inches thick The B2t horizon ranges from 5 to 10 inches in thickness and from clay loam to clay in texture When the C1ca horizon is moist, colors range from olive (5Y 5/3) to light brownish gray (2.5Y 6/2). The profile normally is free of lime in the upper 4 or 5 inches, but in a few places it is calcareous throughout Depth to hard shale or sandstone ranges from 20 to 40 inches. In the southwestern part of the county are a few areas of a Renohill loam that is much redder than is typical for Renohill soils

The Renohill soils are less deeply leached of lime and are more shallow over shale or sandstone than the Buick soils, which are nearby. They are deeper and have more distinct horizons than the Thedalund and Samsil soils.

Renohill loam, 3 to 9 percent slopes (RdD).—This gently sloping to sloping soil is on uplands in the western three-fourths of the county. It has the profile described as typical for the series. Surface runoff is medium to rapid. The available water holding capacity is moderate.

Included with this soil in mapping were small areas of Thedalund clay loam, of Samsil clay, and of Buick loam. Also included in cultivated areas were areas of a Renohill soil that has a clay loam surface layer because the original surface layer has been mixed with material from the subsoil.

This soil is not suited to cultivated crops, and most areas are in native grass. Good range management is needed to prevent overgrazing. (Capability unit VIe–1; Loamy Plains range site; tree planting suitability group 4)

Renohill loam, reddish variant, 5 to 20 percent slopes (ReE).—This soil occurs on uplands in the southwestern part of the county. It is scattered in areas that generally are less than 40 acres in size. Except for the slope and the reddish color of this soil, it is similar to Renohill loam, 3 to 9 percent slopes.

Included with this soil in mapping were small areas of Litle silty clay loam.

This soil is mostly in native grass and is used for grazing livestock. It also is a source of clay material that is used to make bricks and tile. Because surface runoff is medium to rapid and the hazard of erosion is moderate, careful range management is needed. (Capability unit VIe–1; Loamy Foothill range site; tree planting suitability group 4)

Renohill-Buick loams, 3 to 9 percent slopes (RhD).—This complex is on uplands in the western three-fourths of the county. Drainageways are well established and generally are less than 150 feet wide.

Renohill loam makes up to 40 to 70 percent of this complex, and Buick loam, 20 to 40 percent. Included with these soils in mapping were areas of Fondis silt loam, of Litle silty clay loam, and of Loamy alluvial land. Also included, along crests of ridges that face north or west, were areas of Buick soil where soil blowing has been severe. Lime is near the surface in these areas, which have shallow gullies and are lighter colored where cultivated.

The Renohill soil occurs on side slopes that generally extend to the drainageways. Its surface layer is loam to clay loam about 4 inches thick. The subsoil is calcareous clay loam to clay. Depth to shale is about 30 inches.

The Buick soil occupies the higher areas of the complex. It has a loam surface layer about 4 inches thick. In the subsoil, which is clay loam about 16 inches thick, lime is about 10 inches from the soil surface. The underlying material is clay loam that extends to a depth of 4 or 5 feet.

Most of this complex is in grass. Because of shallowness and the severe hazard of erosion, the soils in this complex are not suited to cultivated crops. (Capability unit VIe–1; Loamy Foothill range site in the western part of the county, Loamy Plains range site in the eastern part; tree planting suitability group 4)

Renohill-Buick loams, 9 to 20 percent slopes (RhE).—These soils are on uplands in the western three-fourths of the county.

Renohill loam makes up about 50 to 70 percent of this complex, and Buick loam, 10 to 30 percent. Included with these soils in mapping were areas of Samsil clay and of Loamy alluvial land.

The Renohill soil occurs on the lower parts of slopes. Except for slopes and the thinner surface layer, this soil has a profile similar to that described as typical for the series.

The Buick soil is on the upper parts of slopes. Except for the thinner surface layer and lime at a depth of about 8 inches, this soil has a profile similar to that described as typical for the series.

Surface runoff is medium to rapid, and water intake is moderate to slow.

Most of this complex is in native grass. Because of shallowness and the severe hazard of erosion, the soils in this complex are not suited to cultivated crops. (Capability unit VIe–1; Loamy Foothill range site in the western part of the county, Loamy Plains range site in the eastern part; tree planting suitability group 5)

Renohill-Buick complex, 5 to 20 percent slopes, eroded (RkE2).—This complex occurs in the western three-fourths of the county.

Renohill clay loam makes up 40 to 50 percent of this complex; Buick loam or clay loam, 20 to 40 percent; and Thedalund clay loam, about 10 to 20 percent. Included with these soils in mapping were areas of Colby soils and of Adena soils.

The Renohill soil occurs on the lower parts of slopes, the Buick soil is on the higher slopes, and the Thedalund soil occupies areas near drainageways. Most slopes are more than 500 feet long. Erosion has removed most of the original surface layer from these soils, and many gullies have formed. The gullies range from 6 inches to 2 feet in depth and from 1 to 3 feet in width; they generally are less than 300 feet apart.

The soils in this complex are used as range. They have been cultivated, but cropping has been abandoned in many areas, though some have been reseeded to grass. The recovery of plant cover, which helps to control erosion, can be accelerated by building diversions to carry runoff, by contour furrowing, and by pitting in conjunction with controlled grazing. (Capability unit VIe–2; Clayey Foothill range site; tree planting suitability group 5)

Renohill-Litle clay loams, 3 to 9 percent slopes (RlD).—These soils are on uplands in the southwestern part of the county.

Renohill clay loam and Litle clay loam are in about equal acreages, and together they make up about 90 percent of the complex. Fondis and Buick soils make up the remaining 10 percent. Included with these soils in mapping were small areas of Loamy alluvial land along the well established drainageway. Also included were many small knobs covered with gravel.

The Renohill and Litle soils are intermingled on side slopes that generally are 500 feet or more long. They are thinnest in areas next to drainageways. Each kind of soil has a profile similar to the one described for its respective series. The Fondis and Buick soils occupy the highest areas in the complex.

Most of this complex is in native grass or is used for homesites. Because of rapid runoff and the severe hazard of erosion, the soils in this complex are not suited to cultivated crops. Gullies as much as 12 inches deep are common in cultivated areas. If not protected by a plant cover, these soils are susceptible to severe soil blowing. They have a moderate to slow rate of water intake and moderate to high available water holding capacity. Pitting, contour furrowing, and diversions help to control runoff so that water can soak into the soil. (Capability unit VIe–2; Clayey Foothill range site; tree planting suitability group 4)

Renohill-Litle-Thedalund complex, 9 to 30 percent slopes (RtE).—This complex occurs in the western part of the county and occupies areas ranging from 20 to 320 acres in size.

Renohill loam makes up 20 to 40 percent of this complex; Litle silty clay loam, 30 to 40 percent; and Thedalund loam or clay loam, 10 to 30 percent. Included with these soils in mapping were areas of Tassel soils, of Gravelly land, and of Rock outcrop that together make up as much as 15 percent of some mapped areas.

The Renohill soil has a loam surface layer about 3 inches thick and a calcareous clay loam to clay subsoil about 12 inches thick. Depth to shale is about 24 inches.

The Litle soil has a silty clay loam surface layer about 3 inches thick. The next layer is calcareous clay loam to clay, and it extends to shale at a depth below 24 inches.

The Thedalund soil has a surface layer of clay loam or loam about 5 inches thick. Shale is at a depth of less than 16 inches.

The soils in this complex are too shallow and steep to be cultivated. Most of the acreage is in grass. Runoff is medium to rapid, and there are a few small gullies and small landslips. Good range practices are needed to prevent overgrazing and to control erosion. (Capability unit VIe–2; Clayey Foothill range site; tree planting suitability group 5)

Rock Outcrop

Rock outcrop (Ru) occurs near large structures in the western part of the county. The largest areas are near the runways at Buckley Air National Guard Base and near Cherry Creek Dam. In areas of Rock outcrop, the soils have been stripped so that interbedded shale and sandstone are exposed at the surface. The areas are sloping to nearly level and as much as 60 acres in size.

Shale is dominant. It varies in color and texture, but normally is olive clay loam. It is hard and platy and resists penetration of water. The sandstone is very hard and coarse grained.

Except for a few annual weeds in most areas, little vegetation grows in areas of Rock outcrop. The hazards of soil blowing and water erosion are severe. (Capability unit VIIIs–1; tree planting suitability group 5; no range site assigned)

Samsil Series

The Samsil series consists of shallow, well-drained, strongly sloping to very steep soils that occur on uplands throughout the county.

In a typical profile the surface layer is light yellowish-brown, strongly calcareous clay loam about 5 inches thick. The next layer is light brownish-gray, slightly calcareous clay about 7 inches thick. This layer is underlain by slightly calcareous, light brownish-gray to pale-olive clay shale.

The Samsil soils have a very slow rate of water intake. Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

These soils are not suited to cultivated crops. Most of the acreage is in native range.

Typical profile of a Samsil clay loam, 200 feet south and one-half mile east of the northwest corner of section 25, T. 5 S., R. 59 W.:

A1—0 to 5 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) when moist; moderate, fine, granular structure, slightly hard when dry, firm when moist, strongly calcareous, clear, slightly wavy boundary

AC—5 to 12 inches light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist, massive (structureless) that breaks to weak, coarse, subangular blocky structure, very hard when dry, very firm when moist, slightly calcareous, material from A1 horizon in cracks that extend to bottom of AC horizon

R—12 to 20 inches, light brownish-gray to pale-olive clay shale; few vertical fractures, slightly calcareous

The A horizon ranges from clay loam to clay in texture and from 3 to 6 inches in thickness. Depth to shale is 6 to 14 inches. In some places the profile contains much gypsum and other salts. In many places, plates or crystals of selenite (gypsum) are scattered on the surface and throughout the profile. These plates are about 6 inches long and 4 inches wide.

The Samsil soils are more shallow over shale than Renohill soils, which have a B horizon.

Samsil clay, gypsum, 5 to 20 percent slopes (SaE).—This soil occurs on uplands in the eastern part of the county. It has a surface layer of light olive-gray, calcareous silty clay 2 to 6 inches thick. Many selenite (gypsum) crystals are scattered on the surface. The next layer, 2 to 8 inches thick, is silty clay that is high in content of gypsum. The underlying material consists of dense, clayey shale that is high in gypsum and other salts.

Included with this soil in mapping were barren spots of raw shale that make up 10 to 30 percent of each area mapped. On these spots, gypsum crystals, several inches long, are common. Also included were small areas of Litle silty clay loam and of Clayey alluvial land in the drainageways.

This soil is not suited to cultivated crops. All of the acreage is in native grasses that include blue grama, alkali sacaton, saltgrass, and western wheatgrass. Because surface runoff is rapid and water intake is slow, good range management is needed for controlling erosion. On slopes of more than 8 percent, steps 6 to 18 inches high are common where the soil has slipped. (Capability unit VIs–1; Alkaline Plains range site; tree planting suitability group 5)

Samsil-Litle stony clays, 20 to 50 percent slopes (SlF).—These soils are on uplands southeast of South Cherry Creek in the southwestern part of the county. Slopes generally are less than 300 feet long, and drainageways are about 50 feet wide.

This complex consists of Samsil stony clay and Litle stony clay in about equal acreages. Included with these soils in mapping were small areas of Renohill and Thedalund soils and of Clayey alluvial land in drainageways.

The Samsil soil has a surface layer about 3 inches thick. Depth to shale is about 6 to 14 inches. The Litle soil has a surface layer of stony clay or stony clay loam about 3 inches thick. It is underlain by a layer of calcareous clay about 16 inches thick that contains fewer stones than the surface layer. Depth to shale is about 20 to 30 inches. On these Samsil and Litle soils, round, waterworn cobblestones and stones of granite and quartz, 3 to 20 inches in diameter, cover 50 percent or more of the surface. They are thickest in areas that occur on knobs, and they slow runoff and help to increase water intake.

This complex is in native grasses and shrubs that include western wheatgrass, blue grama, green needlegrass, sideoats grama, junegrass, and mountain-mahogany. (Capability unit VIIs–1; tree planting suitability group 5; range site not assigned)

Samsil-Renohill clay loams, 3 to 20 percent slopes (SrE).—This complex occurs on uplands in the central part of the county. Most areas are large and are on slopes facing west or north. The Samsil and Renohill soils each have a profile similar to the one described as typical for its respective series.

Samsil clay loam makes up about 35 to 70 percent of this complex, and Renohill clay loam, 30 to 65 percent. Included with these soils in mapping were small areas of Buick soils, of Colby soils, and of Shale outcrop. Also included were gravelly knobs and some slick spots.

The Samsil soil is near drainageways, and the Renohill soil occurs on the smoother part of slopes.

Most of this complex is in native grass and is used for grazing livestock. The main native plants are western wheatgrass and blue grama. Surface runoff is medium to rapid. In the steeper areas, some gullies and steps have formed. The steps are 3 to 12 inches high. (Capability unit VIe–2; Clayey Plains range site; tree planting suitability group 5)

Samsil-Shale outcrop complex (Ss).—In this complex are Samsil soils and outcrops of shale that occur on uplands in the western three-fourths of the county. Slopes range from 9 to 20 percent. This Samsil soil has the profile described as typical for the Sansil series.

The Samsil soil makes up 60 to 70 percent of this complex, and Shale outcrop, 30 to 40 percent. Included with this complex in mapping were small areas of Renohill loam.

This complex is in native vegetation. It supports very thin stands of blue grama, western wheatgrass, and sideoats grama. Surface runoff is rapid, and erosion is severe. Soil slips, which have exposed large areas of shale, are common. (Capability unit VIIs–1; Shale Breaks range site; tree planting suitability group 5)

Sand Pits

Sand pits (St) occur in nearly level areas in the western part of the county near Cherry Creek Dam. They are open excavations several feet deep and 20 acres or more in size. Pale-brown sand is visible at the border of these pits.

Sand pits are very low in natural fertility and are highly susceptible to soil blowing. Soil blowing can be reduced by a cover of weeds or by applications of straw and manure. (Capability unit VIIIs–1; tree planting suitability group 5; no range site assigned)

Sandy Alluvial Land

Sandy alluvial land (Su) occurs as narrow areas along the major drainageways next to the stream channels in the western three-fourths of the county.

The profile is variable, but commonly the surface layer is pale-brown, loose sand and some fine gravel. It is noncalcareous and about 10 inches thick. In this layer are roots of grasses and weeds. The next layer consists of pale-brown, loose sand and some fine gravel. It is 1 foot to many feet thick. In some places strata of loam to sandy loam that contain some lime occur below a depth of 2 feet. Water is below a depth of 5 feet in some places, and roots are below 3 feet.

Included with this land in mapping were a few small areas of Wet alluvial land and of Loamy alluvial land.

Sandy alluvial land is droughty and unstable. It is subject to yearly flooding, to deposition of sand, and to soil blowing. Growing in most places are trees, such as cottonwood, and some grasses, normally annuals. The trees protect livestock and provide cover for wildlife. (Capability unit VIIw–1; tree planting suitability group 2; no range site assigned)

Shale Outcrop

Shale outcrop (Sv) is made up of areas in which shale and some sandstone are exposed. These areas are adjacent to the major drainageways in the county. Slopes from 9 to 50 percent, and gullies, 1 foot to 20 feet deep, have formed in some places. Included with this mapping unit were small areas of Thedalund clay loam.

A good cover of grass and a few trees grow in some places along the bottoms of drainageways that contain flowing springs. The side slopes are sparsely covered with grass, mainly alkali sacaton. Because of the slope and the texture of the soil material, surface runoff is rapid and erosion is a severe hazard. (Capability unit VIIs–1; Shale Breaks range site; tree planting suitability group 5)

Stapleton Series

The Stapleton series consists of moderately deep, strongly sloping to steep soils on uplands in the southwestern part of the county. These soils developed in material that weathered from arkosic sandstone.

In a typical profile the surface layer is grayish-brown sandy loam about 8 inches thick. It contains mica and fine gravel in noticeable amounts. The next layer, about 8 inches thick, is light brownish-gray sandy loam. The underlying material extends to a depth of 25 inches and consists of pale-yellow sandy loam and partly consolidated fine gravel and siltstone in which there is much visible mica. This layer is underlain by arkosic sandstone.

The Stapleton soils have moderate to rapid water intake and low available water holding capacity. Because of the slope, runoff is rapid. These soils are susceptible to both water erosion and soil blowing, but water erosion is the more severe hazard.

These soils are in native grass and pine trees. Because these soils are only moderately deep and are droughty, they are not suited to cultivated crops.

Typical profile of Stapleton sandy loam, 9 to 30 percent slopes, 1,750 feet south and 400 feet west of northeast corner of section 30, T. 5 S., R. 65 W.:

A1—0 to 8 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; fine gravel and mica; noncalcareous; clear, wavy boundary.

AC—8 to 16 inches, light brownish-gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; horizon is a mixture of light olive-brown and grayish-brown sandy loam material in which fine gravel and mica are evident. noncalcareous, clear, smooth boundary

C—16 to 25 inches, pale-yellow (2.5Y 7/3) sandy loam, light olive brown (2.5Y 5/6) when moist; massive (structureless); hard when dry, very friable when moist; poorly consolidated beds of fine gravel, siltstone, and much visible mica; noncalcareous

R—25 inches +, arkosic sandstone.

The A horizon ranges from sandy loam to loamy sand in texture and from 3 to 10 inches in thickness. The profile contains enough mica for the soil to feel slick Depth to sandstone ranges from 20 to 40 inches.

The Stapleton soils are lighter colored, more gravelly, and more shallow than the associated Bresser soils and have less well-defined horizons They are similar to the Thedalund soils but have a darker colored surface layer, and they formed in material that weathered from arkosic sandstone instead of sandstone and shale.

Stapleton sandy loam, 9 to 30 percent slopes (SwE).—This soil occurs only along South Cherry Creek and its tributaries in the southwestern part of the county. Included with this soil in mapping were small areas of Bresser sandy loam and of Sandy alluvial land. Also included were a few outcrops of sandstone and shale.

This soil is in native grasses that include big bluestem, sand reedgrass, needle-and-thread, and blue grama. A few ponderosa pine grow in places. Surface runoff is rapid, and deep gullies having vertical banks 5 to 10 feet high are common along the drainageways. (Capability unit VIe–3; tree planting suitability group 5; no range site assigned)

Tassel Series

The Tassel series consists of shallow, gently sloping to steep soils that occur on uplands, mostly in the eastern half of the county.

In a typical profile the surface layer is slightly calcareous, grayish-brown fine sandy loam 3 inches thick. The next layer, 6 inches thick, is very strongly calcareous, grayish-brown fine sandy loam. The underlying material is pale-yellow, very strongly calcareous fine sandy loam. At a depth of 18 inches is soft, fine-grained sandstone.

The Tassel soils have a rapid rate of water intake and low available water holding capacity. They are low in natural fertility and are highly susceptible to soil blowing unless protected by vegetation.

These soils are in native grasses, mainly sandreed, big bluestem, sand bluestem, and little bluestem.

Typical profile of a Tassel fine sandy loam, near the center of section 26, T. 5 S., R. 58 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, granular structure; soft when dry, very friable when moist, slightly calcareous; clear, smooth boundary.

AC—3 to 9 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure that breaks to weak, coarse, subangular blocky structure; soft when dry, very friable when moist, few sandstone pebbles stained with iron, very strongly calcareous, clear, smooth boundary.

C—9 to 18 inches, pale-yellow (2.5Y 7/4) fine sandy loam, light olive brown (2.5Y 5/4) when moist; massive (structureless); slightly hard when dry, very friable when moist, few sandstone pebbles stained with iron; very strongly calcareous; gradual, smooth boundary.

R—18 inches +, soft, fine-grained sandstone.

The horizons range from fine sandy loam to loamy fine sand in texture. Depth to soft, fine-grained sandstone is 12 to 18 inches

The Tassel soils are shallower to sandstone than the Terry soils.

Tassel-Rock outcrop complex (Ta).—This complex consists of steep soils on broken slopes in the eastern part of the county. It occurs mostly as narrow bands along the eastern side of Deer Trail Creek.

The Tassel soil makes up about 70 to 80 percent of this complex, and Rock outcrop, 20 to 30 percent.

The Tassel soil has the profile described as typical for the series. Rock outcrop is fine-grained sandstone.

This complex provides limited grazing. Good range management is needed to prevent overgrazing and to control erosion. Water intake is rapid, but erosion is a severe hazard because the soil material holds little water and slopes are steep. (Capability unit VIIs-1; Sandstone Breaks range site; tree planting suitability group 4)

Terrace Escarpments

Terrace escarpments (Tc) occur throughout the county next to streams and drainageways. They consist of areas in which nearly vertical banks as much as 20 feet high have been cut. The soil material is deep, clayey to sandy, and generally is stratified and calcareous. Included with this land type in mapping were small areas of Loamy alluvial land.

Terrace escarpments are suitable for limited grazing. Erosion, mainly water erosion, is a severe hazard, and soil slipping and sloughing are common. Because the slips and sloughs can be stabilized by vegetation, grazing should be carefully controlled. (Capability unit VIIs-1; tree planting suitability group 5; no range site assigned)

Terry Series

The Terry series consists of moderately deep, rolling to hilly soils on uplands in the eastern part of the county. These soils developed in material weathered from sandstone.

In a typical profile the surface layer is grayish-brown, noncalcareous fine sandy loam about 8 inches thick. The subsoil, about 12 inches thick, is light yellowish-brown, noncalcareous fine sandy loam. The underlying material is light-gray, very strongly calcareous fine sandy loam to a depth of 26 inches and is light brownish-gray decomposed sandstone below. Hard sandstone occurs at a depth of 50 inches.

The Terry soils have a rapid rate of water intake and low available water holding capacity. These soils are low to moderate in fertility and are subject to severe erosion. Unprotected areas are highly susceptible to soil blowing.

These soils are not suited to cultivated crops. Most of the acreage is in native grass.

Typical profile of Terry fine sandy loam, 5 to 20 percent slopes, 300 feet north and 1,440 feet east of the center of section 6, T. 4 S., R. 58 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, loose when moist, noncalcareous; clear, smooth boundary.

A3—5 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure that breaks to weak, coarse, subangular blocky structure; soft when dry, very friable when moist; noncalcareous, clear, smooth boundary

B2t—8 to 13 inches, light yellowish-brown (2.5Y 6/4) fine sandy loam, olive brown (2.5Y 4/4) when moist; weak, medium, prismatic structure that breaks to moderate, medium, subangular blocky structure; slightly hard when dry, very friable when moist; few thin clay films on vertical faces of peds; noncalcareous, clear, smooth boundary.

B3—13 to 20 inches, light yellowish-brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) when moist; weak, coarse, prismatic structure that breaks to weak, medium, subangular blocky structure; soft when dry, very friable when moist; few thin, patchy clay films on vertical faces of peds; noncalcareous; clear, smooth boundary.

C1ca—20 to 26 inches, light-gray (2.5Y 7/2) fine sandy loam, light brownish gray (2.5Y 6/2) when moist; weak, coarse, prismatic structure that breaks to weak, coarse, subangular blocky structure; soft when dry, very friable when moist; very strongly calcareous; some mica visible; gradual boundary.

C2—26 to 50 inches, light brownish-gray (2.5Y 6/2), partly decomposed sandstone

R—50 inches, hard sandstone.

The A horizon ranges from 3 to 8 inches in thickness and from loamy fine sand to fine sandy loam in texture. The B2t horizon ranges from 5 to 10 inches in thickness Flat fragments of sandstone, as much as 2 inches in diameter, are common and increase with depth. Lime occurs at a depth of 8 to 26 inches. The hard sandstone generally is noncalcareous.

The Terry soils are more shallow and more sandy than the associated Olney soils and have less distinct horizons They are deeper over sandstone, less limy, and more sandy than the nearby Thedalund soils.

Terry fine sandy loam, 5 to 20 percent slopes (TdE).—This rolling to hilly soil occurs in large areas on uplands in the southeastern part of the county. These areas are on the eastern side of Deer Trail Creek. This soil has the profile described as typical for the series. Surface runoff is slow to medium, water intake is rapid, and available water holding capacity is low.

Included with this soil in mapping were a few small areas of Thedalund loam, of Olney fine sandy loam, and of Sandy alluvial land in drainageways. Outcrops of sandstone make up less than 10 percent of the area mapped.

This soil is in native grass, or it has been seeded to grass in formerly cultivated areas. Soil blowing is a severe hazard where the plant cover is sparse. A good stand of grass can be maintained and soil blowing controlled by deferring grazing periodically. (Capability unit VIe-3; Sandy Plains range site; tree planting suitability group 2)

Terry-Olney-Thedalund sandy loams, 5 to 20 percent slopes (TeE).—This complex occurs on uplands in the eastern part of the county. Runoff is moderate to rapid.

In some places small slips or steps occur on the Thedalund soil.

Terry sandy loam makes up 40 to 50 percent of this complex; Olney sandy loam, 20 to 30 percent; and Thedalund sandy loam, 20 to 30 percent. Outcrops of sandstone make up about 10 percent of the area mapped. Included with these soils in mapping were small areas of Baca loam and of Tassel sandy loam.

Most of this complex is rangeland. Because the soils are steep and are severely susceptible to erosion, they are not suited to cultivated crops. The few areas that were cultivated have been severely eroded and, in places, the subsoil has been exposed. Numerous gullies, 6 to 12 inches deep and 20 to 100 feet apart, have formed. In most places, however, the formerly cultivated areas have been reseeded to grass. Good range management, including regulation of grazing, is essential in controlling erosion. (Capability unit VIe–3; Sandy Plains range site; tree planting suitability group 4)

Thedalund Series

The Thedalund series consists of moderately deep, strongly sloping to steep soils on uplands throughout the county. These soils developed in material weathered from interbedded sandstone and shale.

In a typical profile the surface layer is light olive-brown, noncalcareous light clay loam about 5 inches thick. Below this is a layer of light olive-brown, strongly calcareous light clay loam about 4 inches thick. The underlying material is very strongly calcareous and consists of light yellowish-brown silty clay loam to a depth of 13 inches and of light yellowish-brown disintegrated shale and sandstone below. Consolidated shale that contains crystals and seams of gypsum and strata of sandstone and siltstone are at a depth of about 30 inches.

The Thedalund soils have moderate to rapid water intake and moderate available water holding capacity. They are droughty, moderate to low in natural fertility, and susceptible to severe water erosion and soil blowing.

These soils are used mainly for native pasture. Because of droughtiness, low fertility, and the severe hazards of water erosion and soil blowing, they are not suited to cultivated crops.

Typical profile of Thedalund clay loam, 9 to 20 percent slopes, 800 feet east of the southwest corner of section 12, T. 5 S., R. 58 W.:

A11—0 to 1 inch, light olive-brown (2.5Y 5/4) light clay loam, olive brown (2.5Y 4/4) when moist, weak, medium, crumb structure that breaks to weak, medium, platy structure, soft when dry, friable when moist, noncalcareous abrupt, smooth boundary

A12—1 to 5 inches, light olive-brown (2.5Y 5/4) light clay loam, olive brown (2.5Y 4/4) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; small, flat fragments of sandstone common; clear, smooth boundary

AC—5 to 9 inches, light olive-brown (2.5Y 5/4) light clay loam, olive brown (2.5Y 4/4) when moist; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; strongly calcareous; small, flat fragments of sandstone common; clear, smooth boundary.

C1ca—9 to 13 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) when moist; weak, medium, prismatic structure; slightly hard when dry, friable when moist; concretions of lime and mottles of iron; very strongly calcareous; more fragments of sandstone than in the AC horizon; clear, smooth boundary

C2—13 to 30 inches, light yellowish-brown (2.5Y 6/4) disintegrated shale and sandstone, some concretions of iron and lime; very strongly calcareous.

R—30 inches +, consolidated shale containing crystals and seams of gypsum and strata of sandstone and siltstone; strongly calcareous.

The A horizon ranges from 2 to 5 inches in thickness and from light clay loam to heavy sandy loam in texture. The C horizon is 15 to 35 inches thick. The texture of the strata within the C horizon ranges from clay loam to sand, but is generally loam.

The Thedalund soils contain more clay than the Terry soils, which have a B horizon. They are coarser textured, generally are deeper, and support more vegetation than Samsil soils.

Thedalund clay loam, 9 to 20 percent slopes (ThE).—This soil is on uplands, mainly in the eastern part of the county along Badger Creek. Areas generally are less than 160 acres in size. Runoff is rapid, water intake is moderate, and available water holding capacity is moderate. This soil has the profile described as typical for the series.

Included with this soil in mapping were a few small areas of Baca loam and of Samsil clay, gypsum. Outcrops of barren, hard sandstone, less than 50 feet across, make up a small percentage of any area mapped.

All of this soil is native range. Some of the grasses are blue grama, western wheatgrass, and needlegrass. Cultivated crops are not suited, but a few fields have been cultivated and then abandoned. These areas can be stabilized by seeding grasses and controlling grazing. (Capability unit VIe–1; Loamy Slopes range site; tree planting suitability group 5)

Thedalund clay loam, 9 to 20 percent slopes, eroded (ThE2).—This soil is mainly along drainageways and in old abandoned fields in the eastern part of the county. It occurs within and adjacent to areas of Thedalund clay loam, 9 to 20 percent slopes.

In the abandoned fields, erosion has removed all of the original surface soil, and in many places the underlying shale and sandstone are exposed. Along drainageways the soil has slipped and gullies have formed, and in many places the underlying material has been exposed. This soil has a moderate rate of water intake and low available water holding capacity, and it erodes easily and tends to slip during periods of heavy rains.

Included with this soil in mapping were a few areas of Baca loam and of Samsil clay, gypsum. Also included, in areas generally less than 50 feet in diameter, were barren knobs of hard sandstone, but these make up only a small percentage of the area mapped.

Most of this Thedalund soil is in grass. Much more grass grows on the deep loamy alluvium in the drainageways than grows on the side slopes. (Capability unit VIe–2; Clayey Plains range site; tree planting suitability group 5)

Truckton Series

The Truckton series consists of deep, rolling to hilly soils that occur on uplands in the western three-fourths of the county. These soils developed in sandy material deposited by wind.

In a typical profile the surface layer is dark grayish-brown, lime-free loamy sand about 6 inches thick. The subsoil, about 24 inches thick, also is free of lime and consists of grayish-brown, brown, and pale-brown sandy loam that is hard or very hard when dry. The underlying material is very pale brown, noncalcareous loamy sand that extends to a depth of 50 inches.

Except in bare areas, the Truckton soils have rapid water intake but only moderate available water holding capacity. In bare areas, the surface tends to crust. Crusting reduces water intake and increases the hazard of water erosion. These soils are droughty, moderate in natural fertility, and highly susceptible to soil blowing.

Truckton soils are suited to grasses and to small grains and sorghums. Most of the acreage is in native grass. Wheat is the main cultivated crop.

Typical profile of a Truckton loamy sand, about 1,100 feet north and 300 feet west of the southeast corner of section 25, T. 5 S., R. 60 W.:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure to massive (structureless); slightly hard when dry, loose when moist: noncalcareous; clear, wavy boundary

B1—6 to 10 inches, grayish-brown (10YR 5/2) light sandy loam, dark grayish brown (10YR 4/2) when moist and crushed; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; hard when dry, very friable when moist; tongues of very dark grayish brown (10YR 3/2) when moist, extend through horizon; noncalcareous; clear, wavy boundary.

B2t—10 to 20 inches, brown (10YR 5/3) sandy loam, brown (10YR 4/3) when moist and crushed; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; hard to very hard when dry, friable when moist; thin, patchy clay skins on faces of peds; tongues of dark grayish brown (10YR 4/2), when moist, extend to base of horizon; noncalcareous; clear, wavy boundary

B3—20 to 30 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist and crushed; weak, medium to coarse, subangular blocky structure; hard when dry, friable when moist; tongues of brown (10YR 4/3), when moist, extend into horizon, noncalcareous; clear, smooth boundary.

C—30 to 50 inches, very pale brown (10YR 7/3) loamy sand, pale brown (10YR 6/3) when moist; massive (structureless); slightly hard when dry, loose when moist; noncalcareous

The A horizon ranges from 4 to 12 inches in thickness and from loamy sand to sandy loam in texture. The B2t horizon is 6 to 18 inches thick and is more clayey than the A horizon. Dark streaks or tongues are common in the B horizon.

The Truckton soils have less clay and more sand than the Bresser soils and thinner, less distinct horizons. They have more clay and less sand than the Blakeland soils and more distinct horizons

Truckton loamy sand, 1 to 5 percent slopes (TrC).—This undulating soil occurs on uplands mainly in the western part of the county, just east of Cherry Creek. It has the profile described as typical for the series. Runoff is slow, the intake of water is rapid, and available water holding capacity is moderate.

Included with this soil in mapping were a few small areas of Blakeland loamy sand and of Bresser sandy loam. Also included were a few severely eroded areas, less than 100 feet in diameter, that are on crests of ridges on slopes facing west.

Most of this soil is cultivated. Winter wheat, barley, and sorghums are commonly grown. Stubble mulch tillage and stripcropping are practices that help to protect this soil from blowing. (Capability unit IVe–5; Sandy Foothill range site; tree planting suitability group 2)

Truckton loamy sand, 5 to 20 percent slopes (TrE).—This rolling to hilly soil is on uplands in the western three-fourths of the county. It occurs in scattered areas, generally on the eastern side of major drainageways. The surface layer is about 5 inches thick and the subsoil is sandy loam about 12 inches thick.

Included with this soil in mapping were a few small areas of Blakeland loamy sand and of Bresser sandy loam. Also included were a few small areas of Samsil-Shale outcrop complex at the base of slopes or in gullies.

Most of this soil is in native grass. Because of droughtiness and a severe hazard of erosion, this soil is not suited to cultivated crops. A few deep gullies have formed, and shale and sandstone are exposed in many places. (Capability unit VIe–3; Sandy Foothill range site; tree planting suitability group 4)

Weld Series

The Weld series consists of deep, well-drained, level to gently sloping soils that occur on uplands throughout most of the county. These soils developed in material deposited by the wind.

In a typical profile the surface layer is grayish-brown, noncalcareous silt loam about 5 inches thick. The subsoil, about 21 inches thick, is brown clay loam in the upper part, grayish-brown silty clay in the middle part, and light yellowish-brown, limy silty clay loam in the lower part. The underlying material is light yellowish-brown, very strongly calcareous silt loam that extends to a depth of more than 60 inches and is easily penetrated by roots.

The Weld soils have a moderate rate of water intake and high available water holding capacity. They are high in natural fertility but are susceptible to erosion if not protected.

These soils are well suited to cultivated crops. Winter wheat and other small grains are suitable crops.

Typical profile of Weld silt loam, 0 to 3 percent slopes, about 800 feet north and 1,000 feet west of the southeast corner of section 16, T. 4 S., R. 59 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B21t—5 to 8 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 3/3) when moist; moderate to strong, medium, prismatic structure that breaks to moderate, fine, subangular blocky structure; thin, nearly continuous clay films on surfaces of peds; noncalcareous; clear, smooth boundary.

B22t—8 to 14 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure that breaks to moderate to strong, fine, angular and subangular blocky structure; very hard when dry, friable when moist; thin, nearly continuous clay films on surfaces of peds; noncalcareous; clear, wavy boundary.

B3ca—14 to 26 inches, light yellowish-brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) when moist; moderate, fine, prismatic structure that breaks to moderate to strong, fine, angular and subangular blocky structure, hard to very hard when dry, friable when moist; thin, patchy clay films on both horizontal and vertical faces of peds; moderate accumulation of

calcium carbonate in form of concretions and thin seams and streaks; very strongly calcareous; gradual, wavy boundary.

Cca—26 to 60 inches +, light yellowish-brown (2.5Y 6/3) silt loam, light olive brown (2.5Y 5/3) when moist; massive (structureless); hard when dry, very friable when moist; weak accumulation of calcium carbonate in form of concretions and thin seams and streaks; very strongly calcareous.

The A horizon ranges from 3 to 9 inches in thickness and from fine sandy loam to silt loam in texture. The B2t horizon is 8 to 20 inches thick.

The Weld soils are more clayey below the surface soil and they have more distinct horizons than the Colby soils and are deeper to lime. They lack the slick spots that are common in the associated Deertrail soils.

Weld fine sandy loam, 1 to 5 percent slopes (WdC).—This soil is on uplands near Deer Trail Creek in the eastern part of the county. Its surface layer is grayish brown and about 7 inches thick. The subsoil is brown clay loam to clay about 20 inches thick. Lime occurs at about 16 inches from the soil surface.

Included with this soil in mapping were a few small areas of Adena fine sandy loam, of Colby fine sandy loam, and of Olney fine sandy loam.

About half of this soil is cultivated, and the rest is range. This soil is easily worked. It is suited to most of the crops commonly grown in the county. Wheat is the most common crop. This soil is more likely to blow than the Weld silt loams because not many clods form on the surface. Stripcropping and stubble mulching help to control soil blowing and to conserve moisture. (Capability unit IVe–6; Loamy Plains range site; tree planting suitability group 1)

Weld silt loam, 0 to 3 percent slopes (WeB).—This soil occurs on uplands in the northern and eastern parts of the county. In many places it has the profile described as typical for the series. In broad depressions and near the foot of slopes, however, the surface soil is about 8 inches thick and the subsoil is about 30 inches thick. Lime occurs at a depth of 18 to 22 inches.

Included with this soil in mapping were small areas of Deertrail silt loam and of Weld silt loam, 3 to 5 percent slopes.

Most of this soil is cultivated. Wheat is the most common crop. This soil has a moderate rate of water intake and high available water holding capacity. The hazard of soil blowing is more severe than that of water erosion. Terracing, stubble mulching, and stripcropping help to control erosion and to conserve moisture. (Capability unit IIIc–1; Loamy Plains range site; tree planting suitability group 1)

Weld silt loam, 3 to 5 percent slopes (WeC).—This soil occurs on uplands. Slopes generally are more than 500 feet long, and drainageways are well established. Except for its thinner surface layer and subsoil, this soil has a profile similar to the one described as typical for the series.

Included with this soil in mapping were a few small areas of Adena silt loam and of Colby silt loam. Also included were a few areas of Loamy alluvial land along drainageways.

This soil is mostly cultivated, though it is more susceptible to soil blowing and to water erosion than Weld silt loam, 0 to 3 percent slopes. Practices that help to control erosion and to conserve moisture are terracing, stubble mulching, stripcropping, and the use of diversions and grassed waterways. (Capability unit IIIe–2; Loamy Plains range site; tree planting suitability group 1)

Weld-Deertrail silt loams, 0 to 3 percent slopes (WrB).—These soils occur on uplands, mainly in the eastern three-fourths of the county.

Weld silt loam makes up 60 to 90 percent of this complex, and Deertrail silty clay loam, 10 to 40 percent.

This Weld soil has a profile similar to the one described as typical for the series. In cultivated areas the Deertrail soil has a silty clay loam surface layer about 4 inches thick, but in sodded areas its surface layer is silt loam about 2 inches thick. The subsoil, about 24 inches thick, is clay in the upper part and is silt loam or silty clay loam in the lower part. Lime occurs at a depth of 5 to 14 inches. The Deertrail soil generally occurs as circular areas, or in slight depressions, less than 1 acre in size. Crops grown on the Deertrail soils are stunted (fig. 7).

Most of this complex is used for cultivated crops. Runoff is slight, and the hazard of soil blowing is moderate. Water intake is moderate on the Weld soil and slow on the Deertrail soil. The Deertrail soil appears as light colored spots in cultivated areas, and crops grown on them are stunted (fig. 8). Practices that help to control erosion and to conserve moisture are stubble mulching and stripcropping. (Capability unit IVs–1; Weld soil is in Loamy Plains range site, and Deertrail soil is in Alkaline Plains range site; tree planting suitability group 4)

Wet Alluvial Land

Wet alluvial land (Wt) occupies nearly level areas next to stream channels throughout the county. It generally is flooded each spring. The soil material is dark colored and occurs in thin layers that range from loam to sand. This material extends to a depth of 4 feet or more and normally becomes more sandy as depth increases. Wet alluvial land is wet below a depth of 3 feet most of the time, and often it is wet at the surface.

Included with this land in mapping were a few small areas of Edgewater loam, of Loamy alluvial land, and of Sandy alluvial land.

This land is not suited to cultivated crops, but it is well suited to grass grown for hay and pasture. Cottonwoods and willows grow in most areas. Some areas along the South Platte River are excellent sources of gravel. (Capability unit VIw–1; Wet Meadow range site; tree planting suitability group 3)

Use and Management of Soils

The soils of Arapahoe County are used extensively for crops, pasture, and range. In some parts of the county cropland is rapidly being replaced by residential and other nonfarm development. In addition to crops, pasture, and range, this section tells how the soils can be managed for nonfarm use, wildlife, recreational areas, and for building highways, farm ponds, and other engineering structures.

In presenting information about the use of soils for crops and pasture, trees, and range, the procedure is to describe a group of similar soils that are suitable for those purposes and to suggest use and management for the group. To determine the soils in each capability unit, range site, and tree planting suitability group, refer to the

Figure 7.—Wheat grown on Weld-Deertrail silt loams, 0 to 3 percent slopes. The wheat on the left was grown on the Deertrail soil and that on the right was grown on the Weld soil.

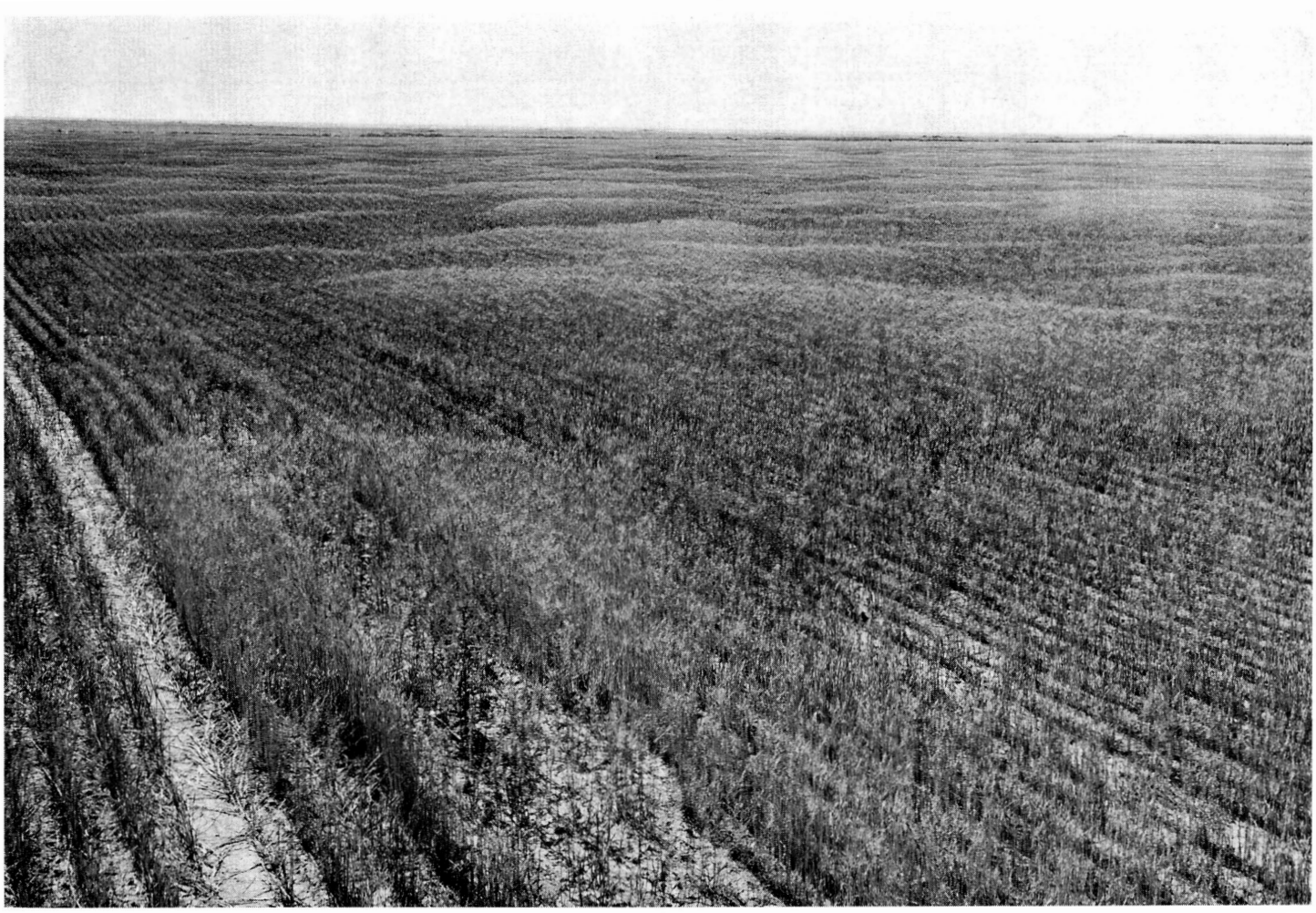

Figure 8.—Wheatfield on Weld-Deertrail silt loams, 0 to 3 percent slopes.

"Guide to Mapping Units" at the back of this survey. In the subsection on engineering, the soils are not grouped but are placed in tables so that properties significant to engineering work can be given readily. In the subsection on nonfarm uses, the soils are rated according to their limitations for selected uses.

Crops and Pasture [2]

This subsection discusses general practices of managing soils for nonirrigated and irrigated crops, explains the system of capability classification used by the Soil Conservation Service, and suggests management by capability groups of soils. Also, a table lists predicted yields of principal nonirrigated crops on arable soils under two levels of management.

General practices of management for nonirrigated and irrigated crops

Farming in Arapahoe County consists mainly of growing nonirrigated winter wheat, barley, and plants that supply supplemental winter feed for livestock. About 60 percent of the acreage is in native range and is grazed by cattle and sheep. About 175,000 acres are used for nonirrigated crops, and only about 2,200 acres are irrigated.

Wheat is the main nonirrigated crop grown in the western part of the county, which is slightly higher, cooler, and wetter than the eastern part. In the eastern part of the county, the principal crops are sorghums and small grains.

In Arapahoe County management practices are particularly needed that conserve moisture, maintain tilth and soil structure, and control soil blowing and water erosion. Most practices used in the county accomplish more than one of these purposes.

Conserving moisture by summer fallowing.—Fallowed soils accumulate moisture and nitrates that can be used by the next crop. In Arapahoe County, 2 years of moisture generally are needed to mature an annual crop. To eliminate vegetation, the soils are worked at about the time weeds or volunteer grains start to grow.

A blade, sweep, or chisel implement is best for tilling fallowed soils, for it leaves on the surface crop residue that protects the soil from soil blowing and helps to keep it porous so that more moisture is absorbed.

Fallowed soils without enough plant cover for protection may require emergency tillage, because they are sus-

[2] James G Bruner, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

ceptible to soil blowing and water erosion. Implements that roughen the surface, bring up clods, and form ridges are effective. Chisels are most effective on the Baca, Fondis, and other loams and silt loams, and listers are most effective on Bijou, Truckton, and other sandy loams and loamy sands.

Maintaining soil tilth and structure.—Crop growth can be maintained or increased by practices that favor or improve soil tilth and structure. In this county the natural structure of most of the soils is favorable for plant growth, but plant growth and water intake are reduced if the structure of the surface layer is destroyed.

Where the soil has been tilled for a long time and most of the crop residue has been removed, soil aggregates of the original structure break into single grains. The sandy loams and loamy sands are then particularly susceptible to soil blowing and to restricted penetration of water and air, and the silt loams also are susceptible.

The tilth of many kinds of soils can be improved by allowing the crop residue to decompose on or near the surface. The decomposed residue helps to form the soil into aggregates that make it mellow and porous. This practice is stubble-mulch farming.

Most of the sandy loams and loamy sands of the county, such as Bijou and Truckton, respond well to nitrogen fertilizer. By applying fertilizer containing nitrogen on these soils, plant growth is increased, more crop residue can be returned to the soil, and soil tilth and structure are improved.

Controlling erosion.—Basic practices that help to control erosion are stubble mulching, leaving crop residue on or near the surface as a protective cover and to improve structure, and seeding permanent grass on steep slopes, in waterways, and in other areas susceptible to erosion.

Stubble-mulch tillage should be practiced on most cultivated soils in the county. Although the Heldt soils are clayey and cloddy, and their surface clods reduce the hazard of soil blowing, residue management may be needed so as to control water erosion and to maintain tilth of the surface layer.

***Figure 9.*—Stripcropping by alternating wheat and fallow helps to control soil blowing. The soils are Fondis-Colby silt loams, 3 to 5 percent slopes.**

Exposed knobs of Truckton, Colby, and Bresser soils should be seeded to permanent grass because they are subject to severe soil blowing. If grazing is controlled, permanent grass also protects steep soils not suitable for cultivation.

Where water concentrates, grassed waterways should be established. If a good grass cover is not maintained, terrace outlets and drainageways are subject to gullying. In addition to controlling erosion, the grass can be used for hay or pasture.

Stripcropping by using strips as much as 165 feet wide and by alternating a crop and summer fallow helps to control erosion (fig. 9). Contour tillage and terraces that have grassed waterways are desirable on loamy soils where slopes are more than 3 percent.

Seeding cropland to permanent grass may be the most effective way to control erosion, and in many places this change is most beneficial to the soils. Other uses that may be suited to nearly all cultivated fields in the county are woodland, windbreaks, shelterbelts, wildlife habitat, and recreational areas.

Irrigated Cropland

The 2,200 acres of irrigated land in Arapahoe County make up less than 1 percent of the total acreage. In the central part of the county, the irrigated land is in small areas along drainageways and is used to grow plants that furnish supplemental feed for livestock. In the western part of the county, a few, small pastures for horses are irrigated with ditchwater from the South Platte River. Much of the irrigated land is rapidly being converted to homesites, and the water is used for domestic purposes.

In the central part of the county, most of the water used for irrigation is from wells that are 50 to 150 feet deep. These wells produce 100 to 400 gallons per minute, and the water is of good to excellent quality for irrigation. Both sprinklers and surface ditches are used. The principal irrigated crops are corn, alfalfa, and pasture. As much as 20 tons of silage per acre is obtained from corn, and annual yields of alfalfa range from 3 to 5 tons per acre.

Adequate fertilizer is required for good growth of irrigated crops. Land leveling, ditch lining, water control structures, and overnight storage ponds help to conserve moisture, to make irrigation easier, and to increase the acreage that can be irrigated.

Most of the soils of the survey area could be irrigated if water were available. The soils most suitable for irrigation are silt loams, loams, and sandy loams in the Bresser, Fondis, Nunn, Fort Collins, Weld, or Bijou series. Among the soils that are difficult to irrigate are the Heldt clays, Samsil clays, Litle silty clay loams, and Truckton loamy sands. These soils contain a large percentage of clay, are sandy, or are shallow.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landform-

ing that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

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

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

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

Class I soils have few limitations that restrict their use. (None in Arapahoe County.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. (None in Arapahoe County.)

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

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Arapahoe County.)

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

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

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

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

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

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe–2 or IVe–1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

The soils of Arapahoe County have been placed in 23 capability units. The soils in each unit have about the same limitations, are subject to similar risks of damage, need about the same kind of management, and respond to management in about the same way. Because the annual precipitation is low in this county, the use of the soils for nonirrigated crops is limited. The soils are only in capability classes III, IV, VI, VII, or VIII. Because only a small acreage is irrigated in this county, none of the soils has been placed in irrigated capability units.

In the following pages each capability unit is described, and management for each is discussed. To determine the soils in each capability unit, refer to the "Guide to Mapping Units" at the back of this survey. Also, the capability unit assigned to any soil is listed at the end of the description of that soil in the section "Descriptions of the Soils."

CAPABILITY UNIT IIIe–1

This unit consists of nearly level to gently sloping, deep soils that occur along major streams and drainageways throughout the county. These soils have a surface layer of sandy loam and a subsoil of sandy loam to sandy clay loam.

The soils in this unit take in water well and have moderate available water holding capacity. They are easy to work but are susceptible to soil blowing if not protected.

These soils are suited to the crops commonly grown in the county. In the western part of the county, winter wheat is the main crop and it is followed by a season of fallow. Farther east some barley and some sorghum are grown for feed. If the content of soil moisture is favorable, sorghum is often planted as a catch crop, as a cover crop, or after wheat is harvested.

The soils in this unit blow unless they are protected. Stubble or crop residue left on the surface through April protects these soils from soil blowing through the windy season. Other practices effective against soil blowing are stripcropping, stubble mulching, minimum tillage, and contour farming.

These soils are well suited to permanent pasture. Suitable pasture plants are smooth brome, wheatgrass, sand lovegrass, and sweetclover.

CAPABILITY UNIT IIIe–2

In this unit are deep, well-drained, gently sloping soils on uplands. These soils have a loamy surface layer and a clayey subsoil.

The soils in this unit absorb water well and have high available water holding capacity. They are easy to work, but erosion and soil blowing are moderate hazards.

These soils are suited to the crops commonly grown in the county. In the western part of the county, winter wheat is the main crop and it is followed by a season of fallow. In the eastern part of the county, sorghum is grown for feed and grain. If moisture is favorable in spring, sorghum is planted as a cover crop, as a catch crop, or after wheat is harvested.

Water erosion and soil blowing are reduced by keeping stubble or crop residue on the surface through spring, and by contour stripcropping. Other practices that help to control erosion are terracing, contour farming, stubble mulching, and wind stripcropping. Grassed waterways are needed as outlets for terraces or in areas where gullies tend to form.

These soils are well suited to permanent pasture. Suitable pasture plants are crested wheatgrass, pubescent wheatgrass, intermediate wheatgrass, and Russian wildrye.

CAPABILITY UNIT IIIc–1

In this unit are deep, well-drained, nearly level to gently sloping soils. These soils have a loamy surface layer and a clayey to loamy subsoil.

The soils in this unit are easily worked. They absorb water well and have moderate to high available water holding capacity. Water erosion is only a slight hazard, but in unprotected areas the hazard of soil blowing is more severe.

These soils are suited to the crops commonly grown in the county. In the southwestern part of the county, low precipitation and a short growing season limit the growth of some crops. Wheat is commonly grown, and it is followed by a season of fallow. Alfalfa and spring barley are also grown.

Runoff and erosion are reduced by keeping crop residue on the surface until early in April. Soil blowing is reduced in spring by planting crops in strips at right angles to the prevailing wind. Other practices for reducing erosion are stubble mulching and terracing.

These soils are well suited to permanent pasture. Suitable pasture plants are smooth brome, wheatgrass, Russian wildrye, and sweetclover.

CAPABILITY UNIT IVe–1

This unit consists of deep, nearly level to gently sloping soils that occur on uplands in the eastern part of the county. These soils have a loamy surface layer and a silt loam to clay loam subsoil.

The soils in this unit are easily worked, absorb water slowly, have rapid runoff, and have high available water holding capacity. Soil blowing and water erosion are severe hazards in unprotected areas.

Sorghum and wheat are the most common crops, but some barley is grown. Generally, wheat is grown for 1 year, and it is followed by 1 year of fallow. Sorghum is sometimes planted after the wheat is harvested, or as a catch crop or a cover crop when the wheat crop fails.

Planting row crops in narrow contour strips or in terraced areas helps to control washing. Essential if a wheat-fallow cropping system is used is careful stubble mulching or contour stripcropping combined with good management of crop residue.

The soils in this unit are better suited to permanent pasture than to cultivated crops. Grasses suitable for seeding pasture are crested wheatgrass, pubescent wheatgrass, intermediate wheatgrass, and Russian wildrye. Native range plants also can be used. Under good management, grazing is regulated so that at least 2 inches of stubble is left on pasture seeded with crested wheatgrass and 3 inches of stubble is left where the pasture is seeded with pubescent wheatgrass and intermediate wheatgrass.

CAPABILITY UNIT IVe–2

Buick loam, 5 to 9 percent slopes, is the only soil in this unit. It is deep and has a clayey subsoil. This soil occurs on uplands in the western three-fourths of the county.

This soil is fairly difficult to work. It absorbs water slowly and has rapid runoff. Water erosion is a severe hazard, and soil blowing is a moderate one.

A large part of the acreage is in native grass, but cultivated crops are grown in some areas. Winter wheat is the main crop, and it is followed by a season of fallow.

Either stubble mulching or terracing combined with contour farming and crop residue management is needed if cultivated crops are grown. Planting crops in narrow, contour strips helps to control soil blowing and water erosion.

Permanent pasture is a good use for this soil. Suitable pasture plants are smooth brome, the wheatgrasses, and Russian wildrye. Native grasses also can be used. Under good management, grazing is regulated so that at least 2 inches of stubble is left in areas in smooth brome, crested wheatgrass, and Russian wildrye and 4 inches is left in areas in other grasses.

CAPABILITY UNIT IVe–3

Only Bresser-Truckton sandy loams, 3 to 5 percent slopes, is in this unit. These soils occur on uplands in the western three-fourths of the county. They are deep and have a sandy loam to sandy clay loam subsoil.

The soils in this unit are easily worked. They absorb water readily and have moderate available water holding capacity. In cultivated areas these soils tend to crust when they dry after a rain. Soil blowing is a severe hazard.

Most of the acreage is in native grass, but some areas are used for cultivated crops. Wheat is the main crop, but sorghum and barley are also grown.

If the soils in this unit are used for cultivated crops, practices are needed that help to control soil blowing and water erosion. Among the practices are keeping stubble or crop residue on the surface through the middle of April, minimum tillage, contour stripcropping, and stubble mulching. Crop residue left on the surface reduces crusting.

These soils are well suited to permanent grass. Suitable pasture plants are smooth brome and the wheatgrasses. Native grasses are also suitable for reseeding. In good pasture management about 3 inches of stubble is left on the surface after grazing.

CAPABILITY UNIT IVe–4

This unit consists of deep and moderately deep, gently sloping to sloping soils on uplands. These soils have a sandy loam surface layer and a sandy loam or sandy clay loam subsoil.

The soils in this unit are easy to work. They take in water readily and have moderate available water holding capacity. Because of the slope, some water is lost through runoff. If these soils are cultivated, both soil blowing and water erosion are hazards.

Most of the acreage is in native grass, but some areas are cropped. Wheat is commonly grown, and it is followed by a season of fallow. Sorghum and sudangrass are also grown.

Intensive management is needed to control soil blowing and water erosion in cultivated areas. Terracing, contour farming, keeping crop residue on the surface through the windy season, and stubble mulching are practices needed to reduce soil blowing and water erosion.

These soils are well suited to permanent pasture. Crested wheatgrass, pubescent wheatgrass, and Russian wildrye are suitable for planting. Pasture is maintained by regulating grazing so that at least 2 inches of stubble is left in areas in crested wheatgrass and 3 inches is left in areas in other grasses.

CAPABILITY UNIT IVe–5

Truckton loamy sand, 1 to 5 percent slopes, is the only soil in this unit. This soil is on uplands in the western part of the county. It has a sandy loam subsoil.

This soil is easy to work, and it absorbs water readily. Unless it is protected, however, it is highly susceptible to soil blowing.

Winter wheat, barley, sorghum, and sudangrass are the principal crops grown on this soil, but a small acreage is used for broomcorn and alfalfa.

This soil needs the protection of growing crops or crop residue at all times. Fallowing is of little benefit and is dangerous. Crops respond well to additions of nitrogen. Practices that protect this soil against soil blowing are stubble mulching and planting crops in extremely narrow strips.

This soil is well suited to permanent native or introduced grasses. Suitable pasture plants are sand lovegrass and bromegrass. Sweetclover also grows well and adds nitrogen to the soil. Under good management, grazing is controlled so that at least 4 inches of stubble is left on the pasture.

CAPABILITY UNIT IVe–6

In this unit are deep, well-drained, nearly level to gently sloping soils on uplands, mainly in the eastern part of the county. These soils have a fine sandy loam surface layer and a clay loam and silt loam subsoil.

The soils in this unit are easy to till. They take in water readily and have high available water holding capacity. Water erosion is a moderate hazard, but in unprotected areas the hazard of soil blowing is severe.

Most areas of these soils are in native grass or seeded pasture, but some cultivated crops are grown, mainly wheat, barley, and sorghum. A year of fallow is needed between crops. Soil blowing is reduced by keeping stubble or crop residue on the surface through April 15 and wind stripcropping, or by stubble mulching.

These soils are suited to permanent native or seeded pasture. Suitable pasture plants are the wheatgrasses, Russian wildrye, and smooth brome. Regulating grazing so that at least 3 inches of stubble is kept on the surface extends the life and productivity of the pasture.

CAPABILITY UNIT IVe–7

Bresser loamy sand, terrace, 0 to 3 percent slopes, is the only soil in this unit. It occurs in nearly level areas, mainly along Kiowa Creek. The subsoil is sandy clay loam.

This soil blows unless it is protected at all times. It absorbs water readily but has only moderate available water holding capacity.

Sorghum and sudangrass are the main crops grown on this soil, but some wheat is grown. Alfalfa grows well but is hard to establish. Crops grown each year help to protect the soil from blowing. Nitrogen is generally beneficial to crops.

If the field is fallowed, it should be carefully stubble mulched or crops should be planted in extremely narrow strips at right angles to the prevailing wind. If annual crops are grown, stubble should be left on the surface until the next crop is planted.

This soil is better suited to permanent grass than to cultivated crops. Plants suitable for pasture are sand lovegrass, bromegrass, and yellow sweetclover. Regulating grazing so that at least 4 inches of stubble is left helps to control erosion and to keep the pasture productive.

CAPABILITY UNIT IVw–1

This unit consists of deep, poorly drained, nearly level to gently sloping soils that occur along major streams in the western part of the county. These soils have a sandy loam or loam surface layer and a sandy loam to clay loam subsoil.

The soils in this unit have a high water table at least part of the year. Unless they are protected, those soils that have a sandy loam surface layer are susceptible to severe soil blowing. Small areas in which salts have accumulated are common.

Some areas in this unit are irrigated, and crops grow well in these areas. Alfalfa is the main nonirrigated crop, but some winter wheat is grown.

If wheat is followed by a season of fallow, stripcropping or stubble mulching is needed to check soil blowing.

The soils in this unit are well suited to permanent grass. Suitable grasses for seeding meadow or pasture are reed canarygrass, tall wheatgrass, intermediate wheatgrass, and tall fescue. Good management requires that grazing be regulated so that at least 4 inches of stubble is left on the surface.

CAPABILITY UNIT IVs–1

In this unit are deep, level to nearly level soils that have a surface layer of clay or silt loam and a subsoil that is clayey or contains a thin layer of silt loam underlain by clay.

The soils in this unit that have a clay surface layer are difficult to work. They absorb water slowly, have high available water holding capacity, and at times are ponded in low areas. The hazards of water erosion and soil blowing are moderate to slight. The soils that have a silt loam surface layer are easy to work, absorb water well, and have high available water holding capacity.

Winter wheat and barley are the main crops grown on these soils. Generally a crop is grown for 1 year and is followed by 1 year of fallow.

On these soils, keeping crop residue on or near the surface is an important practice. The residue increases the intake of water, and it aids in the preparation of seedbeds.

Stubble mulching and stripcropping are practices effective in controlling water erosion and soil blowing.

These soils are well suited to permanent pasture or range. Russian wildrye and the wheatgrasses are suitable pasture plants. Helpful in maintaining the pasture and controlling erosion is the regulation of grazing so that 2 inches of stubble is kept in areas in crested wheatgrass and 3 inches is kept in areas in other grasses.

CAPABILITY UNIT VIe–1

In this unit are moderately deep and deep, gently sloping to steep, loamy soils. These soils take in water well, but they lose a large amount of it through runoff. They erode easily if not protected by a good cover of grass.

The hazard of erosion is so severe that these soils cannot be cultivated safely. They are, however, suited to grass. Most of the acreage is used for grazing, but a part of it is in cultivated crops, and a few areas that were cultivated have been allowed to grow up in annual weeds.

Erosion can be reduced and the plant cover improved by building diversions above areas where gullies have formed, by furrowing on the contour, and by pitting. If the cultivated areas or old fields are reseeded to grass, a cover crop of sorghum or sudangrass should first be established; then suitable grasses can be seeded in the stubble. Suitable pasture plants are crested wheatgrass, intermediate wheatgrass, and pubescent wheatgrass. Suitable range plants are blue grama, side-oats grama, little bluestem, and western wheatgrass. Grazing should be regulated so that at least 2 inches of stubble is left on pasture seeded to crested wheatgrass and 3 inches of stubble is left on pasture seeded to the other grasses.

CAPABILITY UNIT VIe–2

This unit consists of gently sloping to steep soils that have a clay loam surface layer and range from a few inches to several feet in thickness.

These soils take in water slowly, and they lose a large amount of water through runoff. Their surface layer has high available water holding capacity, but generally water from the summer rains moistens only the top 8 to 10 inches of soil.

The soils in this unit are not suited to cultivated crops, but they produce moderate amounts of forage for grazing. Almost all of the acreage is in grass. Cultivated crops are grown in a few small areas, and there are a few bare areas that have been cultivated.

Good management is needed in areas used for grazing. Erosion can be reduced and the plant cover improved by building diversions, by pitting, and by furrowing on the contour. Areas that are now cultivated or that have been cultivated should be seeded to grass. The grass can be seeded in a cover of sorghum stubble. Suitable pasture plants are crested wheatgrass and pubescent wheatgrass. Suitable range plants include blue grama and western wheatgrass. Grazing should be regulated so that at least 2 inches of stubble is left on pasture seeded to crested wheatgrass and 3 inches of stubble is left on pasture seeded to pubescent wheatgrass.

CAPABILITY UNIT VIe–3

In this unit are moderately deep and deep, gently sloping to steep soils. These soils have a surface layer of sandy loam or loamy sand and a subsoil that is mainly sandy clay loam or sandy loam.

The soils in this unit have moderate available water holding capacity. They absorb water rapidly unless the plant cover is poor and the surface soil is compacted. These soils are susceptible to erosion if not protected by a good cover of grass.

Most of the acreage of these soils is used for grazing, but a few areas are cultivated. Areas that are now cultivated should be seeded to permanent pasture or to range. In these areas grass can be seeded in a cover of sorghum or sudangrass stubble. Suitable pasture plants are sand lovegrass and smooth brome. Bluestem and side-oats grama grow well if seeded for range. Because these soils blow, mechanical practices are hazardous and generally are not effective. Careful management of the pasture is necessary for good growth of nutritious forage plants. Under good management, grazing is regulated so that at least 3 inches of stubble is left on the surface.

CAPABILITY UNIT VIe–4

This unit consists of deep, undulating to hilly soils that have a surface layer of loamy sand underlain by loamy sand and sand.

These soils absorb water rapidly but have low available water holding capacity. There is little runoff from these soils, and water erosion is only a slight hazard. In unprotected areas, however, the hazard of soil blowing is severe.

Most of the acreage of this unit is used for range. The soils are too sandy for cultivated crops. Bare areas or areas that are now cultivated should be seeded to range or pasture, but sorghum should be planted first to stabilize the soils, and then the seed can be planted in the stubble. Suitable plants for reseeding range are side-oats grama and the bluestems. Suitable pasture plants include sand lovegrass, smooth brome, and yellow sweetclover. Grazing should be regulated so that at least 4 inches of stubble is left in areas in pasture.

CAPABILITY UNIT VIw–1

Only Wet alluvial land is in this unit. It occupies nearly level areas and is subject to flooding. The soil material is deep to moderately deep alluvium that ranges from loam to sand in texture. It is wet below a depth of 3 feet most of the time, and in many places it is wet at the surface.

This land generally is too wet for cultivated crops, but it is well suited to permanent grass grown for hay or pasture. It is also used as native range. Many areas are an excellent source of gravel.

Suitable pasture plants are tall wheatgrass, tall fescue, intermediate wheatgrass, and reed canarygrass. Switchgrass, indiangrass, and bluestem are suitable for reseeding range. Grazing should be regulated so that at least 3 inches of stubble is left in areas in pasture.

CAPABILITY UNIT VIw–2

This unit consists of deep, nearly level soils. These soils occur along drainageways and major streams and are subject to flooding. They have a moderately fine textured to medium-textured surface layer. Below the surface layer is stratified sandy loam and clay loam or stratified clay and loam.

The soils in this unit take in water well and have moderate to high available water holding capacity. Gullying is a severe hazard in unprotected areas.

These soils are well suited to native range or to permanent pasture. They are not suited to cultivated crops because flooding and erosion are hazards. Barren areas and areas that are now cultivated should be reseeded to grass. Suitable range plants are western wheatgrass and switchgrass. Plants suitable for seeding pasture are tall wheatgrass, intermediate wheatgrass, tall fescue, and sweetclover. Grazing should be regulated so that at least 3 inches of stubble is left in areas in pasture.

CAPABILITY UNIT VIs–1

In this unit are deep and shallow, level to steep, saline soils that occur on stream terraces and uplands. These soils have a clayey surface layer and subsoil. They are underlain by shale at a depth of 6 inches to 3 feet or more. They take in water slowly and lose large amounts of water through runoff.

The soils in this unit are too clayey, too saline, and too shallow or too steep to be used as cropland, but they produce a moderate amount of grass. Nearly all of the acreage is in native grass and should remain so. Barren or critical areas can be reseeded to western wheatgrass, sideoats grama, green needlegrass, and other native grasses, as well as to introduced grasses that include crested wheatgrass and Russian wildrye. Grazing should be regulated so that at least 2 inches of stubble is left in areas where the introduced grasses are seeded.

CAPABILITY UNIT VIs–2

Beckton loam, 0 to 3 percent slopes, is the only soil in this unit. This soil occurs on low terraces, mainly in the eastern part of the county. It is deep, saline, and clayey. Most areas receive water from adjacent areas.

Most of the acreage is in native grass and should remain so. Larger amounts of grass grow in the areas that receive extra moisture through runoff than in other areas. This soil is not suited to cultivated crops because it is clayey and saline. Barren areas should be seeded to alkali sacaton, western wheatgrass, green needlegrass, and other native grasses, or to tall wheatgrass, intermediate wheatgrass, tall fescue, and other suitable pasture plants. Grazing should be regulated so that at least 3 inches of stubble is left in areas in pasture.

CAPABILITY UNIT VIIw–1

This unit consists only of Sandy alluvial land. The soil material is loose sand and fine gravel. In some places strata of loam and sandy loam occur below a depth of 2 feet. Water occurs at a depth of 5 feet or more. This land type is subject to flooding, to deposition of sand, and to severe soil blowing.

Sandy alluvial land is mostly in annual grasses, cottonwood trees, and weeds. It produces very little forage for grazing, but the tall brush or trees growing on this land protect livestock in winter and provide shade in summer. Many areas are suitable as wildlife habitat and recreational areas.

Management of this land type for grazing generally is not feasible unless it is necessary to protect adjacent better soils. Seeding or mechanical treatment of these areas is difficult and has little lasting value.

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CAPABILITY UNIT VIIs–1

This unit consists of shallow, gently sloping to steep soils that are gravelly, sandy, or clayey. These soils generally occur in rough, broken areas where erosion has been active for a long time. Outcrops of sandstone and shale are common.

In this unit the gravelly and sandy soils absorb water rapidly, have low available water holding capacity, and are highly susceptible to soil blowing. The clayey soils absorb water slowly, but large amounts are lost through runoff. Water erosion is a severe hazard.

The soils in this unit are mainly in native grasses and shrubs. They produce only a limited amount of forage for grazing. A protective cover of vegetation is needed at all times to control soil blowing and water erosion. Grazing should be controlled, but seeding or mechanical practices are extremely difficult and have little lasting value.

CAPABILITY UNIT VIIIs–1

This unit consists of nearly level to sloping areas. These areas are made up of barren, interbedded shale and sandstone, or of deep sands, and they range from 20 to 60 acres in size. Soil blowing and water erosion are severe hazards.

Except for a few annual weeds, little or no vegetation grows in the areas that make up this unit. Without major reclamation this land is not suited to any agricultural use, but it can be developed as wildlife habitat. Sand blown from these areas may damage soils in adjacent areas. In some areas it may be necessary to provide a protective cover of mulch, manure, straw, hay, or netted and mastic material to protect the adjacent, more productive soils. Wildlife can be attracted to some areas by planting shrubs and hardy trees and by maintaining the brush piles.

Predicted yields

The predicted average yields per acre of the principal crops grown on the major nonirrigated soils in Arapahoe County are given in table 2 under two levels of management. Predictions are made for nonirrigated soils only. These predictions are based mainly on information obtained from farmers and from other agricultural workers who are familiar with the soils and crops of the county.

Yields in columns A are those expected under the management commonly followed by some farmers in the county. This management does not always include planned cropping systems or conservation practices, such as summer fallow, especially following barley and sorghum; adding fertilizer of any kind; timely tillage; or weed control. The stubble is not left on the surface, and the surface soil may be too fine or pulverized at planting time for soil blowing to be controlled.

Yields expected under improved management are listed in columns B. Improved management includes timely tillage; summer fallow; adequate fertilization; controlling soil blowing; choosing the best crop varieties; and planting pure, clean seeds that have been tested and treated. If these practices are followed and rainfall is above average, yields may be 25 percent or more higher than those shown in columns B of the table. Following these practices may enable crops to survive droughts.

As crop varieties and management techniques improve, yields probably will increase accordingly. Yields may be decreased by dry weather, diseases, or insects.

TABLE 2.—*Predicted average yields per acre for the principal nonirrigated crops under two levels of management*

[Yields in columns A are those to be expected under common management, yields in columns B are those to be expected under improved management]

Soil	Winter wheat		Barley		Forage sorghum	
	A	B	A	B	A	B
	Bu	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Adena-Colby fine sandy loams, 1 to 5 percent slopes	14	17	15	19	1.0	2.5
Adena-Colby silt loams, 1 to 5 percent slopes	14	17	15	19	1.0	2.5
Ascalon sandy loam, 5 to 9 percent slopes	11	14	11	14	.5	1.5
Baca loam, 3 to 5 percent slopes	11	15	12	16	1.0	2.5
Bijou sandy loam, 0 to 3 percent slopes	14	17	15	18	1.5	3.0
Bijou sandy loam, wet, 0 to 3 percent slopes	16	18	15	18	1.5	3.0
Bresser loamy sand, terrace, 0 to 3 percent slopes	12	14	10	12	1.0	2.0
Bresser sandy loam, terrace, 0 to 3 percent slopes	16	18	14	16	1.5	3.0
Bresser loam, gravelly subsoil variant, 1 to 3 percent slopes	14	17	15	18	1.0	2.5
Bresser-Stapleton sandy loams, 3 to 9 percent slopes	12	16	10	12	1.0	2.0
Bresser-Truckton sandy loams, 3 to 5 percent slopes	12	16	10	12	1.0	2.0
Buick loam, 3 to 5 percent slopes	14	18	15	19	1.0	2.5
Buick loam, 5 to 9 percent slopes	12	16	13	17	.5	1.5
Colby silt loam, 1 to 5 percent slopes	11	13	11	13	.5	1.5
Edgewater loam, 0 to 3 percent slopes	14	17	15	18	1.5	3.0
Fondis silt loam, 1 to 3 percent slopes	16	19	17	20	2.0	4.0
Fondis silt loam, 3 to 5 percent slopes	14	18	15	19	1.5	3.0
Fondis-Colby silt loams, 3 to 5 percent slopes	13	16	13	16	1.0	2.5
Fort Collins loam, 0 to 3 percent slopes	15	17	13	16	1.5	3.0
Heldt clay, 0 to 3 percent slopes	13	15	13	15	.75	1.5
Nunn loam, 0 to 3 percent slopes	16	19	17	20	2.0	4.0
Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes	15	18	16	18	1.5	3.0
Truckton loamy sand, 1 to 5 percent slopes	11	14	11	14	1.5	3.0
Weld fine sandy loam, 1 to 5 percent slopes	16	19	17	20	1.5	3.5
Weld silt loam, 0 to 3 percent slopes	16	19	17	20	2.0	4.0
Weld silt loam, 3 to 5 percent slopes	14	18	15	19	1.5	3.0
Weld-Deertrail silt loams, 0 to 3 percent slopes	12	15	13	16	1.0	2.0

Nonfarm Uses of Soils [3]

The expanding metropolitan area of Denver has affected land use in Arapahoe County (fig. 10). The population in the western 15 percent of the county is now about 1,000 people per square mile. As the population expands more areas are used for residential and other nonfarm purposes.

In this county it is very important that the availability of dependable water be determined before planning the use of soils for many nonfarm purposes. The most dependable water for domestic and industrial uses is that piped from municipal water systems. Areas along the major drainageways, particularly along the South Platte River and Cherry Creek, obtain water from wells less than 100 feet deep. In some areas of the uplands, however, a limited amount of water is available from wells that are 300 to 2,500 feet deep. The water from new wells should be tested before it is used for domestic consumption.

In table 3 most of the soils of Arapahoe County are given a rating of *slight*, *moderate*, or *severe* according to the degree of their limitations when used as foundations for small buildings, for homesites, for leaching fields and lagoons, for the disposal of sewage effluent, for streets, for recreational areas, and for landscape plantings. Some of the limiting soil features are also given in the table. The information given in tables 6 and 7 in the section "Engineering Uses of Soils" was used to help evaluate the limitations given in table 3. None of the tables, however, eliminate the need for an investigation at the site of the specified use.

In table 3 a rating of *slight* indicates that a soil has no important limitations to the specified use. A rating of *moderate* shows that the soil has some limitations to the selected use, but these limitations can normally be overcome. A rating of *severe* indicates that the soil has major limitations to the specified use. Some limitations are difficult and expensive to overcome. Areas subject to flooding generally need major and very costly flood control structures before they are used for houses or other buildings, but these areas can be used for parks and other recreational areas. Some limitations can be overcome or corrected. For example, removing and replacing the shaly topsoil in areas of Samsil, Litle, and Renohill soils help in establishing good lawns on those soils.

The nonfarm uses of soils that are listed in table 3 are discussed in the following paragraphs. For the use of a soil as foundations for homes and other small buildings, the ratings in table 3 are based on the soil features requiring special considerations. For example, Fondis and other soils having a high shrink-swell potential generally need specially designed foundations.

The ratings for homesites with public sewage systems are for residential areas, sites for churches, and the like. Slope is a less serious limitation for homesites than for light industrial structures. Some steep soils having slopes that face west, northwest, or southwest are used as homesites in this county because they have an unobstructed view of the Rocky Mountains.

[3] R. D ANDERSON, State resource conservationist, Soil Conservation Service, assisted in preparing this section.

Figure 10.—A housing development on Adena-Colby silt loams, 1 to 5 percent slopes, in the western part of the county.

In this soil survey sites for light industry include shopping centers, industrial buildings that have large parking lots, large buildings not more than two stories high, and large school buildings. Steep soils are less desirable as sites for light industrial construction than as sites for homes (fig. 11) because reshaping of the land is necessary.

The disposal of sewage effluent includes the disposing of effluent from septic tanks. Truckton and other sandy soils have only slight limitations for leaching fields but have severe limitations for lagoons.

In table 3 streets refer to residential streets and roads that are used by light traffic.

In this survey recreational areas include parks, golf courses, and picnic areas.

In evaluating the soils for landscape plantings, the ease or difficulty of establishing and maintaining grasses, ornamental shrubs, and other plants used in landscaping was considered. The ratings are for relatively undisturbed soil material, generally the uppermost 6 to 8 inches.

Use and Management of Soils for Range [4]

In this section the rangeland in Arapahoe County is briefly described, general practices of range management are discussed, and range sites and condition classes are defined. Each range site in the county is discussed, and its annual yield per acre, when in excellent condition, is estimated.

In Arapahoe County, approximately 300,000 acres, or 60 percent of the acreage, is native range. In addition, many formerly cultivated fields have been reseeded to grasses and are used for grazing. Also, the stubble left on the wheat and grainfields after harvesting is grazed. Raising cattle and sheep is the second largest enterprise in the county.

[4] WILLARD D GRAVES and THOMAS K EAMAN, range conservationists, Soil Conservation Service, assisted in the preparation of this section

TABLE 3.—*Limitations of the*

[Absence of ratings indicates that soil is not suited to

Soils	Degree of limitation for—		
	Foundations for small buildings	Homesites with public sewers	Sites for light industries with public sewers
Adena-Colby fine sandy loams, 1 to 5 percent slopes	Moderate	Slight	Slight
Adena-Colby fine sandy loams, 5 to 9 percent slopes	Moderate	Slight	Moderate
Adena-Colby silt loams, 1 to 5 percent slopes	Moderate	Slight	Slight
Adena-Colby silt loams, 5 to 9 percent slopes	Moderate	Slight	Moderate
Ascalon sandy loam, 5 to 9 percent slopes	Slight	Slight	Moderate
Baca loam, 3 to 5 percent slopes	Moderate	Slight	Slight
Baca loam, 5 to 9 percent slopes	Moderate	Slight	Moderate
Baca-Thedalund loams, 3 to 9 percent slopes			
Beckton loam, 0 to 3 percent slopes	Moderate	Severe	Moderate
Bijou sandy loam, 0 to 3 percent slopes	Slight	Slight	Slight
Bijou sandy loam, wet, 0 to 3 percent slopes	Severe	Severe	Moderate
Blakeland loamy sand, 1 to 9 percent slopes, eroded	Slight	Moderate	Moderate
Blakeland loamy sand, 1 to 20 percent slopes	Slight	Moderate	Severe
Bresser loamy sand, terrace, 0 to 3 percent slopes	Slight	Moderate	Slight
Bresser sandy loam, terrace, 0 to 3 percent slopes	Slight	Slight	Slight
Bresser loam, gravelly subsoil variant, 1 to 3 percent slopes	Slight	Slight	Slight
Bresser-Stapleton sandy loams, 3 to 9 percent slopes	Slight	Slight	Moderate
Bresser-Stapleton sandy loams, 9 to 20 percent slopes	Slight	Slight	Severe
Bresser-Truckton sandy loams, 3 to 5 percent slopes	Slight	Slight	Slight
Bresser-Truckton sandy loams, 5 to 20 percent slopes	Slight	Slight	Severe
Bresser and Truckton soils, 3 to 9 percent slopes, eroded	Slight	Slight	Moderate
Buick loam, 3 to 5 percent slopes	Severe	Moderate	Slight
Buick loam, 5 to 9 percent slopes	Severe	Moderate	Moderate
Clayey alluvial land	Severe	Severe	Severe
Colby silt loam, 1 to 5 percent slopes	Moderate	Slight	Slight
Colby silt loam, 5 to 20 percent slopes	Moderate	Slight	Severe
Colby and Adena soils, 1 to 9 percent slopes, eroded	Moderate	Slight	Moderate
Edgewater loam, 0 to 3 percent slopes	Moderate	Severe	Severe
Fondis silt loam, 1 to 3 percent slopes	Severe	Moderate	Slight
Fondis silt loam, 3 to 5 percent slopes	Severe	Moderate	Slight
Fondis-Ascalon, gravelly subsoil variant, complex, 1 to 9 percent slopes		Moderate	Moderate
Fondis-Colby silt loams, 3 to 5 percent slopes	Severe	Moderate	Slight
Fort Collins loam, 0 to 3 percent slopes	Slight	Slight	Slight
Gravelly land	Slight	Moderate	Severe
Heldt clay, 0 to 3 percent slopes	Severe	Moderate	Moderate
Heldt clay, saline, 0 to 3 percent slopes	Severe	Severe	Severe
Litle silty clay loam, 1 to 9 percent slopes	Severe	Moderate	Severe
Litle-Samsil, gypsum, silty clay loams, 3 to 9 percent slopes	Severe	Moderate	Moderate
Loamy alluvial land	Moderate	Severe	Severe
Nunn loam, 0 to 3 percent slopes	Moderate	Moderate	Slight
Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes	Slight	Slight	Slight
Olney fine sandy loam, 5 to 9 percent slopes	Slight	Slight	Moderate
Renohill loam, 3 to 9 percent slopes	Severe	Moderate	Severe
Renohill loam, reddish variant, 5 to 20 percent slopes	Moderate	Moderate	Severe
Renohill-Buick loams, 3 to 9 percent slopes	Severe	Moderate	
Renohill-Buick loams, 9 to 20 percent slopes	Severe	Moderate	Severe
Renohill-Buick complex, 5 to 20 percent slopes, eroded	Severe	Moderate	Severe
Renohill-Litle clay loams, 3 to 9 percent slopes	Severe	Moderate	Severe
Renohill-Litle-Thedalund complex, 9 to 30 percent slopes	Severe	Moderate	Severe
Rock outcrop	Severe	Severe	Severe
Samsil clay, gypsum, 5 to 20 percent slopes	Severe	Severe	Severe
Samsil-Litle stony clays, 20 to 50 percent slopes	Severe	Severe	Severe
Samsil-Renohill clay loams, 3 to 20 percent slopes	Severe	Moderate	Severe
Samsil-Shale outcrop complex	Severe	Severe	Severe

soils for specified nonfarm uses

specified use or that ratings were not made for that soil]

Degree of limitation for—Continued					Limiting soil features
Disposal of sewage effluent into—		Streets	Recreational areas	Landscape plantings	
Leaching fields	Lagoons				
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy; liquefies and settles
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy, liquefies and settles, slope.
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy, liquefies and settles.
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy, liquefies and settles, slope.
Slight	Severe	Slight	Moderate	Moderate	Limy below a depth of 3 feet.
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy, shale below a depth of 5 feet.
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy, shale below a depth of 5 feet, slope
Severe	Slight	Moderate	Moderate	Severe	High in salts; occasional flooding, water table below a depth of 6 feet.
Slight	Severe	Slight	Slight	Moderate	Low available water holding capacity, susceptible to soil blowing
Severe	Severe	Severe	Moderate	Moderate	Water table below a depth of 3 feet, wetness
Slight	Severe	Moderate	Moderate	Severe	Topsoil removed.
Slight	Severe	Moderate	Moderate	Moderate	Sandy, erodes easily, droughty.
Slight	Severe	Slight	Slight	Severe	Susceptible to soil blowing, hazard of flooding in places.
Slight	Severe	Slight	Slight	Moderate	Susceptible to soil blowing.
Slight	Severe	Moderate	Slight	Moderate	Gravel below a depth of 3 feet, some gravel occurs in surface layers.
Slight	Severe	Slight	Slight	Moderate	Strongly rolling, fine cemented gravel at a depth of 2 to 6 feet.
Slight	Severe	Slight	Slight	Moderate	Strongly rolling, fine cemented gravel at a depth of 2 to 6 feet, slope.
Slight	Severe	Slight	Moderate	Moderate	Susceptible to soil blowing.
Slight	Severe	Slight	Slight	Moderate	Susceptible to soil blowing, slope.
Slight	Severe	Slight	Moderate	Moderate	Topsoil removed.
Severe	Slight	Moderate	Moderate	Slight	High swelling clay below a depth of 2 feet
Severe	Slight	Moderate	Moderate	Slight	High swelling clay below a depth of 2 feet; slope.
Severe	Severe	Severe	Moderate	Moderate	Frequent flooding, wet, high swelling clay.
Moderate	Moderate	Moderate	Moderate	Slight	Unstable, limy, liquefies and settles.
Moderate	Moderate	Moderate	Moderate	Severe	Unstable, limy; liquefies and settles, slope
Moderate	Moderate	Moderate	Moderate	Severe	Topsoil removed, unstable, limy, liquefies and settles.
Severe	Severe	Severe	Slight	Slight	High water table, occasional flooding.
Severe	Slight	Moderate	Moderate	Slight	High swelling clay; salts below a depth of 8 inches.
Severe	Slight	Moderate	Moderate	Slight	High swelling clay, salt below a depth of 8 inches, slope.
Severe		Moderate	Moderate	Slight	Fondis soil contains high swelling clay.
Severe		Moderate	Moderate	Slight	Fondis soil contains high swelling clay.
Slight	Moderate	Moderate	Slight	Slight	Occasional flooding.
Slight	Severe	Slight	Moderate	Severe	Steep in most areas.
Severe	Slight	Severe	Moderate	Severe	High swelling clay, very slow rate of water intake.
Severe	Slight	Severe	Severe	Severe	High swelling clay, salty, wet in places.
Severe	Slight	Severe	Moderate	Severe	High swelling clay, salty, shale below a depth of 2½ feet.
Severe	Slight	Severe	Severe	Severe	High swelling clay; salty; shale below a depth of 1½ feet.
Severe	Severe	Severe	Slight	Slight	Frequent flooding.
Moderate	Slight	Moderate	Slight	Slight	Occasional flooding in places.
Moderate	Moderate	Slight	Slight	Moderate	Undulating.
Slight	Severe	Slight	Moderate	Moderate	Strongly rolling; sandstone below a depth of 5 feet.
Severe	Slight	Moderate	Moderate	Moderate	High swelling clay, shale below a depth of 3 feet.
Severe	Slight	Severe	Moderate	Slight	Strongly sloping; shale below a depth of 3 feet.
Severe	Slight	Moderate	Moderate	Moderate	High swelling clay.
Severe	Slight	Moderate	Severe	Severe	High swelling clay.
Severe	Slight	Moderate	Severe	Severe	High swelling clay, eroded.
Severe	Slight	Severe	Moderate	Severe	High swelling clay
Severe	Moderate	Severe	Severe	Severe	High swelling clay, shale or sandstone below a depth of 2½ feet.
Severe	Severe	Severe	Severe	Severe	Bare rock.
Severe	Moderate	Severe	Severe	Severe	Shale at a depth of less than 18 inches.
Severe	Severe	Severe	Severe	Severe	Slope; stony, high swelling clay.
Severe	Slight	Severe	Severe	Severe	High swelling clay.
Severe	Slight	Severe	Severe	Severe	High swelling clay; shale at a depth of less than 20 inches.

TABLE 3.—*Limitations of the soils*

Soils	Degree of limitation for—		
	Foundations for small buildings	Homesites with public sewers	Sites for light industries with public sewers
Sand pits	Slight	Severe	Severe
Sandy alluvial land	Slight	Severe	Severe
Shale outcrop	Severe	Severe	Severe
Stapleton sandy loam, 9 to 30 percent slopes	Slight	Slight	Severe
Tassel-Rock outcrop complex	Slight	Moderate	Severe
Terrace escarpments	Severe	Severe	Severe
Terry fine sandy loam, 5 to 20 percent slopes	Slight	Slight	Severe
Terry-Olney-Thedalund sandy loams, 5 to 20 percent slopes	Slight	Moderate	Severe
Thedalund clay loam, 9 to 20 percent slopes	Moderate	Slight	Severe
Thedalund clay loam, 9 to 20 percent slopes, eroded	Moderate	Slight	Severe
Truckton loamy sand, 1 to 5 percent slopes	Slight	Slight	Slight
Truckton loamy sand, 5 to 20 percent slopes	Slight	Slight	Severe
Weld fine sandy loam, 1 to 5 percent slopes	Moderate	Slight	Slight
Weld silt loam, 0 to 3 percent slopes	Moderate	Slight	Slight
Weld silt loam, 3 to 5 percent slopes	Moderate	Slight	Moderate
Weld-Deertrail silt loams, 0 to 3 percent slopes	Moderate	Slight	Slight
Wet alluvial land	Severe	Severe	Severe

The largest ranches generally are in the eastern part of the county. Most of these ranches are cow-calf enterprises, but some are cattle-sheep enterprises. Wheat-livestock units are more common in the central and western parts of the county. In the extreme western part, however, the small dairy farms are being replaced by residential, commercial, and industrial developments.

The larger ranches generally produce enough native hay to provide adequate feed during winter storms, but the smaller ranches depend on locally grown feed and on hay shipped from other areas to provide supplemental feed in winter.

Climate influences the production of forage. In the eastern part of the county, the climate is favorable for the growth of short grasses, mainly blue grama, buffalograss, and other warm-season grasses. In the western part of the county, western wheatgrass, green needlegrass, and other cool-season grasses grow better than the short grasses.

Range management practices

Proper grazing is the most important of all range practices. Controlling grazing so as to maintain cover adequate to protect the soils and to encourage the growth of perennial forage plants helps to maintain and improve the range. Generally, this means leaving at least half of the annual growth at the end of the growing season.

In addition to proper degree of use, deferred grazing and distribution of grazing also help to conserve plant cover, soil, and water. In their leaves, grasses manufacture the food they need to grow and reproduce. Grasses must store in their roots the food they need to start vigorous growth in spring. The desirable grasses, therefore, should be given an opportunity to manufacture enough plant food for vigorous growth of tops and for good root development before they are grazed in spring. The vegetation should also be adequate to protect the soil against erosion and to encourage the intake and storage of water. Other beneficial practices are developing adequate water facilities and mechanical treatments that will increase the penetration and storage of moisture.

Range sites and condition classes

Soils differ in their capacity to produce vegetation. The kinds and amounts of native forage plants in an area depend on the combined effect of the soil and climate. A range site is an area where climate and soil are sufficiently uniform to produce about the same kinds and amounts of vegetation.

Grazing use and other management practices affect the kind of vegetation on each range site and the productivity of the site. Range condition is determined mainly by comparing the present vegetation on a given site with the vegetation that originally grew there. The classes of range condition used to indicate the degree to which the vegetation has been changed by grazing or other use are *excellent*, *good*, *fair*, and *poor*. A range in excellent condition is producing the maximum amounts of native plants for the site and the climate. Range in poor condition does not produce optimum yields of forage and is not protected against erosion.

The plants on any given range site can be classified or grouped as decreasers, increasers, and invaders, according to their response to grazing. Decreasers generally are the most desirable and productive plants on any given range site. Livestock seek out the most palatable and nutritious

for specified nonfarm uses—Continued

Degree of limitation for—Continued					Limiting soil features
Disposal of sewage effluent into—		Streets	Recreational areas	Landscape plantings	
Leaching fields	Lagoons				
Slight	Severe	Moderate	Moderate	Severe	Occasional flooding.
Severe	Severe	Moderate	Slight	Severe	Frequent flooding.
Severe	Severe	Severe	Severe	Severe.	
Slight	Severe	Slight	Moderate	Severe	Cemented fine gravel below a depth of 2 feet.
Severe	Severe	Moderate	Moderate	Severe	Sandstone at a depth of less than 18 inches, slope.
Severe	Severe	Severe	Slight	Slight	Flooding
Slight	Severe	Moderate	Moderate	Moderate	Sandstone below a depth of 3 feet
Moderate	Severe	Slight	Moderate	Severe	Variable depth to sandstone or shale.
Severe	Moderate	Moderate	Moderate	Severe	Shale or sandstone at a depth of less than 30 inches.
Severe	Moderate	Moderate	Moderate	Severe	Surface soil removed, shale or sandstone at a depth of less than 30 inches.
Slight	Severe	Slight	Moderate	Severe	Sand below a depth of 2 feet, susceptible to soil blowing.
Slight	Severe	Slight	Moderate	Severe	Strongly rolling, sand below a depth of 2 feet; susceptible to soil blowing.
Moderate	Moderate	Moderate	Moderate	Slight	Silty; liquefies.
Moderate	Moderate	Moderate	Moderate	Slight	Silty, liquefies.
Moderate	Moderate	Moderate	Moderate	Slight	Silty, liquefies; slope.
Moderate	Moderate	Moderate	Moderate		Silty; liquefies.
Severe	Severe	Severe	Slight	Slight	Water table at a depth of less than 3 feet; flooding; sand and gravel below a depth of 30 inches

grasses, and under heavy grazing these plants, or decreasers, tend to give way to less desirable plants or increasers. Increasers generally are shorter and less palatable than the decreasers. They are more capable of withstanding close grazing than the decreasers, and they normally increase in abundance as the most desirable plants are reduced. Under continuous heavy grazing, the increaser plants are weakened and reduced and are replaced by invaders, which are shrubby plants or annual weeds and grasses, that eventually dominate the site.

Descriptions of range sites

The 14 range sites in Arapahoe County are described in the following pages. Also given for each site is the total annual yield of herbage in years of favorable moisture and in years of unfavorable moisture. To determine the soils in any given range site, refer to the "Guide to Mapping Units" at the back of this soil survey. Seven mapping units have not been placed in any range site. They are Samsil-Litle stony clays, 20 to 50 percent slopes, Stapleton sandy loam, 9 to 30 percent slopes, Gravelly land, Rock outcrop, Sand pits, Sandy alluvial land, and Terrace escarpments.

LOAMY PLAINS RANGE SITE

This range site occurs in the eastern part of the county, mainly on the larger ranches. It consists of deep to moderately deep, level to steep soils that have a fine sandy loam, loam, or silt loam surface layer.

Short grasses, mainly blue grama and buffalograss, are dominant on this site. If the site is in excellent condition, small amounts of western wheatgrass, junegrass, needlegrass, and other mid grasses appear during years when moisture is favorable. These plants, however, are weakened and eliminated during dry periods. Among the common forbs are scarlet globemallow, wild alfalfa, and groundsel.

On this site the ratio of blue grama to buffalograss indicates range condition. As the condition of the range declines, the percentage of buffalograss increases. Under continuous overgrazing, blue grama grows in dense sod rather than in spaced bunches, and the range takes on a sodlike appearance. If the range is overgrazed in years of unfavorable moisture, there is a decrease of perennial plants and an increase of six-weeks fescue, cheatgrass, wild barley, wooly plantain, gumweed, and other less desirable plants.

This range site is suitable for grazing the year round, but topography gives livestock little protection during snowstorms. Supplemental feeding is needed if this site is grazed in winter.

A protective cover of litter, or a layer of plant residue, is essential in improving a poor or fair range condition or in maintaining a good or poor condition. Litter is increased by controlling grazing and by occasionally resting the range.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 pounds per acre in years of favorable moisture to 400 pounds per acre in years of unfavorable moisture. Nearly all of this yield is forage suitable for cattle.

LOAMY SLOPES RANGE SITE

This range site is adjacent to the Loamy Plains range site in the eastern part of the county. It consists of gently sloping to steep soils that have a surface layer of silt loam or clay loam that contains large amounts of lime. Runoff is rapid, and the surface layer is dry much of the time.

Figure 11.—**A housing development on Buick loam, 5 to 9 percent slopes. Erosion is a severe hazard during construction.**

This range site is better suited to deep-rooted grasses and other plants than to shallow-rooted plants (fig. 12). Western wheatgrass, side-oats grama, little bluestem, and needle-and-thread are dominant, but blue grama grows in bunches throughout the site. Also present are small amounts of sand dropseed, threadleaf sedge, and three-awn.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 pounds per acre in years of favorable moisture to 400 pounds per acre in years of unfavorable moisture. Nearly all of this yield is forage suitable for cattle.

CLAYEY PLAINS RANGE SITE

This range site occupies small areas on stream terraces and side slopes in the eastern part of the county. In most places it is surrounded by the Loamy Plains range site. It consists of moderately deep to shallow, level to steep soils that have a clay loam or clay surface layer and subsoil. Included in this site are a few abandoned fields where erosion has removed much of the original surface layer and has exposed the clayey subsoil.

Western wheatgrass is the principal decreaser and the most important key grass on this range site. Other decreasers are fourwing saltbush and winterfat, but these plants are difficult to maintain if they are grazed the year round. Blue grama and buffalograss are the main increasers, and low rabbitbrush, dryland sedges, and red three-awn are less common increasers. Annual grasses and weeds are the most common invaders. Six-weeks fescue invades areas where the grass cover is thinned by drought or overgrazing. Among the less desirable increasers are gumweed, fringed sage, snakeweed, and pricklypear cactus.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 950 pounds per acre in years of favorable moisture to 400 pounds per acre in years of unfavorable moisture. About three-fourths of this yield is forage suitable for cattle.

ALKALINE PLAINS RANGE SITE

This range site is in the eastern one-fourth of the county. It consists of very shallow to moderately deep, rolling to steep soils that formed in material weathered from saline Pierre shale. These soils have a surface layer of silty clay loam, clay, or silt loam. Gypsum crystals and outcrops of shale are common on the soils that have slopes of more than 10 percent.

This range site is suited to plants that are tolerant of alkali. Alkali sacaton is dominant (fig. 13), but western

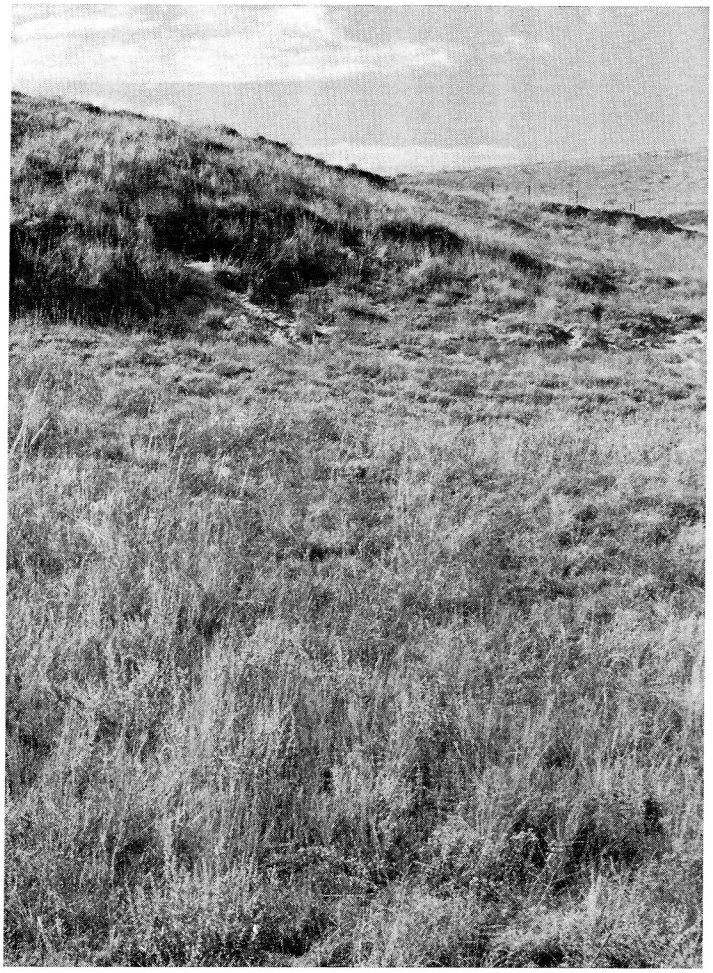

Figure 12.—Loamy Slopes range site on Colby silt loam, 5 to 20 percent slopes.

wheatgrass also helps to provide good cover and suitable forage. Short grasses are the principal increasers. Blue grama and buffalograss are the most common increasers. Saltgrass and dryland sedges are less important increasers, and ring muhly, pricklypear cactus, and annual weeds and grasses are the least desirable increasers.

Because this range site generally is closely intermingled with the Loamy Plains range site, management should be based on the larger or dominant site. Management is needed that encourages the growth of mid grasses, particularly western wheatgrass and alkali sacaton. The soils in this range site are subject to water erosion, but a protective cover of litter or plant residue can be kept on the surface by controlling grazing and resting the site periodically.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,000 pounds per acre in years of favorable moisture to 500 pounds per acre in years of unfavorable moisture. About three-fourths of this yield is forage suitable for cattle.

SANDY PLAINS RANGE SITE

This range site occurs in the eastern half of the county (fig. 14). It consists of undulating to steep, generally deep soils that have a surface layer of sandy loam or fine sandy loam and a subsoil of sandy loam to sandy clay loam. These soils take in water readily, have good available water holding capacity, and can support fairly large amounts of mid grasses.

Figure 13.—Alkali sacaton and fourwing saltbush growing on a Deertrail silt loam on the Alkaline Plains range site.

This range site is suited to a larger variety of grasses than the Loamy Plains range site. Little bluestem, needle-and-thread, side-oats grama, junegrass, and other mid grasses are dominant. Of the tall grasses, sand reedgrass is the most prevalent, but there are small amounts of sand bluestem and big bluestem. If the range is overgrazed or otherwise abused, the mid grasses decrease and blue grama and dryland sedges increase. Other common increasers are western wheatgrass, sand dropseed, and three-awn. Wormwood sage, fringed sage, and other sages are also increasers. Pricklypear cactus and annual weeds and grasses are the most common invaders.

Forbs are more common on this site than on the Loamy Plains range site. American vetch and prairie-clover grow in the higher areas. Wild buckwheat is the main plant for identifying this range site after the key grasses have been eliminated.

The grasses best suited to this site are better suited to grazing in spring and summer than in winter. Most ranchers, therefore, plan for grazing this range site in spring and summer where possible. If this practice continues, grazing pressure will be on the more palatable grasses and grasses that turn green earliest. These desirable grasses will decrease, short grasses and weeds will take their place, and openings will appear in the plant cover. Then these soils will be susceptible to soil blowing and water erosion. It is essential, therefore, to rest this site periodically so that growth of desirable plants is maintained and damage from erosion is reduced.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,800 pounds per acre in years of favorable moisture to 600 pounds per acre in years of unfavorable moisture. About three-fourths of this yield is forage suitable for cattle.

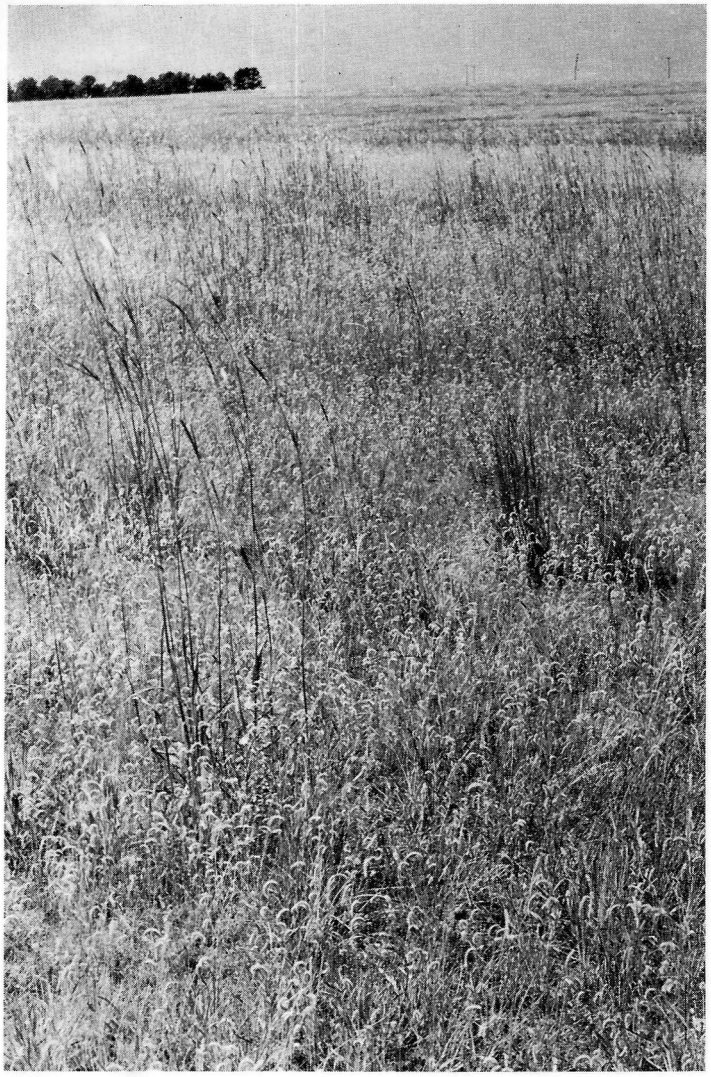

Figure 14.—**Mid grasses, tall grasses, and blue grama growing on the Sandy Plains range site. The soil is Terry fine sandy loam, 5 to 20 percent slopes.**

DEEP SAND RANGE SITE

This range site is on uplands and occurs in narrow bands on the eastern side of major drainageways. It makes up only a small acreage of the county and consists of deep, nearly level to steep soils that have a loamy sand surface layer. These soils take in water readily, but their available water holding capacity is relatively low. They are susceptible to severe soil blowing.

Tall grasses, mainly sand bluestem and sand reedgrass, are dominant on this site. Switchgrass may appear during years when moisture is favorable, but it is difficult to keep on this site. Of the mid grasses, little bluestem and needle-and-thread are the main decreasers. Under continuous heavy grazing, particularly late in spring and in summer, the more productive and desirable grasses give way to blue grama, sand dropseed, sedges, and other less desirable plants. Continued abuse causes an increase in sand muhly, stickleaf, perennial ragweed, hairy goldaster, many annual weeds and grasses, and other undesirable plants.

Keeping litter and a cover of growing plants is especially important on this range site because the wind can quickly gouge blowouts and pile up sand in raw dunes.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 pounds per acre in years of favorable moisture to 1,200 pounds per acre in years of unfavorable moisture. About two-thirds of this yield is forage suitable for cattle.

SANDSTONE BREAKS RANGE SITE

Tassel-Rock outcrop complex, the only mapping unit in this range site, occurs in broken areas at the upper ends of drainageways. The soils generally are shallow, but pockets of deeper soils are intermixed with the shallow soils in some places. The stones and fractured rock in and on the soils increase the amount of water that is available to plants.

On this site most of the vegetation consists of tall grasses, mainly big bluestem and prairie sandreed, and of little bluestem, side-oats grama, needle-and-thread, blue grama, threadleaf sedge, and prairie-clover.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,700 pounds per acre in years of favorable moisture to 800 pounds per acre in years of unfavorable moisture. About two-thirds of this yield is forage suitable for cattle.

SHALE BREAKS RANGE SITE

This range site generally occurs at the upper end of narrow drainageways. It consists partly of shallow, steep soils and partly of areas where shale outcrops are numerous.

On this site side-oats grama, western wheatgrass, and green needlegrass are the main decreasers. If the condition of the range declines, blue grama and buffalograss increase. The less common increasers include wild rose, skunkbush, wild currant, chokecherry, wormwood, and wild buckwheat. Buffalograss, blue grama, and sedges are the dominant increasers in the areas where shale crops out. The less desirable increasers are fringed sage, gumweed, hairy goldaster, pricklypear cactus, and snakeweed.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 800 pounds per acre in years of favorable moisture to 600 pounds per acre in years of unfavorable moisture. About three-fourth of this yield is forage suitable for cattle.

SALT FLAT RANGE SITE

Beckton loam, 0 to 3 percent slopes, is the only soil in this range site. It is along the larger drainageways in the county and is subject to occasional flooding. This soil is deep and is alkaline. Bare, slick spots are common in areas where the condition of the range has declined or in areas where the accumulation of salts is too high for the growth of plants.

When this site is in excellent condition, western wheatgrass and alkali sacaton are the most prevalent, but green needlegrass is also an indicator of range in good condition. If the condition of the range declines, the key grasses are replaced by blue grama, buffalograss, native bluegrass, and low rabbitbrush. The invaders are snakeweed, pricklypear cactus, mouse-ear poverty weed, and annual weeds and plants.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 pounds per acre in years of favorable moisture to 750 pounds per acre in years of unfavorable moisture. About two-thirds of this yield is forage suitable for cattle.

OVERFLOW RANGE SITE

This range site occurs along drainageways and receives extra moisture from floods. It consists of soils that have a loam, sandy loam, or clayey surface layer.

Because of the periodic flooding, forage and hay plants grow well on this range site, particularly in winter and early in spring. Western wheatgrass and switchgrass are the key grasses for indicating range condition, and they can be used in determining the kind of management needed. On this site western wheatgrass generally is more prevalent and is more easily grown than switchgrass. If the key plants are weakened or eliminated, buffalograss, sedges, low rabbitbrush, and blue grama become dominant. Continued deterioration of the site results in the invasion of fringed sage, Kentucky bluegrass, saltgrass, cheatgrass, and other less desirable plants.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 3,000 pounds per acre in years of favorable moisture to 1,500 pounds per acre in years of unfavorable moisture. About two-thirds of this yield is forage suitable for cattle.

WET MEADOW RANGE SITE

This range site occurs on bottom lands and is flooded occasionally (fig. 15). It consists mostly of level to nearly level soils that have a sandy loam or loam surface layer and a high water table. Included in this site are a few small seeps on hillsides. These areas are indicated on the soil map by the standard symbol for wet spots. The water table is the major factor that affects the kind and growth of plants on this site.

When this range site is in excellent condition, switchgrass, cordgrass, wild licorice, indiangrass, and bluestem generally are dominant. Common increasers generally are western wheatgrass, saltgrass, and wild barley. In the wetter spots, sedges, rushes, and horsetail are common increasers. The invaders include blue grama, Kentucky bluegrass, cocklebur, gumwood, and annuals.

When this site is in excellent condition, the total annual yield of air-dry herbage is 4,000 pounds per acre in most years. About three-fourths of this yield is suitable forage for cattle.

LOAMY FOOTHILL RANGE SITE

This range site occurs in the western half of the county. It consists of moderately deep and deep soils that have a surface layer of loam or silt loam and slopes ranging from 0 to 25 percent.

On this site the moisture in winter and spring and the elevation are favorable for the growth of cool-season grasses. Western wheatgrass and, to a lesser extent, green needlegrass are the most productive plants. Junegrass and native bluegrass also grow on this site, but in amounts that vary according to the season. Blue grama is the dominant increaser, but three-awn and soapweed are also increasers. Continuous overgrazing, particularly early in spring, causes blue grama to form a dense sod and to replace the preferred grasses. The invaders, or undesirable plants, include fringed sage, hairy goldaster, and cheatgrass.

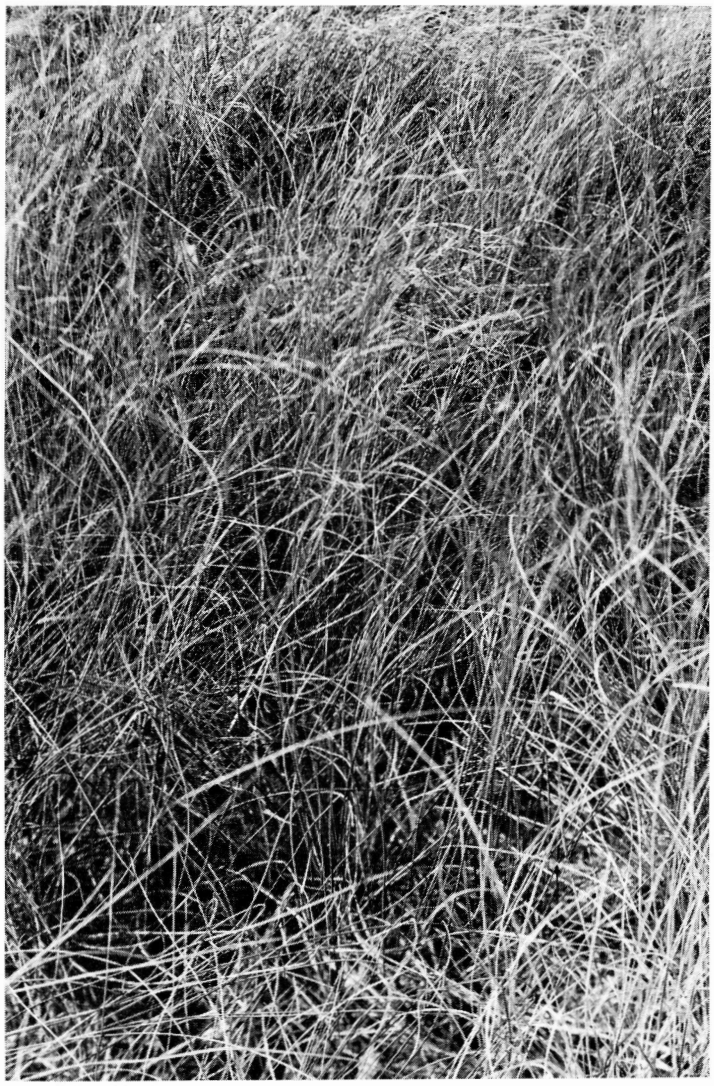

Figure 15.—**An area of the Wet Meadow range site. The soil is Edgewater loam, 0 to 3 percent slopes.**

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 pounds per acre in years of favorable moisture to 700 pounds per acre in years of unfavorable moisture. Nearly all of this yield is forage suitable for cattle.

CLAYEY FOOTHILL RANGE SITE

This range site occurs in the western half of the county, mainly in small areas that are closely intermingled with larger areas of the Loamy Foothill range site. The Clayey Foothill range site consists of shallow to deep soils that have a clay or clay loam surface layer and slopes ranging from 0 to 25 percent. Cultivated areas and severely eroded areas in the adjacent Loamy Foothill site are grazed with this range site.

On this site elevation and the pattern of rainfall are favorable for the growth of cool-season grasses and forbs that include western wheatgrass, green needlegrass, prairieclover, and small pod vetch. The dominant increaser is blue grama, but other increasers are buffalograss, three-awn, dryland sedge, and native bluegrass.

Continued heavy grazing results in the invasion of snakeweed, fringed sage, rabbitbrush, ring muhly, and annual grasses and weeds.

Water erosion is a continuous hazard on this site. If organic matter is depleted and a protective cover of litter is not maintained, the soils tend to seal. This sealing reduces the penetration of moisture and increases runoff. After the vegetation deteriorates, recovery is slow.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 pounds per acre in years of favorable moisture to 600 pounds per acre in years of unfavorable moisture. About three-fourths of this yield is forage suitable for cattle.

SANDY FOOTHILL RANGE SITE

This range site occurs in the western half of the county. It consists of level to steep soils that have a sandy loam or loamy sand surface layer and a sandy clay loam subsoil. These soils formed in noncalcareous sand deposited by wind and water.

Tall grasses grow better on this range site than on the Sandy Plains site. The potential vegetation is dominated by bluestem, sand reedgrass, and needlegrass. If the range is overgrazed, the tall grasses decrease and blue grama, dryland sedge, western wheatgrass, and junegrass increase. As the condition of the range declines, pricklypear cactus, cheatgrass, and six-weeks fescue invade.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 pounds per acre in years of favorable moisture to 800 pounds per acre in years of unfavorable moisture. About three-fourths of this yield is forage suitable for cattle.

Use and Management of Soils for Trees [5]

Most of Arapahoe County was treeless when it was first settled, but since then trees have been planted both for protection and for beautification. The wooded areas now consist mainly of windbreaks, landscape plantings, and a few stands of native trees.

Native woodland makes up about 1 percent of the county. The trees are of little or no commercial value, but they provide shade for livestock and some wooded areas can be developed for recreational uses. A few native stands, consisting mainly of cottonwoods and willows, grow along the South Platte River, Cherry Creek, and intermittent drainageways. Native ponderosa pine grows on the Stapleton soils along South Cherry Creek (fig. 16).

Trees can be planted to provide protection for homes and livestock against wind and cold weather; to add to the beauty of the landscape; to control drifting snow; and to provide shade in summer and food and cover for song birds and game birds. Trees and shrubs are also used as screens to reduce noise and to help protect streambanks and control erosion.

Trees and shrubs can be established and maintained successfully in this county if planning and care are good and if the seedlings are properly planted. It is essential that the seedlings come from good stock and have well-developed roots. Because moisture is limited, competing grass and weeds should be controlled. Tillage helps to control competing vegetation and to permit the penetration of water and air, and it is needed during the life of most trees. Additional water can be obtained by diverting runoff from higher ground into areas where the trees are planted. Stubble-mulch tillage and summer fallow are necessary to store moisture in the sandy loams and clay loams before the site is planted. Planting seedlings in narrow strips and leaving vegetation between the strips is advisable on the loamy sands and sands; the vegetation that is left helps to keep these soils from blowing and, by trapping snow, increases the amount of moisture that enters the soil. The vegetation can be removed when the trees are large enough to protect the soil.

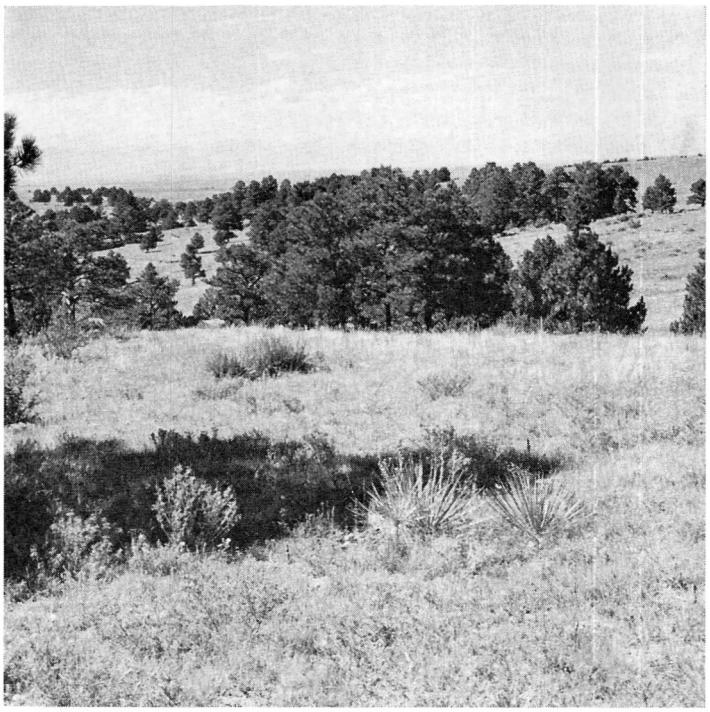

Figure 16.—Native ponderosa pine growing on Stapleton sandy loam, 9 to 30 percent slopes.

Particularly important in planning windbreaks or shelterbelts is determining the proper spacing of trees and shrubs for maximum growth and good density. Enough spacing between the rows is needed to allow growing space for the trees and shrubs and to allow enough room for cultivation. Rows should be at least 20 feet apart on dryland sites and in windbreaks or shelterbelts that have more than 2 rows. Good density is provided by suitable spacing of trees and shrubs in the rows. The seedlings should be planted close enough to provide protection, yet far enough apart to allow growing room. A spacing of 3 or 4 feet is needed for shrubs, 6 to 8 feet for pine, juniper, and other evergreens, and 8 to 10 feet for tall, broad-leaved trees.

Evergreens provide protection throughout the year, and they withstand droughts better than other trees and shrubs. They generally live longer than the broad-leaved trees, but they are more difficult to establish, and they grow more slowly for the first few years. Seedlings are more likely to survive the shock of planting if they are potted.

Further information about the soils and their suitability for trees is available from a representative of the Soil Con-

[5] By WILFRED S. SWENSON, woodland conservationist, Soil Conservation Service.

servation Service and the County Agricultural Extension Service. Assistance in planting trees and shrubs for windbreaks and in securing planting stock at low cost can be obtained from the Colorado State Forest Service at Fort Collins. Residents in the cities and towns can obtain assistance in selecting and planting trees and shrubs from the Horticulture Department of the Colorado State University at Fort Collins and from local nurserymen and landscape specialists.

Tree planting suitability groups

The kind of soil largely determines the trees and shrubs most suitable for planting, the growth of these trees and shrubs, and the management needed for their upkeep. On the basis of their suitability for trees and shrubs and the management needed, the soils of this county have been placed in five tree planting suitability groups. Each group differs from the others in the care and practices used in establishing and managing trees and shrubs and also in their rate of growth. The soils in each tree planting suitability group can be identified by referring to the "Guide to Mapping Units" at the back of this soil survey.

The tree planting suitability groups are described in this section. For each group, the expected growth of broad-leaved trees, evergreens, and shrubs is rated *good*, *fair*, or *poor*. These terms are explained in the following paragraphs, and the trees and shrubs suitable for planting are listed.

Broad-leaved Trees.—A rating of *good* for broad-leaved trees means that the trees are well formed and that their growth is vigorous for at least 20 years, during which time Siberian elm is expected to reach a height of 30 feet or more. A rating of *fair* indicates that these trees are not so well formed and vigorous as those rated good and that Siberian elm is expected to attain a height of 25 to 30 feet at 20 years of age. *Poor* means that these trees are poorly formed and grow slowly and that at 20 years of age Siberian elm generally is less than 25 feet tall and shows signs of failing.

The most suitable broad-leaved trees for planting on nonirrigated sites are Siberian elm and common hackberry. Trees that can be grown successfully only on irrigated sites or in other areas where supplemental moisture is available are white ash, green ash, white birch, flowering crab, elm, honeylocust, horsechestnut, linden, Norway maple, silver maple, mountain-ash, plains popular, Bolleana poplar, Carolina poplar, Lombardy poplar, golden willow, and weeping willow.

Evergreens.—A rating of *good* for evergreens indicates that an average yearly growth of 1 foot or more is expected for the first 20 years. *Fair* means that the average growth is ¾ to 1 foot for the first 20 years. If the rating is *poor*, the average yearly growth is expected to be less than ¾ foot for the first 20 years.

The most suitable evergreens for planting on nonirrigated sites are ponderosa pine, Austrian pine, Rocky Mountain juniper, and eastern redcedar. Evergreens that can be grown successfully only on irrigated sites or in other areas where supplemental moisture is available are concolor fir, Savin and Pfitzer junipers, Mugho Swiss mountain pine, and Colorado blue spruce.

Broad-leaved Shrubs.—For shrubs, a rating of *good* means that 90 to 100 percent of the planted seedlings are expected to live and that the shrubs are dense and have vigorous growth. A rating of *fair* indicates that 80 to 90 percent of the seedlings live and that the shrubs are only moderately dense and their growth is fair to good. *Poor* means that no more than 70 percent of the seedlings live and that the shrubs are poorly formed and their growth is poor to fair.

The most suitable shrubs for planting on nonirrigated sites are squawbush, Siberian peashrub, lilac, Russian-olive, and sand cherry. Shrubs that can be grown successfully only on irrigated sites or in other areas where supplemental moisture is available are bridalwreath, butterfly bush, chokecherry, cinquefoil, cranberry bush, dogwood, forsythia, honeysuckle, maple, mockorange, ninebark, plum, privet, snowberry, snowball, spirea, sumac, and winged euonymus.

TREE PLANTING SUITABILITY GROUP 1

This group consists of deep, level to sloping soils that have a sandy loam to clay loam surface layer and a clayey subsoil. After the seedlings are established, the growth of shrubs and of broad-leaved trees is fair to good and that of evergreens is good.

Wind, drought, and soil blowing are the chief hazards on nonirrigated sites. To overcome these hazards, the soils should be summer fallowed before the seedlings are planted. After planting, clean cultivation is needed for as many years as possible. If practical, water should be diverted from other areas to the planting site. Where water is available for irrigation, summer fallow is not needed, the growth and survival rates of trees and shrubs are better than on dryland sites, and more kinds of trees and shrubs are suitable for planting.

TREE PLANTING SUITABILITY GROUP 2

This group consists mainly of deep, level to steep soils that have a loamy sand or sandy loam surface layer. Also in this group are a few shallow soils in which the content of moisture is adequate for the growth of trees. Broad-leaved trees, evergreens, and shrubs grow well on the soils in this group.

On nonirrigated sites soil blowing and loss of water, which are the main hazards to establishing trees and shrubs, can be lessened by leaving a cover of stubble or growing vegetation near the seedlings; by placing shingles on the south and west sides of each plant for the first 2 or 3 years; by building snow fences; by allowing weeds to grow after mid-August; and by clean cultivation during the period April through July, which is the period of most rapid growth. Generally, all of the adapted trees and shrubs grow better in irrigated areas than on dryland sites. The water should be applied with special care to avoid erosion.

TREE PLANTING SUITABILITY GROUP 3

This group consists of wet, level to gently sloping, loamy soils on which the growth of broad-leaved trees is poor to good and that of evergreens and of shrubs is fair to good.

Establishing trees and shrubs on these soils is difficult in some places. On some sites cultivation and watering are essential for the first 2 or 3 years, but after that the trees can compete successfully with other vegetation.

The water-tolerant trees and shrubs that are most suitable on the soils in this group include willow, cottonwood,

chokecherry, green ash, and honeylocust. Among the suitable evergreens, Colorado blue spruce grows better than ponderosa pine or Austrian pine.

TREE PLANTING SUITABILITY GROUP 4

This unit consists of shallow to deep, level to steep, sandy, loamy, and clayey soils. On most of the soils in this group the growth of broadleaved trees and of shrubs is poor to fair and that of evergreens is fair. Their growth, however, is good to fair in the drainageways and in the small areas that consist of deep, gently sloping soils.

Trees and shrubs are difficult to plant on the soils in this group, and they generally are expected to have poor survival and growth rates. Before trees are planted, a careful onsite examination should be made to find the deep, well-drained, and nonsaline soils. On steep slopes the seedlings should be planted in contour rows.

TREE PLANTING SUITABILITY GROUP 5

This group consists mostly of shallow, level to steep, loamy and clayey soils. There are, however, a few small areas of deep soils along the drainageways and small areas of deep, gently sloping, loamy soils in other places. These areas can be located only by a careful onsite examination; trees and shrubs can be planted in these areas, but their growth is poor to fair. Generally, the soils in this group are not suitable for planting most trees and shrubs; if trees are planted their growth is poor.

Growing trees and shrubs is not practical on these soils. They are too difficult to plant and to keep alive because the soils are steep, shallow, saline, alkaline, and have a high or fluctuating water table, or inadequate moisture content. Some areas can be reclaimed for trees and shrubs by correcting the salinity or alkalinity of the soils, by hauling in soil material, or by increasing the depth of the soils.

Use of Soils for Wildlife [6]

Wildlife is a product of the soil on which it lives. The habitat largely determines the kinds and numbers of wildlife present in any area. It must be in an area where various kinds of wildlife can find food, cover, and water. Generally, the largest number of wildlife frequent areas that provide enough of the kind of food and cover necessary for their survival. Because the expanding metropolitan areas have affected the land use in the county, the natural habitat has been altered for wildlife in this county, and much of it has been practically destroyed, particularly in the western part. These changes in land use have altered the numbers and kinds and also the distribution of wildlife in the county.

Table 4 shows the suitability of the soils, by soil associations, as habitat for the major kinds of wildlife in this county. The general soil map at the back of this survey shows, in color, the location of the soil associations in the county. For descriptions of the soil associations, see the section "General Soil Map" in this survey. Because the ratings shown in table 4 are based on soil associations, which is a broad classification for this use, additional information about developing and managing wildlife habitat and assistance for onsite investigations should be obtained from the local office of the Soil Conservation Service.

Use of Soils for Recreation [7]

The development of outdoor recreational areas is closely related to the soils. Most of the soils in Arapahoe County have properties that limit their suitability for recreational uses. It is important, therefore, to know the limitations that affect use of soils for recreational areas. Table 5 indicates the degree of limitations of the soil associations in the county for vacation farms or dude ranches; picnic and sports areas; fishing, camping, and hunting areas; and shooting preserves; and as sites for rural cottages and homes.

Because rating of limitations by soil associations are broad, the ratings given in table 5 do not eliminate the need for careful onsite investigations. The general soil map at the back of this survey shows the location of the soil associations in the county, which are described in the section "General Soil Map."

Factors other than soil characteristics to consider in evaluating the soil associations for recreational purposes are those that concern health, safety, and economic returns.

The limitations of the soil associations shown in table 5 are rated slight, moderate, and severe. A rating of *slight* means that the soils in the association have no important limitations to the specified use or that the limitations are not difficult to overcome. *Moderate* means that the soils have some limitations to the specified use, but that these limitations generally can be overcome. Some of the limiting factors are unfavorable soil texture and soil depth, stoniness, and other soil deficiencies that slow the growth of plants. A rating of *severe* indicates that the soils have serious limitations to the specified use. The limiting features include steep slopes, a high water table, flooding, unfavorable soil texture, acidity, and stoniness or rockiness.

Additional information useful in planning recreational developments can be found in this soil survey in the sections "Engineering Uses of Soils," "Nonfarm Uses of Soils," and "Use and Management of Soils for Trees." Technical assistance in planning recreational enterprises and for onsite investigations can be obtained from the local representative of the Soil Conservation Service.

Engineering Uses of Soils [8]

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material and as foundation material upon which structures are built. Some properties of soils are of special interest to the engineer because they affect construction and maintenance of roads, airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. Among the properties most important to the engineer are permeability,

[6] By ELDIE W. MUSTARD, biologist, and O A. PARSONS, soil scientist, Soil Conservation Service.

[7] By ELDIE W. MUSTARD, biologist, and O A PARSONS, soil scientist, Soil Conservation Service

[8] RONALD I. BLEWITT, conservation engineer, Soil Conservation Service, assisted in preparing this section

TABLE 4.—*Suitability of soil associations for wildlife habitat*

Soil association	Wildlife	Suitability for—			
		Food	Cover	Water	
				Natural streams, lakes, and ponds	Developed lakes and ponds
1. Alluvial land-Nunn.	Mule deer	Moderately well suited.	Moderately well suited	Well suited	Moderately well suited
	Antelope	Moderately well suited.	Not applicable	Well suited	Moderately well suited
	Cottontail rabbit	Well suited	Moderately well suited.	Not applicable	Not applicable
	Jackrabbit	Well suited	Not applicable	Not applicable	Not applicable.
	Pheasant	Moderately well suited	Moderately well suited	Not applicable	Not applicable
	Mourning dove	Well suited	Well suited	Well suited	Moderately well suited
	Bobwhite	Moderately well suited	Moderately well suited	Not applicable	Not applicable
	Waterfowl	Moderately well suited	Moderately well suited.	Moderately well suited.	Moderately well suited
	Fish	Not applicable	Not applicable	Poorly suited	Poorly suited
2. Litle-Samsil.	Antelope	Moderately well suited	Not applicable	Poorly suited	Well suited.
	Jackrabbit	Moderately well suited.	Not applicable	Poorly suited	Well suited.
	Mourning dove	Poorly suited	Poorly suited	Poorly suited	Well suited.
	Fish	Not applicable	Not applicable	Poorly suited	Well suited
3. Weld-Adena-Colby	Antelope	Moderately well suited.	Not applicable	Poorly suited	Moderately well suited.
	Jackrabbit	Moderately well suited.	Not applicable	Not applicable	Not applicable
	Pheasant	Moderately well suited	Poorly suited	Poorly suited	Not applicable
	Mourning dove	Moderately well suited.	Moderately well suited	Poorly suited	Moderately well suited
	Fish	Not applicable	Not applicable	Poorly suited	Moderately well suited.
4 Thedalund-Baca.	Antelope	Well suited	Not applicable	Poorly suited	Poorly suited
	Jackrabbit	Well suited	Not applicable	Not applicable	Not applicable
	Mourning dove	Moderately well suited.	Poorly suited	Poorly suited	Poorly suited
	Fish	Not applicable	Not applicable	Poorly suited	Poorly suited
5. Terry-Olney-Thedalund.	Antelope	Well suited	Not applicable	Poorly suited	Poorly suited
	Jackrabbit	Well suited	Not applicable	Not applicable	Not applicable
	Mourning dove	Moderately well suited	Poorly suited	Poorly suited	Poorly suited.
	Fish	Not applicable	Not applicable	Poorly suited	Poorly suited.
6 Renohill-Buick-Litle	Antelope	Moderately well suited.	Not applicable	Poorly suited	Moderately well suited
	Jackrabbit	Moderately well suited	Not applicable	Not applicable	Not applicable
	Mourning dove	Moderately well suited	Poorly suited	Poorly suited	Moderately well suited
	Fish	Not applicable	Not applicable	Poorly suited	Moderately well suited.
7. Nunn-Bresser-Ascalon	Antelope	Well suited	Not applicable	Moderately well suited.	Moderately well suited.
	Jackrabbit	Well suited	Not applicable	Not applicable	Not applicable
	Pheasant	Moderately well suited	Moderately well suited.	Not applicable	Not applicable
	Mourning dove	Moderately well suited	Moderately well suited	Moderately well suited.	Poorly suited
	Fish	Not applicable	Not applicable	Moderately well suited	Poorly suited.

TABLE 4.—*Suitability of soil associations for wildlife habitat*—Continued

Soil association	Wildlife	Suitability for—			
		Food	Cover	Water	
				Natural streams, lakes, and ponds	Developed lakes and ponds
8. Truckton-Bresser.	Antelope	Well suited	Not applicable	Poorly suited	Poorly suited.
	Jackrabbit	Well suited	Not applicable	Not applicable	Not applicable
	Pheasant	Moderately well suited.	Moderately well suited.	Not applicable	Not applicable.
	Mourning dove	Moderately well suited.	Moderately well suited	Moderately well suited	Poorly suited
	Fish	Not applicable	Not applicable	Moderately well suited.	Poorly suited
9. Stapleton-Bresser.	Antelope	Well suited	Not applicable	Poorly suited	Poorly suited.
	Mule deer	Well suited	Well suited	Poorly suited	Poorly suited.
	Jackrabbit	Well suited	Not applicable	Not applicable	Not applicable
	Cottontail rabbit	Well suited	Well suited	Not applicable	Not applicable.
	Mourning dove	Moderately well suited	Well suited	Poorly suited	Poorly suited.
	Fish	Not applicable	Not applicable	Poorly suited	Poorly suited.
10. Fondis-Weld.	Antelope	Moderately well suited.	Not applicable	Poorly suited	Poorly suited
	Mule deer	Poorly suited	Poorly suited	Poorly suited	Poorly suited.
	Cottontail rabbit	Well suited	Well suited	Not applicable	Not applicable
	Jackrabbit	Moderately well suited.	Moderately well suited.	Not applicable	Not applicable.
	Pheasant	Moderately well suited.	Poorly suited	Not applicable	Not applicable.
	Mourning dove	Moderately well suited.	Well suited	Poorly suited	Poorly suited
	Fish	Not applicable	Not applicable	Poorly suited	Poorly suited.

TABLE 5.—*Limitations of the soil*

Soil association	Degree of limitation for—			
	Vacation farms or dude ranches	Picnic and sports areas	Fishing	
			Natural	Developed
1. Alluvial land-Nunn	Severe	Moderate	Severe	Moderate
2 Litle-Samsil	Severe	Severe	Severe	Moderate
3. Weld-Adena-Colby	Moderate	Moderate	Severe	Moderate
4. Thedalund-Baca	Moderate	Severe	Severe	Severe
5. Terry-Olney-Thedalund	Moderate	Severe	Severe	Severe
6. Renohill-Buick-Litle	Severe	Severe	Severe	Moderate
7. Nunn-Bresser-Ascalon	Moderate	Moderate	Severe	Severe
8 Truckton-Bresser	Moderate	Moderate	Severe	Severe
9. Stapleton-Bresser	Moderate	Moderate	Severe	Severe
10 Fondis-Weld	Severe	Severe	Severe	Severe

shear strength, density, shrink-swell potential, compaction characteristics, grain-size distribution, plasticity, and reaction. Depth to water table, depth to bedrock, water holding capacity, and slope are also important.

The information in the survey can be used to—

1. Assist in designing drainage and irrigation systems and in planning farm ponds, terraces and diversions, and other structures for controlling water and conserving soil.
2. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning detailed investigations at the selected locations.
3. Locate probable sources of sand, gravel, and other construction material.
4. Make soil and land use studies that will aid in selecting and developing sites for industry, business, homes, and recreation.

With the use of the soil map for identification, the engineering intrepretations in this section can be useful for many purposes. It should be emphasized, however, that the interpretations do not eliminate the need for sampling and testing at the site of specific engineering works where loads are heavy and where the excavations are deeper than the depths of layers reported. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Much of the information in this section is given in tables 6, 7, and 8. Additional information useful to engineers can be found in other sections of this soil survey, particularly the section "Descriptions of the Soils" and "Formation and Classification of Soils."

Some of the terms used by soil scientists may not be familiar to the engineer, and some commonly used terms may have special meaning in soil science. Several of these terms are defined in the Glossary at the back of this survey.

Engineering classification systems

Two systems of soil classification are in general use by engineers. Both of these systems are used in this survey.

Many highway engineers classify soil materials according to the AASHO system (*1*). In this system the soils are placed in seven basic groups, designated A–1 through A–7. In group A–1 are gravelly soils of high bearing capacity, or the best soils for road subgrade, and in group A–7 are the poorest soils, clays that have low strength when wet. Groups A–1, A–2, and A–7 can be further divided to indicate more precisely the nature of the soil material. Within each group the relative engineering value of the soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. Index numbers are shown in parentheses following the group symbol, for example, A–4 (8), as is shown for the surface layer of Buick loam in table 8.

In the Unified classification, the soils are grouped on the basis of texture and plasticity and their performance as material for engineering structures (*7*). Soil materials are identified as gravels (G), sands (S), silts (M), clays (C), organic (O), and highly organic (Pt). Clean sands are identified by the symbols SW and SP; sands mixed with fines of silt and clay are identified by the symbols SM and SC; silts and clay that have a low liquid limit are identified by the symbols ML and CL; and silts and clays

associations for selected recreational uses

Degree of limitation for—Continued					
Campsites, scenic areas, and nature areas	Hunting areas			Shooting preserves	Sites for rural cottages and homes
	Big game	Upland game	Waterfowl		
Slight	Moderate	Moderate	Moderate	Moderate	Severe
Moderate	Severe	Severe	Severe	Severe	Severe.
Moderate	Moderate	Severe	Severe	Severe	Severe.
Moderate	Moderate	Severe	Severe	Severe	Severe.
Moderate	Moderate	Severe	Severe	Severe	Severe
Moderate	Moderate	Severe	Severe	Severe	Moderate
Moderate	Moderate	Severe	Severe	Moderate	Moderate.
Moderate	Moderate	Severe	Severe	Severe	Slight.
Moderate	Moderate	Moderate	Severe	Severe	Slight
Moderate	Severe	Moderate	Severe	Moderate	Moderate

TABLE 6.—*Estimated engineering*

[Absence of data indicates estimate was not made The

Soil and map symbols	Depth to bedrock	Depth from surface	Classification		
			Dominant USDA texture	Unified	AASHO
	Inches	*Inches*			
Adena. AcC, AcD, AdC, AdD (For properties of the Colby soils in these mapping units, refer to the Colby series.)	>60	0–60	Silt loam, silty clay loam	ML–CL or CL	A–4 or A–7
Ascalon AsD	>60	0–17	Sandy clay loam	SC or CL	A–6
		17–60	Sandy loam, loamy sand	SM or SC	A–2
Baca BcC, BcD, BhD (For properties of the Thedalund soil in mapping unit BhD, refer to the Thedalund series)	48–60	0–46	Silty clay loam and clay loam	ML–CL or CL	A–7 or A–6
		46–60	Sandy loam	SM	A–2
Beckton BkB	>60	0–60	Clay loam and silty clay loam to clay.	CL or CH	A–7
Bijou BlB, BmB	>60	0–44	Loamy sand, sandy loam	SM–SC or SC	A–2
		44–60	Stratified silt loam and sand.		
Blakeland. BoD2, BoE	>60	0–60	Sand and loamy sand	SP–SM or SM	A–2
Bresser BrB, BsB, BuD, BuE, BvC, BvE, BwD2 (For properties of the Stapleton soils in mapping units BuD and BuE, refer to the Stapleton series For properties of the Truckton soils in BvC, BvE, and BwD2, refer to the Truckton series)	>60	0–28	Sandy loam and sandy clay loam	SM or SC	A–2,A–6, or A–4
		28–50	Loamy sand and sandy loam	SP–SM or SM	A–2
Bresser loam, gravelly subsoil variant· BtB	>60	0–30	Clay loam	CL	A–6 or A–7
		30–60	Sand and gravel	SP	A–1
Buick BxC, BxD	48–72	0–22	Loam to clay loam	CL	A–6 or A–7
		22–56	Sandy clay loam	CL	A–7
Clayey alluvial land Ca	>60	0–40	Stratified clay and loam	ML or CL	A–6 or A–7
Colby CoC, CoE, CyD2 (For properties of the Adena soil in mapping unit CyD2, refer to the Adena series.)	>60	0–60	Silt loam	ML or CL	A–4 or A–6
Deertrail (mapped only with Weld soils)	>60	0–12	Clay	CH	A–7
		12–55	Silty clay loam to silt loam	CL or ML	A–7 or A–6
Edgewater EdB	>60	0–28	Loam and sandy clay loam to clay loam	SC or MH	A–6 or A–7
		28–60	Gravel with some sand	SP	A–1
Fondis FdB, FdC, FgD, FoC (For properties of the Ascalon soil in mapping unit FgD, refer to the Ascalon series For properties of the Colby soil in FoC, refer to the Colby series)	>60	0–32	Clay and silty clay loam	CH or CL	A–7
		32–60	Clay loam and silt loam	CL or CH	A–7
Fort Collins FrB	>60	0–60	Stratified fine sandy loam to clay loam.	ML or CL	A–6
Gravelly land· Gr	>60	0–30	Sandy loam, gravelly clay loam	SP–SM, SM and SC	A–2
		30–60	Gravel, silt and sand	GP–GM	A–1
Heldt HlB, HsB	>40	0–23	Silty clay to clay	CL or CH	A–7
		23–54	Stratified fine sandy loam to clay.	ML or CL	A–6, A–7

properties of soils

sign < means less than, and > means more than]

Percentage passing sieve—				Permeability	Available water holding capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.76 mm)	No. 10 (2.0 mm.)	No 40 (0.42 mm)	No 200 (0.074 mm)					
				Inches per hour	*Inches per inch of soil*	*pH*		
----------	100	90–100	70–95	0 20–2. 0	0 20–0 25	6. 8–9. 0	Slight----------	Low to moderate.
100	90–100	70–90	35–70	0 63–6 3	0 18	6. 6–7 3	None----------	Low to moderate.
100	50–95	30–60	10–25	0 63–6 3	0 07	7 9–8 4	None----------	Low.
----------	100	90–100	70–95	0. 63–6. 3	0. 20–0. 25	6 8–9 0	Slight to moderate-----	Low to moderate.
85–95	80–90	50–65	25–35	0. 63–6 3	0 07	7. 8–8 5	None to slight--------	Low.
----------	100	90–100	70–90	<0 63	0 15–0. 25	7. 0–9 0	Slight----------	Moderate
----------	100	50–70	15–35	>6. 3	0. 05–0. 08	6 2–7 5	None to slight--------	Low.
----------	100	50–70	5–15	>6 3	0 08	6 2–7. 2	None----------	Low
----------	100	60–80	20–50	0 63–6 3	0. 20	6 4–7. 5	None----------	Low.
----------	100	40–70	5–25	>6. 3	0 08	7. 4–9. 0	None----------	Low.
90–100	85–100	85–100	60–80	0. 63–6. 3	0. 20	6. 5–7 5	None----------	Low
50–70	10–40	25–50	0–5	>6. 3	0	6. 5–7 5	None----------	Low.
----------	100	90–100	70–85	0–63–6 3	0 20	6. 8–8 0	None----------	Moderate.
----------	100	90–100	70–90	0. 63–6 3	0. 20	8. 0–9 0	None----------	High
----------	100	85–100	60–95	<0 63	0. 18–0. 25	7 5–8 5	Slight----------	Moderate.
----------	100	100	85–95	0. 63–6. 3	0 21	7. 5–9. 0	Slight to moderate-----	Low
----------	100	100	85–100	<0 63	0 25	6 8–7 5	None----------	High.
----------	100	100	85–100	0 63–6. 3	0 20	8 0–9 5	Slight to moderate-----	Low.
----------	80–100	70–100	35–80	<0 63	0. 18–0 20	6 5–7 5	None to slight--------	Low to moderate
50–70	10–40	25–50	0–5	>6. 3	0	6. 5–7. 5	None----------	Low.
100	95–100	90–100	80–100	<0 63	0. 25	6. 4–7. 5	None----------	High
100	90–100	90–100	75–100	<0. 63	0 25	7. 5–9 0	None to moderate-----	Moderate.
100	90–100	70–90	50–90	0 63–6 3	0. 20	7. 0–8 5	None----------	Low.
50–80	30–50	20–40	5–20	0 63–6 3	<0. 08	6 6–8. 4	Slight----------	Low.
30–50	20–30	15–25	5–10	>6 3	<0 08	6 6–8 4	Slight----------	Low.
----------	100	95–100	75–95	<0 63	0. 25	7. 0–9 5	Moderate to strong----	High.
----------	100	70–90	40–90	0. 63–6 3	0 20	7 0–9 0	Moderate to strong----	Moderate.

TABLE 6.—*Estimated engineering*

Soil and map symbols	Depth to bedrock	Depth from surface	Classification		
			Dominant USDA texture	Unified	AASHO
	Inches	*Inches*			
Little· LcD, LsD (For properties of the Samsil soil in mapping unit LsD, refer to Samsil clay, gypsum)	20–40	0–39 39	Clay Clayey beds of shale	CH	A–7
Nunn: NlB, NrB (For properties of the Bresser soil and of the Ascalon soil in mapping unit NrB, refer to the Bresser and Ascalon series, respectively)	>60	0–22 22–60	Clay Stratified sands and loams	CL SM, ML, and CL	A–6 or A–7 A–4, A–2
Olney. OnD	>60	0–42	Fine sandy loam	SC or SM	A–2 or A–4
Renohill RdD, RhD, RhE, RkE2, RlD, RtE (For properties of the Buick soils in mapping units RhD, RhE, and RkE2, refer to the Buick series For properties of the Litle soil in RlD and of the Litle and Thedalund soils in RtE, refer to the Litle and Thedalund series, respectively.	20–40	0–36 36	Clay loam Shale.	CL	A–6 or A–7
Renohill, reddish variant· ReE	20–40	0–40 40–50	Clay loam and silty clay Loam	MH ML	A–7 A–4
Samsil: SlF, SrE Ss (For properties of the Litle soil in mapping unit SlF and of the Renohill soil in SrE, refer to the Litle and Renohill series, respectively For properties of Shale outcrop in Ss, refer to Shale outcrop.)	6–14	0–12 12	Clay or clay loam Shale	CH or CL CH or CL	A–7 A–7
Samsil clay, gypsum: SaE	6–12	0–10 10	Silty clay Shale.	CL	A–6 or A–7
Sand pits St	>60	0–60	Loamy sand to sand	SM or SM–SP	A–2
Shale outcrop· Sv	0–12	0–12 12	Clay loam to clay Shale and sandstone.	CL	A–6
Stapleton: SwE	20–40	0–25 25	Sandy loam Arkosic sandstone	SM–SC	A–2
Tassel· Ta (Estimates are for Tassel soils only. Estimates were not made for the Rock outcrop part of this mapping unit)	12–18	0–18 18	Fine sandy loam Soft sandstone.	SM	A–2
Terry TdE, TeE (For properties of the Olney soil and of the Thedalund soil in mapping unit TeE, refer to the Olney and the Thedalund series, respectively)	24–60	0–26 26	Fine sandy loam Partly decomposed sandstone (hard sandstone at 50 inches).	SC–SM	A–4
Thedalund ThE, ThE2	20–40	0–30 30	Silty clay loam, disintegrated sandstone and shale. Shale and sandstone.	CL	A–7
Truckton: TrC, TrE	>60	0–30 30–50	Sandy loam Loamy sand	SC SM or SP–SM	A–2 A–2
Weld: WdC, WeB, WeC, WrB (For properties of the Deertrail soil in mapping unit WrB, refer to the Deertrail series)	>60	0–26 26–60	Silty clay loam to silty clay Silt loam	CL or CH ML–CL	A–7 A–4
Wet alluvial land: Wt	>60	0–48	Loam to sand and gravel	SM or SM–SP	A–4, A–3, or A–2

[1] Little or none.

properties of soils—Continued

Percentage passing sieve—				Permeability	Available water holding capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4 76 mm)	No 10 (2 0 mm.)	No 40 (0 42 mm)	No. 200 (0 074 mm)					
				Inches per hour	*Inches per inch of soil*	*pH*		
----------	100	90–100	80–90	<0 63	0 15–0. 21	7. 5–8. 5	Slight----------	High.
----------	100	90–100	85–95	<0. 63	0 20	6 5–7. 0	Slight----------	Moderate.
100	90–100	50–90	10–70	0 63–6. 3	0. 20	7 5–8. 5	Slight----------	Low.
----------	100	65–80	30–50	0 63–6 3	0. 12–0 15	7. 4–8 0	None----------	Low.
90–100	80–100	85–100	60–80	<0 63	0 20	7 5–8. 5	None----------	Moderate.
----------	100	90–100	75–95	<0 63	0. 20	6 4–7 4	None----------	Low.
100	90–100	85–95	60–70	0 63–6. 3	0 15	7 0–7. 8	None----------	Low.
----------	100	90–100	80–90	<0 63	0 25	8 0–8 5	Slight----------	High
----------	100	90–100	80–90	<0 63	(1)	7 5–8 5	Slight.	
----------	100	95–100	85–100	<0 63	0 25	8 0–9 5	Strong----------	Moderate to high.
----------	100	50–75	5–15	>6 3	<0 07	6 2–7 2	None----------	Low.
100	85–100	80–100	50–90	<0 63	0 20	7 5–8. 5	Slight----------	Low.
90–100	50–80	30–70	15–35	0 63–6 3	0 11	6 0–7. 0	None----------	Low.
100	95–100	60–85	5–35	>6. 3	0 08–0. 11	6 8–7 5	Slight----------	Low.
----------	100	60–80	35–50	0. 63–6. 3	0 11	6 8–7. 5	None----------	Low.
100	85–100	60–95	50–90	0 63–6. 3	0 20	7 5–8. 5	Slight----------	Low to moderate.
----------	100	65–75	15–35	0 63–6. 3	0. 11	6. 5–7. 2	None----------	Low.
----------	100	60–70	5–15	>6. 3	0. 06	7. 0–8. 0	None to slight----------	Low.
----------	100	100	85–100	<0. 63	0. 25	6. 5–9 0	Slight to moderate----------	Moderate.
----------	100	100	85–100	0 63–6. 3	0. 20	8. 0–9 0	Slight to moderate----------	Low.
100	95–100	50–70	5–40	0. 63–6. 3	0. 08–0. 15	6. 5–7. 5	Slight----------	Low.

TABLE 7.—*Engineering*

[Interpretations were not made for Loamy alluvial land (Lv),

Soils and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Adena. AcC, AcD, AdC, AdD (For interpretations for the Colby soils in these mapping units, refer to the Colby series)	Fair	Unsuitable	Fair to poor· low to moderate shrink-swell potential; low shear strength.	Silty and plastic material.
Ascalon· AsD	Fair to good	Sand is good for roads but is unsuitable for concrete	Fair to good	No unfavorable features
Baca: BcC, BcD, BhD (For interpretations for the Thedalund soil in mapping unit BhD, refer to the Thedalund series.)	Fair to good	Unsuitable	Poor to fair: low to moderate shrink-swell potential.	Plastic material
Beckton BkB	Poor· saline; slow drainage.	Unsuitable	Poor plastic material; slow internal drainage.	Flood hazard, plastic material.
Bijou· BlB, BmB	Fair· droughty; susceptible to soil blowing.	Unsuitable	Good· moderately to severely susceptible to soil blowing	Seasonal high water table in some areas; susceptible to soil blowing.
Blakeland BoD2, BoE	Poor· droughty; highly susceptible to soil blowing	Sand is excellent for roads but is poor for concrete.	Good	No unfavorable features
Bresser BrB, BsB, BuD, BuE, BvC, BvE, BwD2. (For interpretations for the Stapleton soils in mapping units BuD and BuE, refer to the Stapleton series. For interpretations for the Truckton soils in mapping units BvC, BvE, and BwD2, refer to the Truckton series.)	Fair to a depth of 18 inches.	Sand is good for roads below a depth of 2 feet but is unsuitable for concrete	Good to fair	No unfavorable features.
Bresser, gravelly subsoil variant: BtB	Good	Clean sand and gravel below a depth of 3 feet; suitable for concrete if washed.	Poor to a depth of 3 feet; low shear strength Good below a depth of 3 feet	Plastic material
Buick: BxC, BxD	Fair to good	Unsuitable	Poor· moderate to high shrink-swell potential	Plastic material
Clayey alluvial land· Ca	Fair	Unsuitable	Poor· moderate shrink-swell potential.	Flood hazard; plastic material.
Colby CoC, CoE, CyD2 (For interpretations for the Adena soil in mapping unit CyD2, refer to the Adena series.)	Fair. susceptible to water erosion and to soil blowing.	Unsuitable	Fair to poor low shear strength, poor compaction, susceptible to erosion.	Susceptible to erosion; plastic material.

interpretations of soils

Rock outcrop (Ru), Sandy alluvial land (Su), and Terrace escarpments (Tc)]

Soil features affecting—Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Moderate seepage, holes are common, fair to poor compaction.	Moderately pervious, poor to fair stability; piping in places, low shear strength; fair to poor compaction	Silty, unstable for ditchbanks.	Moderate water intake, high available water holding capacity, deep.	Poor to fair stability, susceptible to soil blowing.
Pervious material below a depth of 18 inches	Moderate permeability if compacted for sandier material, fair stability.	Moderate to moderately rapid permeability, drainage not needed	Undulating to sloping, moderate to low available water holding capacity; high water intake rate, susceptible to soil blowing	Susceptible to soil blowing.
Shale or sandstone at depth of 5 feet.	Fair to poor stability, piping in places, fair to poor compaction.	Moderate to moderately rapid permeability; drainage not needed.	Moderate water intake, high available water holding capacity.	Susceptible to soil blowing.
Gypsum layer, low seepage	Moderate shrink-swell potential, fair stability, fair to poor compaction	Salinity, slow internal drainage, slow permeability.	Drainage needed, salts must be leached; slow permeability.	Salinity
Pervious material, seasonal high water table in some areas.	Moderate permeability, susceptible to soil blowing; fair stability.	Seasonal high water table in some areas.	Low available water holding capacity, susceptible to soil blowing	Susceptible to soil blowing.
Pervious material	Moderate to rapid permeability, fair to poor stability, piping in some places.	Rapid permeability; drainage not needed.	Low available water holding capacity, highly susceptible to soil blowing, undulating to hilly.	Highly susceptible to soil blowing, undulating to hilly.
Pervious material below a depth of 16 inches.	Moderate permeability if compacted for sandier material, fair stability.	Moderate to moderately rapid permeability; drainage not needed.	Undulating to strongly rolling, low available water holding capacity below a depth of 2 feet.	Susceptible to soil blowing.
Pervious material below a depth of 2 feet.	Variable	No unfavorable features Water table generally below a depth of 8 feet, gravel occurs below a depth of 3 feet.	Limited rooting depth	No unfavorable features.
Moderate seepage if material is compacted, high content of lime at a depth of 12 inches.	Moderate to high shrink-swell potential, fair to good stability.	No unfavorable features	Gently sloping to steep; high available water holding capacity.	Variable.
Stratified layers of pervious and impervious material.	Moderate shrink-swell potential to a depth of 2 feet and high below, fair stability; fair to poor compaction.	Layers of stratified clay and loam	Flood hazard	Variable.
Moderate seepage; holes are common, high content of lime; poor compaction.	Moderate permeability if compacted; poor stability; piping in some places, susceptible to erosion	Poor stability	Moderate water intake; moderate available water holding capacity, low fertility, nearly level to steep	Poor compaction; low shear strength; susceptible to water erosion and to soil blowing.

TABLE 7.—*Engineering*

Soils and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Deertrail (mapped only with Weld soils)--	Poor clayey material.	Unsuitable----------	Poor: high shrink-swell potential; slow internal drainage; poor compaction.	Fair to poor compaction; fair to poor stability; plastic material.
Edgewater. EdB----------	Good----------	Good below a depth of 28 inches.	Poor to a depth of 28 inches; low shear strength. Good below a depth of 28 inches.	Water table at a depth of 2 to 6 feet; plastic material; flood hazard in some places.
Fondis FdB, FdC, FgD, FoC---------- (For interpretations for the Ascalon soil in mapping unit FgD, refer to the Ascalon series. For interpretations for the Colby soil in mapping unit FoC, refer to the Colby series)	Fair to good------	Unsuitable----------	Poor high shrink-swell potential; slow internal drainage.	Plastic material------
Fort Collins. FrB----------	Fair----------	Unsuitable----------	Poor low shear strength.	Plastic material------
Gravelly land· Gr----------	Poor: sandy material	Good----------	Good----------	6 to 50 percent slopes--
Heldt. HlB, HsB----------	Poor clayey material, saline.	Unsuitable----------	Poor high shrink-swell potential, low shear strength; poor compaction; slow internal drainage.	Plastic material------
Litle· LcD, LsD---------- (For interpretations for the Samsil soil in mapping unit LsD, refer to the Samsil, gypsum)	Poor: clayey material	Unsuitable----------	Poor high shrink-swell potential; low shear strength; poor compaction, slow internal drainage.	Plastic material------
Nunn: NlB, NrB---------- (For interpretations for the Bresser soil and the Ascalon soil in mapping unit NrB, refer to the Bresser and Ascalon series, respectively.)	Fair----------	Unsuitable----------	Poor poor compaction.	Plastic material------
Olney· OnD----------	Fair----------	Unsuitable for gravel; good for sand for roads.	Fair low shrink-swell potential.	No unfavorable features
Renohill RdD, RhD, RhE, RkE2, RlD, RtE. (For interpretations for the Buick soils in mapping units RhD, RhE, and RkE2, refer to the Buick series For interpretations for the Litle soils in mapping units RlD and RtE and for the Thedalund soil in mapping unit RtE, refer to the Litle and Thedalund series, respectively)	Poor: shaly------	Unsuitable----------	Poor poor compaction, slow drainage; moderate shrink-swell potential.	Plastic material to a depth of 2 feet; shale below a depth of 2 feet

interpretations of soils—Continued

Soil features affecting—Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Moderate seepage below a depth of 18 inches; holes are common, poor compaction, high content of lime	High shrink-swell potential, fair to poor stability; piping in some places, poor compaction, susceptible to water erosion and to soil blowing	Fair to poor stability, surface ponding, moderate salinity, slow permeability.	Very slow water intake, high available water holding capacity, clayey topsoil, slow permeability	High shrink-swell potential, moderate salinity; piping in some places.
Pervious material below a depth of 28 inches, water table at a depth of 2 to 6 feet.	Variable, low to moderate shrink-swell potential	Water table at a depth of 2 to 6 feet, sand and gravel at a depth of 28 inches, flood hazard.	Limited rooting depth, flood hazard	No unfavorable features.
High content of lime, moderate to low seepage	High shrink-swell potential, fair to poor compaction, fair stability.	Moderate to slow permeability; slow permeability at a depth of 8 to 16 inches.	High available water holding capacity, slow to moderate water intake, slow to moderate permeability.	High shrink-swell potential.
Moderate seepage, strata of sand below a depth of 3 feet in some places.	Fair to poor stability; piping in some places.	Moderate permeability; unstable ditchbanks.	High available water holding capacity, moderate water intake; 0 to 3 percent slopes.	Susceptible to soil blowing.
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable.
Low seepage to a depth of 3 feet and variable below, stratified sand and loam below a depth of 3 feet.	High shrink-swell potential, fair to poor stability; poor compaction	Slow water intake; slow permeability.	High available water holding capacity, difficult to till, salinity	High shrink-swell potential
Low seepage, beds of shale at a depth of 20 to 40 inches	High shrink-swell potential, poor compaction, fair stability	Slow permeability	Very slow water intake, moderate available water holding capacity.	High shrink-swell potential.
Moderate seepage, lenses of sand occur below a depth of 3 feet; high content of lime.	Moderate shrink-swell potential, poor compaction, fair to good stability.	Medium internal drainage, sandy below a depth of 3 feet, banks may slough, water table at a depth of 5 to 10 feet in some areas, flood hazard in some areas.	Moderate water intake; high available water holding capacity	Variable.
Pervious material below a depth of 2 feet.	Moderate permeability; fair stability.	Moderate to moderately rapid permeability, drainage not needed.	Moderate available water holding capacity.	Susceptible to soil blowing.
Low seepage below a depth of 2 feet	Moderate shrink-swell potential, fair to good stability.	Moderately slow to slow permeability, shale and sandstone below a depth of 2 feet.	Limited rooting depth, shale and sandstone below a depth of 2 feet, 3 to 20 percent slopes.	3 to 20 percent slopes, susceptible to soil blowing and to siltation.

TABLE 7.—*Engineering*

Soils and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Renohill, reddish variant ReE	Poor shaly	Unsuitable	Poor to fair poor compaction, low shear strength	No unfavorable features
Samsil SlF, SrE, Ss (For interpretations for the Litle soil in mapping unit SlF, refer to the Litle series For interpretations for the Renohill soil in mapping unit SrE and for Shale outcrop in mapping unit Ss, refer to the Renohill series and to Shale outcrop in this table)	Poor clayey, shaly	Unsuitable	Poor: low shear strength, poor compaction, poor drainage, shale at a depth of 6 to 14 inches.	Plastic material over shale, shale at a depth of 6 to 14 inches, seepage in a few places
Samsil, gypsum: SaE	Poor clay texture, shaly, contains gypsum	Unsuitable	Poor shale at a depth of 0 to 14 inches.	Plastic material over shale, shale at a depth of 0 to 14 inches
Sand pits St	Poor sandy	Unsuitable for gravel Excellent for sand for roads, in some places sand is suitable for concrete if washed.	Fair to good	Susceptible to soil blowing.
Shale outcrop Sv	Poor shaly	Unsuitable	Poor very shallow	Shale and sandstone below a depth of 1 foot, 9 to 50 percent slopes.
Stapleton SwE	Fair shallow	Poor for concrete Good for roads	Good	9 to 30 percent slopes
Tassel Ta (Interpretations were not made for the Rock outcrop part of this mapping unit)	Fair sandy	Unsuitable for concrete Fair for sand for roads.	Good sandstone is at a depth of 15 to 18 inches, 3 to 20 percent slopes	Sandstone is at a depth of 15 to 18 inches, 3 to 20 percent slopes
Terry TdE, TeE (For interpretations for the Olney soil and for the Thedalund soil in mapping unit TeE, refer to the Olney series and to the Thedalund series, respectively)	Poor sandy	Unsuitable for gravel Fair for sand for roads. Poor for sand for concrete	Fair to good	Sandstone is at a depth of 2 to 5 feet, 5 to 20 percent slopes
Thedalund ThE, ThE2	Poor clayey	Unsuitable	Poor low shear strength, medium to high compressibility.	Plastic material, 9 to 20 percent slopes, sandstone and shale below a depth of 1 foot, slow internal drainage
Truckton: TrC, TrE	Fair	Unsuitable for gravel. Good for sand for roads Poor for sand for concrete	Good	No unfavorable features.

interpretations of soils—Continued

Soil features affecting—Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Pervious material	Poor stability, poor compaction	Moderately slow to slow permeability, shale and sandstone below a depth of 2 feet.	Moderate available water holding capacity, 5 to 20 percent slopes.	Not applicable.
Shallow over shale	High shrink-swell potential, fair to poor stability, poor compaction.	Shale at a depth of 6 to 14 inches.	Shale at a depth of 6 to 14 inches; steep.	Shale at a depth of 6 to 14 inches; high shrink-swell potential; not applicable for terraces.
Shallow over shale, contains gypsum and sodium salts	Moderate to high shrink-swell potential; poor stability.	Shale at a depth of 0 to 14 inches.	Shale at a depth of 0 to 14 inches; slow water intake, 5 to 20 percent slopes; salinity.	Shale at a depth of 0 to 14 inches; salinity, not applicable for terraces
Not applicable	Not applicable	Not applicable	Not applicable.	Not applicable
Shallow over shale	Poor stability	Shale and sandstone below a depth of 1 foot.	Not applicable	Not applicable for terraces
Pervious material, seals with sediments in some areas	Moderate permeability if compacted, fair stability	Poorly consolidated fine gravel and siltstone at a depth of 12 to 42 inches, 9 to 30 percent slopes	Low available water holding capacity, shallow rooting depth, 9 to 30 percent slopes.	9 to 30 percent slopes, susceptible to soil blowing.
Not applicable	Not applicable	Rapid permeability, sandstone is at a depth of 15 to 18 inches; drainage not needed.	Not applicable	3 to 20 percent slopes, susceptible to soil blowing.
Pervious material, sandstone is at a depth of 2 to 5 feet.	Moderate to rapid permeability if compacted, fair stability; susceptible to soil blowing.	Sandstone is at a depth of 2 to 5 feet, restricted drainage in some places.	Low available water holding capacity, rapid water intake.	5 to 20 percent slopes, susceptible to soil blowing.
Shallow to interbedded shale and sandstone, high content of lime in many areas	Fair stability; medium compressibility	Generally shallow to impervious material; 9 to 20 percent slopes	9 to 20 percent slopes, shallow rooting depth.	9 to 20 percent slopes, sandstone and shale below a depth of 1 foot.
Pervious material	Good stability to a depth of 30 inches, but fair to poor stability below, piping in some places, moderate to moderately rapid permeability if compacted.	Moderate to moderately rapid permeability, drainage not needed	Moderate to low available water holding capacity; undulating; 1 to 20 percent slopes.	Undulating, susceptible to soil blowing, 1 to 20 percent slopes.

TABLE 7.—*Engineering*

Soils and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Weld WdC, WeB, WeC, WrB (For interpretations for the Deertrail soil in mapping unit WrB, refer to the Deertrail series)	Good	Unsuitable	Poor low to moderate shrink-swell potential, low shear strength, medium to high compressibility	Plastic material
Wet alluvial land Wt	Fair	Sand and gravel is available below a depth of 18 inches in some places	Fair water table at a depth of 0 to 4 feet	Flood hazard, water table at a depth of 0 to 4 feet

that have a high liquid limit are identified by the symbols MH and CH. Liquid limit and plastic limit are defined in the subsection "Soil Test Data."

The United States Department of Agriculture classifies soils according to texture, which is determined by the proportion of sand, silt, and clay in the soil material (*5*). The terms "sand," "silt," and "clay" are defined in the Glossary at the back of the survey.

Engineering properties of soils

Table 6 shows some estimates of soil properties that are important to engineering, and it gives estimated engineering and textural classifications for the soils. The data in table 6 are based on field classifications and descriptions, on the test data given in table 8, on test data obtained from similar soils in adjacent counties, and on past experience in engineering construction. Not included in table 6 are Loamy alluvial land (Lv), Rock outcrop (Ru), Sandy alluvial land (Su), and Terrace escarpments (Tc).

The depth to bedrock is indicated in table 6. Depth to a seasonal high water table refers to the highest level at which the ground water stands for a significant period of time. Soils that have a high water table are limited in their use for highways and for other construction. Bedrock is at a depth of less than 2 feet in some of the soils of Arapahoe County, but some soils are more than 5 feet deep to bedrock. Depth to bedrock is important to the engineer because it may greatly affect designing, constructing, and maintaining structures.

In Arapahoe County the depth to the water table ranges from 2 to 6 feet for Edgewater soils, from 0 to 4 feet for Wet alluvial land, and from 2 to 5 feet for Bijou sandy loam, wet. For the other soils in the county, the water table remains at such a great depth that it is not significant to engineering.

The column headed "Depth from surface" indicates the depth of the soil material for which estimates were made. For these estimates, layers given in the technical profiles in the section "Descriptions of the Soils" were combined.

Listed for the soils in table 6 are the USDA textural classification, the Unified and AASHO engineering classifications, and the estimated percentages of material that passes Nos. 4, 10, 40, and 200 sieves.

Permeability refers to the rate that water moves downward through undisturbed and uncompacted soil material. It does not include lateral seepage. The estimates in table 6 are based mainly on the texture, structure, and porosity of the soils.

The available water holding capacity, expressed in inches of water per inch of soil, is the approximate amount of water that a soil can hold available for plants. It is the water held in a soil between field capacity and permanent wilting point.

Reaction is given in pH values and indicates the degree of acidity or alkalinity of the soil material. Higher values indicate alkaline material and lower values acid material, as defined in the Glossary.

Estimates of salinity are based on the electrical conductivity of saturated soil extract, as expressed in millimhos per centimeter at 25° C. In table 6, salinity is expressed in words—none, slight, moderate, or high. Most of the soils are not saline or are only slightly saline. The salinity of a soil affects its suitability for crops, its stability when it is used as construction material, and its corrosiveness when other materials are placed in it.

Shrink-swell potential indicates the expected volume change of soil material when its moisture content changes. The ratings given in table 6 were estimated primarily on the basis of the kind and amount of clay that a soil contains. In general, soils classified CH and A–7 have a high shrink-swell potential. The shrinking and swelling of a soil causes damage to foundations of buildings, to roads, and to other structures. Structures built on, in, or with a soil having a high shrink-swell potential are difficult to maintain.

Engineering interpretations of soils

In table 7, the soils of Arapahoe County are rated according to their suitability as a source of topsoil, sand and gravel, and road fill. In addition, the table lists soil features that affect location of highways and the construction and maintenance of farm ponds, drainage systems, irrigation systems, and terraces and diversions. The interpretations are based on the estimated soil properties shown in table 6, the actual test data shown in table 8, other available test data, and field experiences. Not in-

interpretations of soils—Continued

Soil features affecting—Continued				
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions
Reservoir area	Embankment			
Moderately slow permeability, holes are common, high in content of lime below a depth of 18 inches	Fair to poor stability, piping in some places, poor compaction	Moderately slow permeability, unstable ditchbanks.	High available water holding capacity, deep, salinity at a depth of 1 to 2 feet.	No unfavorable features
Pervious material, water table at a depth of 0 to 4 feet	Fair to poor stability, piping in some places.	Wet, drainage generally not feasible	Not applicable	Not applicable

cluded in table 7 are Loamy alluvial land (Lv) Rock outcrops, Sandy alluvial land (Su), and Terrace escarpments (Tc).

The suitability of soil material as a source of topsoil, sand and gravel, and road fill is rated *good*, *fair*, or *poor* in table 7. Topsoil is fertile soil or soil material, ordinarily rich in organic matter, that is used to topdress lawns, gardens, roadbanks, and the like. The ratings given for the suitability of a soil as a source of sand and gravel are based on the probability of a soil to contain deposits of sand and gravel. They do not indicate the quality or quantity of the deposits. The suitability ratings for road fill are based on the performance of the soil material that is excavated and used for highway embankments and subgrades.

In estimating the soil features that affect selection of highway location, evaluation is for the profile of an undisturbed soil that has not been drained but that has had its organic surface layer removed, if one occurs. Some of the features considered are the height of the water table, the hazard of flooding, the stability of the soil material, particularly under heavy loads of pressure, depth to and kind of bedrock, and slope.

Where farm ponds are constructed, suitability of soils for both reservoirs and for embankments is considered. The choice of a site for the reservoir of a farm pond depends largely on the rate of seepage that can be expected through undisturbed soil. Among the soil features affecting use of soils for reservoir areas and embankments for farm ponds are susceptibility to seepage, the sealing potential of the soil material, depth to a high water table, depth to and nature of the bedrock, stability, permeability, shrink-swell potential, and compactibility. Susceptibility to soil blowing affects embankments. Both the subsoil and the underlying material are considered when the soil material is excavated and used as borrow for embankments. Heldt clay, saline, 0 to 3 percent slopes, is one of the most suitable soils in the county for use as sites for farm ponds. This soil has a high content of sodium, and ponds on it seal rapidly and lose very little water through seepage.

Soil features affecting agricultural drainage are texture, stability, salinity, permeability, and a high water table.

Some of the features considered in evaluating a soil for irrigation purposes are rate of water intake, available water holding capacity, slope, and susceptibility to soil blowing.

Stability, slope, susceptibility to water erosion and to soil blowing, shrink-swell potential, shear strength, and compactibility are some of the soil features affecting terraces and diversions.

Soil test data

To help to evaluate the soils for engineering purposes, samples were taken from the soils of the Bresser, Buick, Deertrail, Fondis, Litle, Nunn, Renohill, Truckton, and Weld series and were tested by the Colorado Department of Highways, in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*). The results of these tests and the classification of each sample according to both the AASHO and the Unified systems are given in table 8.

The engineering soil classifications in table 8 are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by the combined sieve and hydrometer methods. The percentage of clay obtained by the hydrometer method should not be used in naming the textural classes of soils.

The liquid limit and plasticity index given in table 8 indicate the effect of water on the consistence of soil material. As the moisture content of a clayey soil is increased from a very dry state, the material changes from a solid to a semisolid to a plastic state. As the moisture content is further increased, the material changes, when disturbed, from a plastic state to a liquid state. The plastic limit is the moisture content at which the material changes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material changes, when disturbed, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Specific gravity refers to the ratio of the weight of the soil material to the weight of pure water.

TABLE 8.—*Engineering test data*

[Tests performed by the Colorado Department of Highways in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Soil name and location	Depth	Mechanical analyses[1]			Liquid limit	Plasticity index	Specific gravity	Moisture density[2]		Classification	
		Percentage passing sieve—						Optimum moisture	Maximum dry density	AASHO[3]	Unified[4]
		No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
	Inches							*Percent*	*Lbs. per cu. ft.*		
Bresser sandy loam											
1,321 feet north and 44 feet west of S¼ corner of sec. 23, T. 4 S., R. 61 W.	0–6	100	69	32	[5] NV	[6] NP	2.57	10	121	A–2–4(0)	SM
	10–18	100	77	39	31	13	2.63	14	116	A–6(2)	SC
	29–40	100	60	12	NV	NP	2.65	10	117	A–2–4(0)	SP–SM
Buick loam:											
2,300 feet south and 89 feet east of northwest corner of sec. 2, T. 4 S., R. 60 W.	0–3	100	98	79	NV	NP	2.56	16.2	104	A–4(8)	ML
	6–10	100	98	83	35	14	2.65	19.4	105	A–6(10)	CL
	42–55	100	98	82	42	23	2.70	16.4	107	A–7–6(14)	CL
Deertrail silt loam:											
521 feet east and 252 feet north of northeast corner of sec. 23, T. 5 S., R. 59 W.	2–9	------	100	97	48	27	2.69	23	99	A–7–6(16)	CL
	12–23	------	100	98	42	20	2.70	23	101	A–7–6(12)	CL
	32–44	------	100	98	36	13	2.71	23	100	A–6(9)	CL–ML
Fondis silt loam.											
750 feet north and 150 feet west of the E¼ corner, sec. 25, T. 4 S., R. 64 W.	0–5	[7] 99	94	85	25	4	2.57	18	106	A–4(8)	ML–CL
	8–12	100	99	96	66	39	2.72	22	90	A–7–6(20)	CH
	44–54	[7] 99	91	80	46	25	2.77	20	105	A–7–6(15)	CL
Litle silty clay loam:											
220 feet north and 2,820 feet east of southwest corner of sec. 23, T. 5 S., R. 57 W. (Modal)	0–3	------	100	98	37	12	2.60	24	94	A–6(9)	ML–CL
	6–13	------	100	99	49	26	2.69	22	99	A–7–6(16)	CL
	31–43	------	------	100	54	32	2.81	24	100	A–7–6(19)	CH
Nunn loam											
1,100 feet north and 600 feet east of southwest corner of sec. 23, T. 4 S., R. 61 W.	0–4	100	82	56	21	3	2.62	14	114	A–4(4)	ML
	8–16	100	91	70	41	22	2.67	18	107	A–7–6(12)	CL
	32–60	100	82	36	19	3	2.70	11	122	A–4(0)	SM
Renohill loam.											
1,300 feet east of northwest corner of sec. 27, T. 5 S., R. 59 W. (Shallow phase)	0–5	------	100	94	37	15	2.67	22	100	A–6(10)	CL
	5–13	------	100	92	41	16	2.66	22	98	A–7–6(11)	ML–C
	22–48	------	100	89	54	22	2.83	30	91	A–7–5(16)	MH
Truckton loamy sand:											
1,350 feet north of S¼ corner of sec. 23, T. 4 S., R. 61 W.	0–5	100	71	34	NV	NP	2.57	12	118	A–2–4(0)	SM
	5–12	100	65	21	24	6	2.64	11	119	A–2–4(0)	SM–SC
	20–60	100	65	14	NV	NP	2.63	12	118	A–2–4(0)	SM
Weld silt loam											
2,162 feet south and 184 feet east of northwest corner of sec. 16, T. 4 S., R. 59 W.	0–3	------	100	91	NV	NP	2.56	18	100	A–4(8)	ML
	6–12	------	100	97	49	24	2.65	23	95	A–7–6(15)	CL
	43–56	------	100	97	30	8	2.70	20	106	A–4(8)	ML–CL

[1] Mechanical analyses according to AASHO Designation T 88 (*1*). Results obtained by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[2] Based on AASHO Designation: T 99–57, Method A (*1*).

[3] Based on AASHO Designation: M 145–49 (*1*).

[4] Based on the Unified Soil Classification System, Tech. Memo. No. 3–357, v. 1, Corps of Engineers (*7*). SCS and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SP–SM and ML–CL.

[5] NV = No value

[6] NP = Nonplastic

[7] 100 percent of the material passed the No. 4 sieve.

Moisture density, or the relation between moisture content and the density of compacted soil material, also is given in table 8. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture. The highest dry density obtained in the compaction test is termed maximum dry density. Moisture density data are important in earthwork, for as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Formation and Classification of Soils

In this section, the major factors of soil formation are discussed in terms of their effect on the development of the soils in Arapahoe County. The current system of soil classification is briefly described, and the soil series are placed in some classes of that system and in great soil groups of an older system. The soil series in the county, including a profile typical for each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

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

Climate and vegetation are the active factors of soil formation. They act on the accumulated parent material and slowly change it into a soil that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme instances, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. The time needed may be long or short, but some time is always required for the development of horizons. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes that affect soil development are unknown.

Parent material

The soils in Arapahoe County formed in a wide variety of parent material, mainly material that weathered from hard shale and sandstone and loose material deposited by water and wind. The formations underlying the county and the kinds of material from which the parent material weathered are described in the section "Geology and Soil Development."

In the smoother uplands the parent material is a thin mantle of loose silty and sandy material deposited by wind. The silty material contains a large amount of lime, but the sandy material is essentially free of lime.

The wind-laid material consists mainly of sediments that have been deposited by water on the flood plains along the larger streams, but mixed with these sediments are deposits blown from weathered beds of shale and sandstone. In the western four-fifths of the county, these mixed wind-laid deposits range from 1 to 10 feet in thickness, and in some places they are underlain by older material that was deposited by water and contains a developed profile of a buried soil. The Fondis soils, for example, have formed over a buried soil consisting of calcareous loam to clay loam that has various amounts of fine gravel. The texture, structure, and color of the buried soil indicate that the soil developed under grass, but in a climate that is wetter and warmer than the present climate. The soils on the steeper slopes along drainageways developed from material weathered from shale and sandstone because erosion removed the material deposited by wind and water.

Climate

Precipitation, temperature, and wind are climatic factors that have affected the formation of soils in this county. Climatic data for the county are given in the section "Climate of Arapahoe County," beginning on page 73.

When the windblown material accumulated in its present location, the precipitation probably was greater than it presently is and silt-laden floodwaters frequently deposited material on the broad stream channels. Strong winds probably blew from the north and west, the same direction that they generally blow today. This is indicated by the position of the material. The deepest, sandiest material is closest to the streams, on the eastern side, and the finer textured material is farther east of the streams. Shale, sandstone, or water-deposited materials occur at the surface on the western side of the streams.

The present climate of the county is gradational from west to east and from south to north. The average temperature is a little less, rainfall a little more, and elevation a little higher in the south and west than they are in the north and east. Most of the strong winds blow from the west and the northwest.

These differences in climate have affected the formation of soils to some extent. The soils in the western and southern parts of the county have a little darker surface layer and lime 1 to 3 inches deeper than have similar soils in the northern and eastern parts. Because of strong winds and soil blowing, soils are thinnest at the crest of ridges that face north and west. Lime has been leached to a greater depth in soils on slopes that face east and south than in soils on slopes that face north and west. These differences partly result from the fact that more drifting snow was deposited on south- and east-facing slopes and that more soil material was blown from north- and west-facing slopes. The depth to lime indicates the depth to which the soil material is saturated during most of the storms. In this county, however, lime is leached to a depth of more than 20 inches in only a few places.

Plants and animals

Grasses, trees, shrubs, micro-organisms, and other forms of plants and animals that live on and in the soils are active in the soil-forming processes.

In Arapahoe County the plant cover consists mainly of short and tall grasses and a few pine trees that are growing on the Stapleton soils on the eastern side of Cherry Creek along the southern edge of the county. Soils that form under grass generally have a dark-colored, granular surface layer that is easily penetrated by water and roots. The short grasses grow on the medium-textured and clayey soils, and the tall grasses grow on the sandy soils. Because the short grasses obtain much of the water they need from near the surface of loamy soils their roots are closer to the surface than those of tall grasses, which send their roots deeper into the sandy soils in search of moisture. When grasses decay, they add organic matter, high in calcium and other bases, to the surface soil, which tends to hold the clay particles together and helps to form aggregates and granules.

In this county domestic and wild animals return organic matter to the soil in the form of manure. Many microorganisms live in the soil and are active in helping to decompose plant and animal residue and in releasing nutrients, such as nitrogen and phosphorus, that can be used again by plants; they also help to return carbon dioxide to the air. The remaining humus helps to bind the soil material together and gives it a distinctive dark color.

Relief

Relief, including direction of slope, affects soil formation through its influence on drainage, erosion, vegetation, and soil temperature. The topography of this county is nearly level to very steep, and the slopes range from 0 to 50 percent.

South-facing slopes receive more direct sunshine and are warmer than north-facing slopes. The amount of water that runs off a soil increases as steepness increases. The amount of runoff also is affected by the texture of the soil material. Little water runs off from slopes of less than 3 percent where plants grow on the soils. The less sloping soils, therefore, have a darker surface layer and more dense vegetation than steeper soils, and lime is at a greater depth. Slips or catsteps, about 3 to 12 inches high, occur on clayey soils that have slopes of more than 8 percent. In contrast, slips do not occur on sandy soils unless the slope is more than 15 percent. Rills, 2 to 6 inches deep, form in some places in soils having slopes of more than 3 percent. Gullies, a foot to many feet deep, may form where water collects and runs off. In areas where the surface layer is removed by blowing, slipping, or washing, the soils are thinner than in undisturbed areas and the soil-forming processes are slowed.

Time

Time is required for the formation of soils. The length of time that was required for the soils to form as they now occur in the county is unknown, but probably this time should be measured in thousands of years. In a few hundred years, some soil material was removed from nearly all slopes by wind and water. Also, some material was deposited in low areas and on slopes that face south and east. Soil horizons form faster in loose material that has been redeposited than they do in material weathered in place from hard sandstone or shale that water and plant roots cannot penetrate so easily.

Classification of Soils

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

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

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*4*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. It is under continual study. Therefore, readers interested in developments of this system should refer to the latest literature available (*3, 6*). In table 9, the soil series of Arapahoe County are placed in some categories of the current system and in the great soil groups of the older system.

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

ORDER: Ten soil orders are recognized in this system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Three exceptions are the Entisols, Inceptisols, and Histosols, which occur in many different climates. Three of the soil orders are represented in Arapahoe County. They are Entisols, Aridisols, and Mollisols.

Entisols are recent soils in which there has been little, if any, horizon development.

Aridisols formed in dry climate. They have a light-colored surface layer, and some have a clay-enriched B horizon high in base saturation. Others have free carbonates throughout their profile.

Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and base saturation of more than 50 percent.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in

TABLE 9.—*Soil series classified according to the current system of classification and the 1938 system with its later revisions*

Series	Current classification [1]			1938 classification with later revisions
	Family	Subgroup	Order	Great soil group
Adena	Fine, montmorillonitic, mesic	Ustollic Palcargids	Aridisols	Brown soils
Ascalon	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils
Baca	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols	Brown soils
Beckton	Fine, montmorillonitic, mesic	Typic Natrustolls	Mollisols	Solonetz soils
Bijou	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols	Brown soils
Blakeland	Sandy, mixed, mesic	Torriorthentic Haplustolls	Mollisols	Chestnut soils
Bresser	Fine-loamy over sand or sandy skeletal, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils
Buick	Fine-silty, mixed, mesic	Ustollic Haplargids	Aridisols	Brown soils
Colby	Fine-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Regosols
Dectral	Fine, montmorillonitic, mesic	Haplustollic Natrargids	Aridisols	Solonetz soils
Edgewater	Fine-loamy over sand or sandy skeletal, mixed, noncalcareous, mesic	Cumulic Haplaquolls	Mollisols	Chestnut soils
Fondis	Fine, montmorillonitic, mesic	Abruptic Aridic, Paleustolls	Mollisols	Chestnut soils
Fort Collins	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols	Brown soils
Heldt	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols	Brown soils
Litle	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols	Brown soils
Nunn	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols	Chestnut soils
Olney	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols	Brown soils
Renohill	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols	Brown soils
Samsil	Clayey, mixed, calcareous, mesic, shallow	Ustic Ustorthents	Entisols	Lithosols
Stapleton	Coarse-loamy, mixed, mesic	Aridic Haplustolls	Mollisols	Chestnut soils
Tassel	Loamy, mixed, calcareous, mesic, shallow	Ustic Ustorthents	Entisols	Lithosols
Terry	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols	Brown soils
Thedalund	Fine-loamy, mixed, calcareous, mesic	Ustic Torriorthents	Entisols	Lithosols
Truckton	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols	Chestnut soils
Weld	Fine, montmorillonitic, mesic	Abruptic Aridic Paleustolls	Mollisols	Chestnut soils

[1] Placement of some series in the current system of classification, particularly in families and subgroups, may change as more precise information becomes available.

the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP: Suborders are separated into great groups according to the presence or absence of genetic horizons and the arrangement of these horizons. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that have pans that interfere with the growth of roots or the movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium) and the like. The great group is not shown separately in table 9, because it is the last word in the name of the subgroup.

SUBGROUP: Each great group is subdivided into subgroups. One of these subgroups represents the central, or typic, segment of a group, and the others, called intergrades, contain those soils that have properties mostly of one great group, but also one or more properties of soils in another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order.

FAMILY: Each subgroup is divided into families, primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

Geology and Soil Development

From oldest to youngest, the geologic formations exposed in Arapahoe County are Pierre shale and the Fox Hills and Laramie formations of Upper Cretaceous age, the Dawson formation of Pleistocene age, and sand of Recent age.

Pierre shale crops out only in the eastern part of the county, mainly in the area drained by Beaver Creek. It is olive silty clay that has much crystalline gypsum. The Litle and Samsil soils were derived from Pierre shale. Colby and Adena soils formed on the tops of most ridges and on east-facing slopes, which are gently sloping and mantled with eolian silt (loess). Beaver Creek and its tributaries that drain this area have many vertical banks more than 30 feet high. Along the upper parts of the tributaries are small flood plains on which the material is clay. Terraces as much as a half mile wide occur above the flood plains and on them Heldt and Beckton soils are dominant.

The upper part of the Pierre shale and the lower 100 feet of the Fox Hills formation form a zone of transition

that extends from north to south across the eastern part of the county and crops out in a narrow band that is drained mainly by Badger Creek. This zone is dominantly light olive brown and consists of interbedded sandy shale, shale, and sandstone. The beds are calcareous and have some gypsum. In this area, the Baca and Thedalund soils occur on rolling topography and the Weld, Colby, and Deertrail soils are on the higher, gently sloping, west-facing slopes. In many parts of this area, water has cut deep, narrow drainageways that have many vertical banks 10 to 30 feet high.

A sandstone bed, 150 to 200 feet thick, forms the upper part of the Fox Hills formation, and it crops out in a narrow strip that extends from north to south across the eastern part of the county, mainly between Beaver Creek and Deer Trail Creek. The sandstone is fine grained, buff to white, and mainly calcareous. The soils derived from this sandstone in rolling areas are Terry fine sandy loam and Olney fine sandy loam. In gently sloping areas, Weld fine sandy loam occurs where loess has been deposited. Resistant sandstone crops out in a hilly area where the Thedalund, Tassel, and Terry soils are closely associated. Deer Trail and Badger Creeks have flood plains 100 to 1,000 feet wide on which the soils are of medium to heavy texture. On terraces above the flood plains, Beckton loam is dominant.

The Laramie formation overlies the Fox Hills formation, and the contact line between the two formations is approximately along Deer Trail Creek. The Laramie formation underlies most of the area between Deer Trail Creek and West Bijou Creek. It commonly crops out along the streams and the lower slopes of drainageways on side hills. This formation consists of gray to black shale and thin beds of sandstone. The shale is highly carbonaceous in places. The sloping Samsil and Renohill soils developed in these areas, generally on slopes that face west.

Pleistocene alluvium consisting of loam and clay loam and varying amounts of gravel has been deposited on the Laramie formation from Deer Trail Creek westward. This alluvium is thicker to the west and south than it is to the north and east. Over this older alluvium is a younger eolian silty mantle that is 8 to 10 inches thick in the smoother areas. The highest lying soils developed in the loess. They include the nearly level to gently rolling Weld, Colby, Adena, and Deertrail soils. The more deeply weathered Buick soils developed next to the drainageways and below the loessal soils. The Buick soils normally are in bands less than 300 feet wide around the upper parts of drainageways. They grade to Renohill soils that developed in material weathered from the Laramie formation near the base of the drainageways on east-facing slopes and well up on west-facing slopes. In most of these areas, the Buick and Renohill soils are closely associated on sloping and rolling topography. The shallow Samsil soils occur in broken areas of the side slopes close to the drainageways.

In the area that extends westward from East Bijou Creek to Kiowa Creek, the soils developed mainly in a mixture of sand and silt deposited by the wind. These deposits are probably of Pleistocene or Recent age and were carried by water from the Dawson formation, deposited, and then reworked by the wind. The Nunn soils developed in the more nearly level areas, and the Bresser soils developed in the rolling areas or on small humps. The topography is gently undulating. Sandy materials deposited by the wind in dunes, 20 to 50 feet high, are common at the southern edge of the county, but the dunes are less numerous or disappear at the northern border. The Blakeland, Bresser, and Truckton soils developed in these areas. The Buick and Renohill soils formed in the sloping to rolling areas along the drainageways where the sandy deposits are thinnest. The valleys along Kiowa Creek and East Bijou, Middle Bijou, and West Bijou Creeks are similar. In these valleys are wide, barren, sandy stream channels that are generally dry and a few sandy flood plains and low terraces. The streams are 50 to 300 feet below the surrounding uplands. In these valleys are deposits of Recent age in which the Bresser, Nunn, Beckton, and Heldt soils formed. The major drainageways between Bijou Creek and Kiowa Creek are Rattlesnake, Comanche, and Wolf Creeks. They are a little lower than the surrounding uplands, and their flood plains blend into the surrounding uplands.

Near East Bijou Creek is the contact line between the Laramie and the overlying Dawson formation. The lower part of the Dawson formation is made up of clay and sandy shale, thin beds of fine- to medium-grained arkosic sandstone, and some conglomeratic sandstone. Several thin beds of coal also occur. The dominant colors range from various shades of gray and brown to brown and black.

West of Kiowa Creek the wind-deposited sand is not so dominant as it is east of the creek. In the Pleistocene alluvial mantle, which is thicker than the mantle farther east, at least two kinds of buried soils have formed. Where the loessal mantle occurs, it is thinner and in some places older than that in the eastern part of the county. In this area the gently sloping to sloping Fondis and Weld soils formed on uplands. On sloping and rolling topography, the Buick soils formed in material deposited by wind and water and the Litle, Renohill, and Thedalund soils formed in material weathered from the Dawson formation. All of these soils are closely associated. Outcrops of shale and sandstone of the Dawson formation are visible close to the drainageways in some places.

The sandy Truckton and Bresser soils and the Nunn soils overlie more clayey older soils in bands as much as 2 miles wide along the eastern sides of Box Elder (fig. 17), Coal, Toll Gate, and Cherry Creeks and of the South Platte River. These soils formed on Recent sand that was blown out of the channels and deposited on uplands adjacent to the streams.

Just east of the Box Elder Creek, along the southern boundary of the county is a layer of red clay about 200 feet above the line of contact between the upper and lower parts of the Dawson formation. From the southern boundary, this layer extends about 6 miles northward in the county, then goes west and south in a rough semicircle, and leaves the county just east of Cherry Creek. It closely follows the 6,000-foot contour. The reddish variant of the Renohill series developed on this layer.

The upper part of the Dawson formation occurs in the southwestern part of the county above an elevation of about 5,900 feet. It consists of poorly consolidated, noncalcareous beds of coarse sand and fine gravel mixed with layers of siltstone. Colors range from buff to white. The gravel, mainly feldspar and mica, is evident throughout these beds. More resistant beds of arkosic conglomerate are exposed. The Bresser and Stapleton soils were derived from the upper part of the Dawson formation. The Stapleton soils are moderately steep and support the only pine

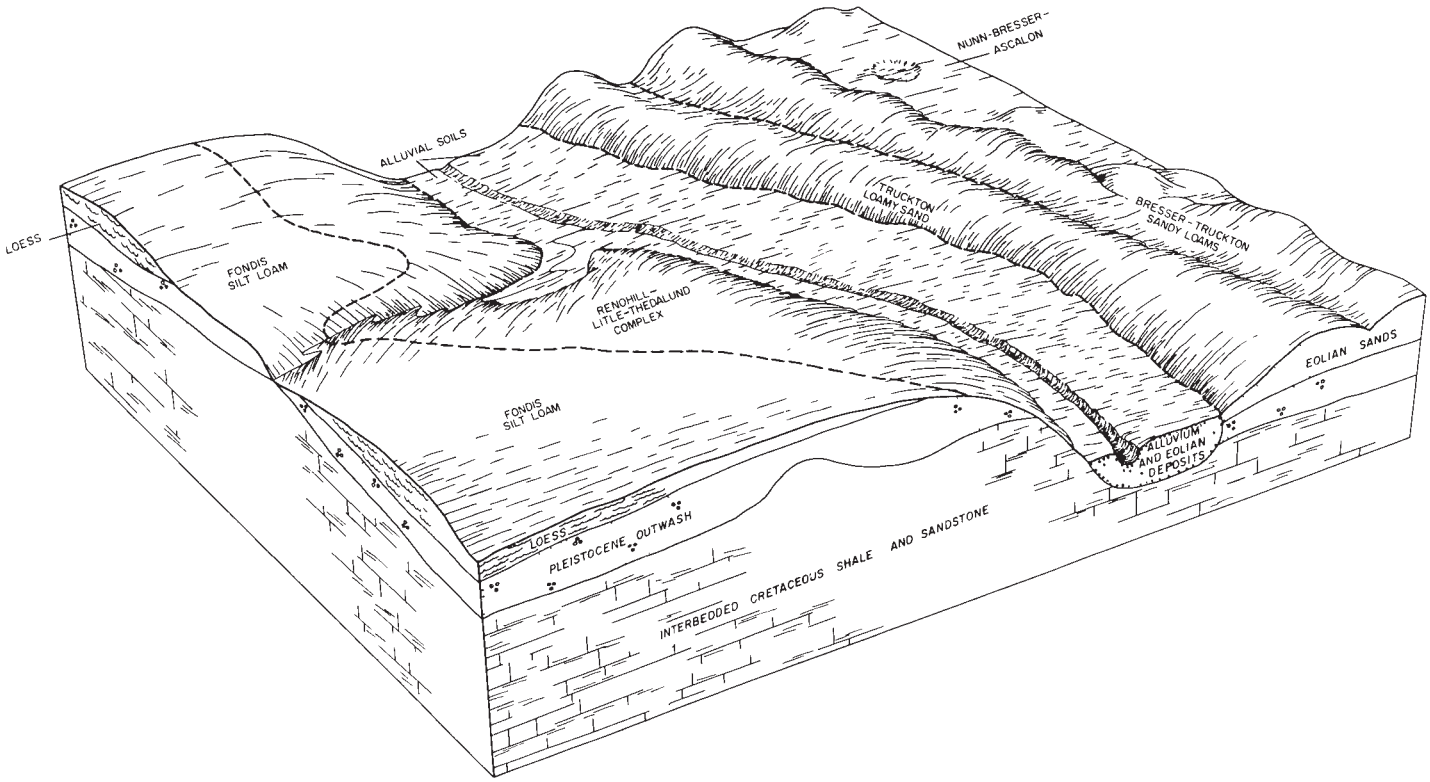

Figure 17.—**Cross section of Box Elder Creek and vicinity.**

trees in this county. The Bresser soils are residual and developed on mixed eolian and colluvial material. These soils occur with the Stapleton soils on rolling topography. Some Pleistocene outwash is present on side slopes.

All of the creeks from Wolf Creek westward to the South Platte River have small flood plains and narrow gently sloping terraces. The Nunn and Fort Collins soils occur in these areas, and there are small areas of Heldt soils on loamy alluvium along Piney Creek. Bresser and Bijou soils formed in alluvial and eolian sandy materials. The colors of these soils generally are darker than those of the soils east of Wolf Creek, and more feldspar and mica are in the materials.

Along the South Platte River, the alluvium of the flood plains is somewhat finer textured than that along the other streams in the county, and it stays wet the year round because the river flows all year. The terrace above this flood plain is underlain by medium to fine gravel, is as much as 1 mile wide, and is wider than the terraces along other streams in the county. Along the South Platte River on flood plains and terraces are the Nunn, Bresser, and Edgewater soils and Wet alluvial land.

Dominant west of the South Platte River are soils developed from Pleistocene alluvium in which the lower part of the Dawson formation is exposed in places on the steeper slopes. Some geologists subdivide the lower part of the Dawson formation into the Denver and Arapahoe formations. West of the South Platte River, more gravel is present in the alluvial material, which may be of different geologic age than the material on uplands east of the river. Heldt, Fondis, and Ascalon soils and Wet alluvial land occur on the Pleistocene alluvium west of the South Platte River.

Climate of Arapahoe County[9]

Arapahoe County has a semiarid climate that is somewhat characteristic of the climate of the High Plains but is modified by the Rocky Mountains to the west and by the high areas of the Black Forest to the south. Data on temperature and precipitation are given in table 10.

The effect of the Rocky Mountains on the climate of the county lessens as distance eastward from the western boundary increases. The county, which from west to east is about 72 miles long, lies in a belt where there is a fairly rapid change from the climate of the foothills to that of the plains.

From south to north in the western half of the county, there is a noticeable change from the climate of the foothills to that of the plains. This change is largely caused by the increase in elevation from north to south and by the effect of the higher area of the Black Forest to the south. Generally, the climate of the plains ranges from an elevation of about 5,300 feet at the western edge of the county to about 5,600 feet in the south-central part of the county. The boundary of the plains climate is indicated by native shrubs, such as snowberry and mountain-mahogany, above an elevation of 5,600 feet, and by the disapperance of sand sage in the southwestern part of the

[9] J. W. Berry, State climatologist, U S. Weather Bureau, assisted in preparing this section

county. In the central part of the county, soils are slightly darker and are 1 to 2 inches deeper above an elevation of 5,600 feet than they are below that elevation. No weather station in the county is above an elevation of 5,600 feet.

The average annual temperature is about 50° F. at an elevation of about 5,200 to 5,300 feet, though this average varies a few degrees as elevation changes. Elevation ranges from slightly less than 5,000 feet at the eastern border of the county to about 5,500 feet in the central and west-central parts and to 6,000 feet or more along the middle part of the southern border. The wide average range in daily temperature of 25° to 30° in this county and a wide average range in annual temperature are typical for the High Plains. Because variations in temperature are wide from day to day, and for periods of a few days, extremely hot weather in summer and extremely cold weather in winter normally do not last long and are followed by much more moderate temperature.

The average growing season in Arapahoe County is about 160 days. Table 11 gives the probability of the last freezing temperatures in spring and the first freezing temperatures in fall.

Data for long periods indicate that the average annual precipitation in the county ranges from 13.5 to 14.5 inches, the highest precipitation occurring at the western edge of the county. Variations within the county are related

TABLE 10.—*Temperature and precipitation data*

[Data for temperature and precipitation from Byers. Data on snow cover from Stapleton Airfield at Denver]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	Two years in 10 will have—		Average number of days with snow cover	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F	°F	°F	°F	Inches	Inches	Inches		Inches
January	43	14	61	−6	0 43	0 1	0 8	8	2
February	47	18	64	−2	47	2	7	9	3
March	52	23	70	4	87	4	1 6	7	3
April	62	33	79	19	1 86	7	2 8	3	4
May	71	42	86	32	2 54	9	3 7	1	3
June	84	51	96	40	1 58	7	2 6	0	0
July	91	57	99	50	2 01	1 0	3 2	0	0
August	89	56	98	49	1 49	7	2 1	0	0
September	80	47	94	35	1 14	2	1 7	(1)	4
October	69	36	83	25	72	1	1 5	1	2
November	54	23	71	7	54	2	9	5	3
December	46	18	64	2	40	1	6	7	3
Year	66	35	[2] 101	[3] −14	14 05	9 2	18 3	41	3

[1] Less than one-half day.

[2] Average annual highest temperature

[3] Average annual lowest temperature

TABLE 11.—*Probable dates of last freezing temperatures in spring and first in fall*

[Based on data at Byers]

Probability	Dates for a given probability at a temperature of—				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring					
1 year in 10 later than	April 17	April 23	May 4	May 13	May 29
2 years in 10 later than	April 11	April 18	April 28	May 7	May 23
5 years in 10 later than	March 31	April 7	April 17	April 27	May 11
Fall					
1 year in 10 earlier than	October 24	October 14	October 3	September 25	September 13
2 years in 10 earlier than	October 29	October 19	October 8	September 30	September 18
5 years in 10 earlier than	November 8	October 29	October 18	October 10	September 29

to the terrain, including elevation and slope. Particularly in spring and summer, precipitation may vary from year to year and in different areas in the same year. Averages for long periods are so affected by chance occurrences of precipitation that these averages are not easily interpreted in terms of actual differences in precipitation in a year or in a locality.

The probability of annual precipitation, however, is significant because it is the chance of receiving specified amounts of precipitation in any year. Figure 18 shows this probability, in percent, at Byers.

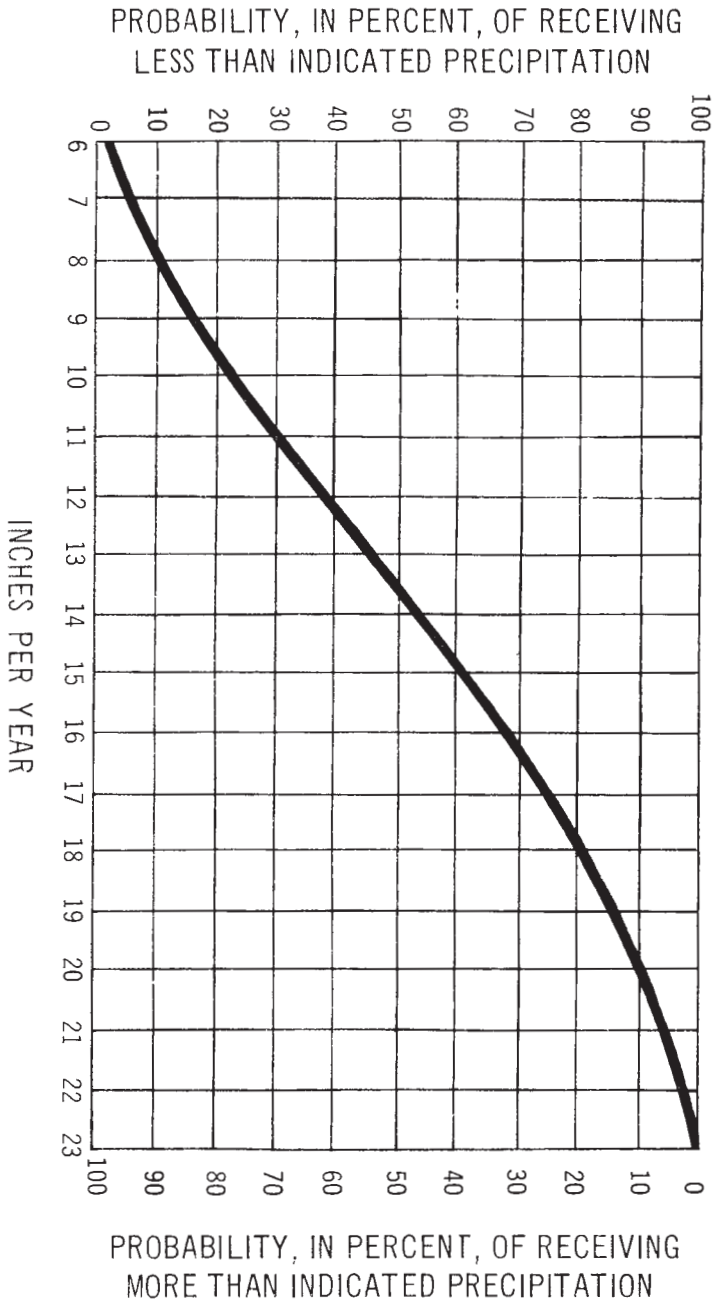

Figure 18.—**Probability, in percent, of receiving less and more than specified amounts of annual precipitation at Byers.**

Precipitation in winter is more in the western part of the county than it is in other parts. These differences are sometimes small but are consistent from October to May. The annual snowfall is about 59 inches at Denver and is about 46 inches at Byers. The eastern part of the county, however, usually receives more rainfall in summer than the rest of the county, but local rainfall varies widely from year to year.

From the western border eastward, variations in the climate of Arapahoe County include (1) increased average windspeed because the shielding effect of the Rocky Mountains is reduced, (2) slightly lower average annual precipitation, (3) smaller amounts of precipitation in winter and early in spring, (4) an increase in amount and variability of precipitation in summer, (5) greater average variation in daily and annual temperatures, and (6) somewhat less cloudiness and more sunshine.

The relative humidity averages 39 percent during the day and 62 percent at night, but these averages are slightly higher in winter than in summer. In an average year, the percentage of sunshine is about 69 percent.

Hailstorms cause some local damage to crops almost every year. The hail generally falls in strips 1 mile wide and 6 miles long. These storms are more common in the eastern part of the county than in the western part, and they are most common at an elevation of less than 5,600 feet. They generally occur from about May 15 to September 1 but are most common in June and July.

Additional Facts About the County

The first settlers in Arapahoe County were gold miners who moved into the area just west of the present town of Englewood in 1857. Irrigation farming began in about 1859, when an irrigation ditch was built along Bear Creek. Irrigation farming grew rapidly along the South Platte River between 1859 and 1872. Most of the acreage east of the South Platte River was occupied by large cattle ranches from 1860 until 1885, when settlers were allowed to homestead the open range.

Although many of the soils in the county are suitable for farming, the lack of water limits their use for that purpose. Water from streams and wells is used mainly for domestic purposes.

The quarrying of gravel is important along the South Platte River. The gravel is used for the construction of roads and buildings in the metropolitan area of Denver. A small amount of coal has been mined in the central part of the county. Natural rock, limestone, sandstone, and rhyolite are also available for local use.

The population of Arapahoe County is steadily increasing, particularly in the western 15 percent of the county where much of the acreage is used for nonfarm purposes. Several incorporated towns are in the Denver metropolitan area. According to reports of the U.S. Bureau of the Census, the population of the county was about 32,150 in 1940, 52,125 in 1950, and 113,426 in 1960. About 105,000 of these people lived in the Denver metropolitan area, or the western 15 percent of the county, in 1960. Littleton, the county seat, had a population of 13,670 in 1960.

According to the U.S. census of agriculture, about 96.3 percent, or 501,802 acres of Arapahoe County was farmland in 1964. The number of farm units has decreased since

1940, but the average size of farms has increased. The average size of farms increased from 417 acres in 1940 to 1,107 acres in 1959. The number of farms decreased from 463 in 1959 to 321 in 1964, but the average size increased to 1,563 acres.

Winter wheat is the major crop grown in the county. Because of acreage controls, however, grasses, particularly wheatgrass, and barley are now grown on much of the acreage that was used for wheat. In 1959 about 59,782 acres were planted to winter wheat, compared to 47,895 acres in 1964. In 1959 about 19,028 acres were planted to barley, but this acreage decreased to 11,030 in 1964. From 1930 to 1964 the acreage in beans decreased from about 20,000 acres to 273 acres. In the same period, the number of acres planted to corn decreased from 25,000 to 806. Grass is excellent for the control of erosion, as well as for grazing livestock. Barley, beans, and corn do not protect the soil against erosion as well as winter wheat, and they do not withstand droughts so well.

According to assessments and levies in Arapahoe County, more than 22,000 acres were irrigated in 1950, but only 2,200 acres were irrigated in 1961. This decrease has been caused by residential and industrial development and by an increase in recreational facilities and in highway construction. Also, much of the water from the South Platte River that was once used to irrigate crops is now used for domestic purposes.

The U.S. census of agriculture reports that from 1959 to 1964 the number of cattle and calves in the county increased from 15,127 to 19,261, and the number of sheep and lambs decreased from 14,097 to 8,362. There were 1,688 hogs and pigs in 1959 and only 1,543 in 1964.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8 5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both. that the growth of most crop plants is low from this cause

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Arkose (petrography). A term to describe sandstone derived from disintegrated granite or gneiss and characterized by fragments of feldspar An arkosic conglomerate is one in which the fine material, or matrix containing the boulders or pebbles, is arkose

Available water holding capacity. The capacity of a soil to hold water in a form available to plants Amount of moisture held in soil between field capacity, or about one-third atmosphere of tension, and the wilting coefficient, or about 15 atmospheres of tension.

Buried soil. A developed soil, once exposed but now overlain by more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid

Clay. As a soil separate, the mineral soil particles less than 0 002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms : Clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil Calcium carbonate and iron oxide are examples of material commonly found in concretions

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose—Noncoherent when dry or moist; does not hold together in a mass

Friable—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump

Firm—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable

Plastic—When wet, readily deformed by moderate pressure but can be pressed into a lump, will form a "wire" when rolled between thumb and forefinger.

Sticky—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material

Hard—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Dryland farming. Production of crops that require some tillage in a subhumid or semiarid region, without irrigation. Usually involves use of periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Fragipan. A dense, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur in the B horizon, 15 to 40 inches below the surface.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum

C horizon—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C

R layer—Consolidated rock beneath the soil The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Leaching. The removal of soluble material from soils or other material by percolating water.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent* The size measurements are these: *fine,* less than 5 millimeters (about 0 2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0 6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value alkalinity; and a lower value, acidity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7 0 is precisely neutral in reaction because it is neither acid nor alkaline An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4 5	Neutral	6 6 to 7 3
Very strongly acid	4 5 to 5 0	Mildly alkaline	7 4 to 7 8
Strongly acid	5 1 to 5 5	Moderately alkaline	7 9 to 8 4
Medium acid	5 6 to 6.0	Strongly alkaline	8 5 to 9 0
Slightly acid	6.1 to 6.5	Very strongly alkaline.	9 1 and higher

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0 05 to 2 0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0 002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2 0 to 1 0 millimeter); *coarse sand* (1 0 to 0 5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0 05 millimeter); silt (0 05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2 0 to 0.2 millimeter); II (0 2 to 0.02 millimeter); III (0 02 to 0.002 millimeter); IV (less than 0 002 millimeter)

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans)

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting of winter grains.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm Terraces in fields are generally built so they can be farmed Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow Marine terraces were deposited by the sea and are generally wide

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till

Upland (geologic). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace Land above the lowlands along rivers

Water spreading. Diverting runoff from a gully or watercourse onto gently sloping, absorptive land to conserve waste water or to increase plant growth, to reduce flood peaks, or to replenish ground-water supplies.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water In some places an upper, or perched, water table may be separated from a lower one by a dry zone

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introduction to the section it is in for general information about its management. For information on the use and management of soils for trees, see the section beginning on page 50. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Predicted yields, table 2, p. 40.
Nonfarm uses of soils, table 3, p. 42.
Use of soils for wildlife, table 4, p. 53.
Use of soils for recreation, table 5, p. 54.
Engineering uses of soils, tables 6, 7, and 8, pp. 56 through 68.

Map symbol	Mapping unit	Described on page	Capability unit		Range site		Tree planting suitability group
			Symbol	Page	Name	Page	Number
AcC	Adena-Colby fine sandy loams, 1 to 5 percent slopes	8	IVe-6	37	Loamy Plains	45	1
AcD	Adena-Colby fine sandy loams, 5 to 9 percent slopes	8	VIe-1	38	Loamy Plains	45	1
AdC	Adena-Colby silt loams, 1 to 5 percent slopes	9	IVe-1	36	Loamy Plains	45	1
AdD	Adena-Colby silt loams, 5 to 9 percent slopes	9	VIe-1	38	Loamy Plains	45	1
AsD	Ascalon sandy loam, 5 to 9 percent slopes	9	IVe-4	36	Sandy Plains	47	1
BcC	Baca loam, 3 to 5 percent slopes	10	IVe-1	36	Loamy Plains	45	1
BcD	Baca loam, 5 to 9 percent slopes	10	VIe-1	38	Loamy Plains	45	1
BhD	Baca-Thedalund loams, 3 to 9 percent slopes	10	VIe-1	38	Loamy Plains	45	4
BkB	Beckton loam, 0 to 3 percent slopes	11	VIs-2	39	Salt Flat	48	5
BlB	Bijou sandy loam, 0 to 3 percent slopes	12	IIIe-1	35	Sandy Foothill	50	2
BmB	Bijou sandy loam, wet, 0 to 3 percent slopes	12	IVw-1	37	Wet Meadow	49	3
BoD2	Blakeland loamy sand, 1 to 9 percent slopes, eroded	12	VIe-4	38	Deep Sand	48	2
BoE	Blakeland loamy sand, 1 to 20 percent slopes	13	VIe-4	38	Deep Sand	48	2
BrB	Bresser loamy sand, terrace, 0 to 3 percent slopes	13	IVe-7	37	Sandy Foothill	50	2
BsB	Bresser sandy loam, terrace, 0 to 3 percent slopes	13	IIIe-1	35	Sandy Foothill	50	2
BtB	Bresser loam, gravelly subsoil variant, 1 to 3 percent slopes	13	IIIc-1	36	Loamy Foothill	49	1
BuD	Bresser-Stapleton sandy loams, 3 to 9 percent slopes	14	IVe-4	36	Sandy Foothill	50	2
BuE	Bresser-Stapleton sandy loams, 9 to 20 percent slopes	14	VIe-3	38	Sandy Foothill	50	4
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes	14	IVe-3	36	Sandy Foothill	50	2
BvE	Bresser-Truckton sandy loams, 5 to 20 percent slopes	14	VIe-3	38	Sandy Foothill	50	4
BwD2	Bresser and Truckton soils, 3 to 9 percent slopes, eroded	15	VIe-3	38	Sandy Foothill	50	2
BxC	Buick loam, 3 to 5 percent slopes	15	IIIe-2	35	Loamy Foothill	49	1
BxD	Buick loam, 5 to 9 percent slopes	15	IVe-2	36	Loamy Foothill	49	1
Ca	Clayey alluvial land	16	VIw-2	38	Overflow	49	5
CoC	Colby silt loam, 1 to 5 percent slopes	16	IVe-1	36	Loamy Plains	45	1
CoE	Colby silt loam, 5 to 20 percent slopes	16	VIe-1	38	Loamy Slopes	45	4
CyD2	Colby and Adena soils, 1 to 9 percent slopes, eroded	17	VIe-1	38	Loamy Plains	45	1
EdB	Edgewater loam, 0 to 3 percent slopes	18	IVw-1	37	Wet Meadow	49	3
FdB	Fondis silt loam, 1 to 3 percent slopes	19	IIIc-1	36	Loamy Foothill	49	1
FdC	Fondis silt loam, 3 to 5 percent slopes	19	IIIe-2	35	Loamy Foothill	49	1
FgD	Fondis-Ascalon, gravelly subsoil variant, complex, 1 to 9 percent slopes	19	VIe-1	38	Loamy Foothill	49	1
FoC	Fondis-Colby silt loams, 3 to 5 percent slopes	19	IIIe-2	35	Loamy Foothill	49	1

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit		Range site		Tree planting suitability group
			Symbol	Page	Name	Page	Number
FrB	Fort Collins loam, 0 to 3 percent slopes---	20	IIIc-1	36	Loamy Plains	45	1
Gr	Gravelly land----------	20	VIIs-1	39	----------	--	5
HlB	Heldt clay, 0 to 3 percent slopes----------	21	IVs-1	37	Clayey Foothill (western part)	49	4
					Clayey Plains (eastern part)	46	
HsB	Heldt clay, saline, 0 to 3 percent slopes--	21	VIs-1	39	Alkaline Plains	46	5
LcD	Little silty clay loam, 1 to 9 percent slopes----------	21	VIs-1	39	Clayey Foothill (western part)	49	4
					Alkaline Plains (eastern part)	46	
LsD	Little-Samsil, gypsum, silty clay loams, 3 to 9 percent slopes----------	22	VIs-1	39	Alkaline Plains	46	5
Lv	Loamy alluvial land----------	22	VIw-2	38	Overflow	49	1
NlB	Nunn loam, 0 to 3 percent slopes----------	23	IIIc-1	36	Loamy Foothill (western part)	49	1
					Loamy Plains (eastern part)	45	
NrB	Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes----------	23	IIIc-1	36	Loamy Foothill	49	1
OnD	Olney fine sandy loam, 5 to 9 percent slopes----------	23	VIe-3	38	Sandy Plains	47	1
RdD	Renohill loam, 3 to 9 percent slopes-------	24	VIe-1	38	Loamy Plains	45	4
ReE	Renohill loam, reddish variant, 5 to 20 percent slopes----------	24	VIe-1	38	Loamy Foothill	49	4
RhD	Renohill-Buick loams, 3 to 9 percent slopes----------	24	VIe-1	38	Loamy Foothill (western part)	49	4
					Loamy Plains (eastern part)	45	
RhE	Renohill-Buick loams, 9 to 20 percent slopes----------	25	VIe-1	38	Loamy Foothill (western part)	49	5
					Loamy Plains (eastern part)	45	
RkE2	Renohill-Buick complex, 5 to 20 percent slopes, eroded----------	25	VIe-2	38	Clayey Foothill	49	5
RlD	Renohill-Little clay loams, 3 to 9 percent slopes----------	25	VIe-2	38	Clayey Foothill	49	4
RtE	Renohill-Little-Thedalund complex, 9 to 30 percent slopes----------	25	VIe-2	38	Clayey Foothill	49	5
Ru	Rock outcrop----------	25	VIIIs-1	39	----------	--	5
SaE	Samsil clay, gypsum, 5 to 20 percent slopes----------	26	VIs-1	39	Alkaline Plains	46	5
SlF	Samsil-Little stony clays, 20 to 50 percent slopes----------	26	VIIs-1	39	----------	--	5
SrE	Samsil-Renohill clay loams, 3 to 20 percent slopes----------	26	VIe-2	38	Clayey Plains	46	5
Ss	Samsil-Shale outcrop complex----------	26	VIIs-1	39	Shale Breaks	48	5
St	Sand pits----------	26	VIIIs-1	39	----------	--	5
Su	Sandy alluvial land----------	27	VIIw-1	39	----------	--	2
Sv	Shale outcrop----------	27	VIIs-1	39	Shale Breaks	48	5
SwE	Stapleton sandy loam, 9 to 30 percent slopes----------	27	VIe-3	38	----------	--	5
Ta	Tassel-Rock outcrop complex----------	28	VIIs-1	39	Sandstone Breaks	48	4
Tc	Terrace escarpments----------	28	VIIs-1	39	----------	--	5
TdE	Terry fine sandy loam, 5 to 20 percent slopes----------	28	VIe-3	38	Sandy Plains	47	2

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Described on page	Capability unit		Range site		Tree planting suitability group
			Symbol	Page	Name	Page	Number
TeE	Terry-Olney-Thedalund sandy loams, 5 to 20 percent slopes	28	VIe-3	38	Sandy Plains	47	4
ThE	Thedalund clay loam, 9 to 20 percent slopes	29	VIe-1	38	Loamy Slopes	45	5
ThE2	Thedalund clay loam, 9 to 20 percent slopes, eroded	29	VIe-2	38	Clayey Plains	46	5
TrC	Truckton loamy sand, 1 to 5 percent slopes	30	IVe-5	37	Sandy Foothill	50	2
TrE	Truckton loamy sand, 5 to 20 percent slopes	30	VIe-3	38	Sandy Foothill	50	4
WdC	Weld fine sandy loam, 1 to 5 percent slopes	31	IVe-6	37	Loamy Plains	45	1
WeB	Weld silt loam, 0 to 3 percent slopes	31	IIIc-1	36	Loamy Plains	45	1
WeC	Weld silt loam, 3 to 5 percent slopes	31	IIIe-2	35	Loamy Plains	45	1
WrB	Weld-Deertrail silt loams, 0 to 3 percent slopes	31	IVs-1	37	Loamy Plains (Weld part) Alkaline Plains (Deertrail part)	45 46	4
Wt	Wet alluvial land	31	VIw-1	38	Wet Meadow	49	3

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Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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