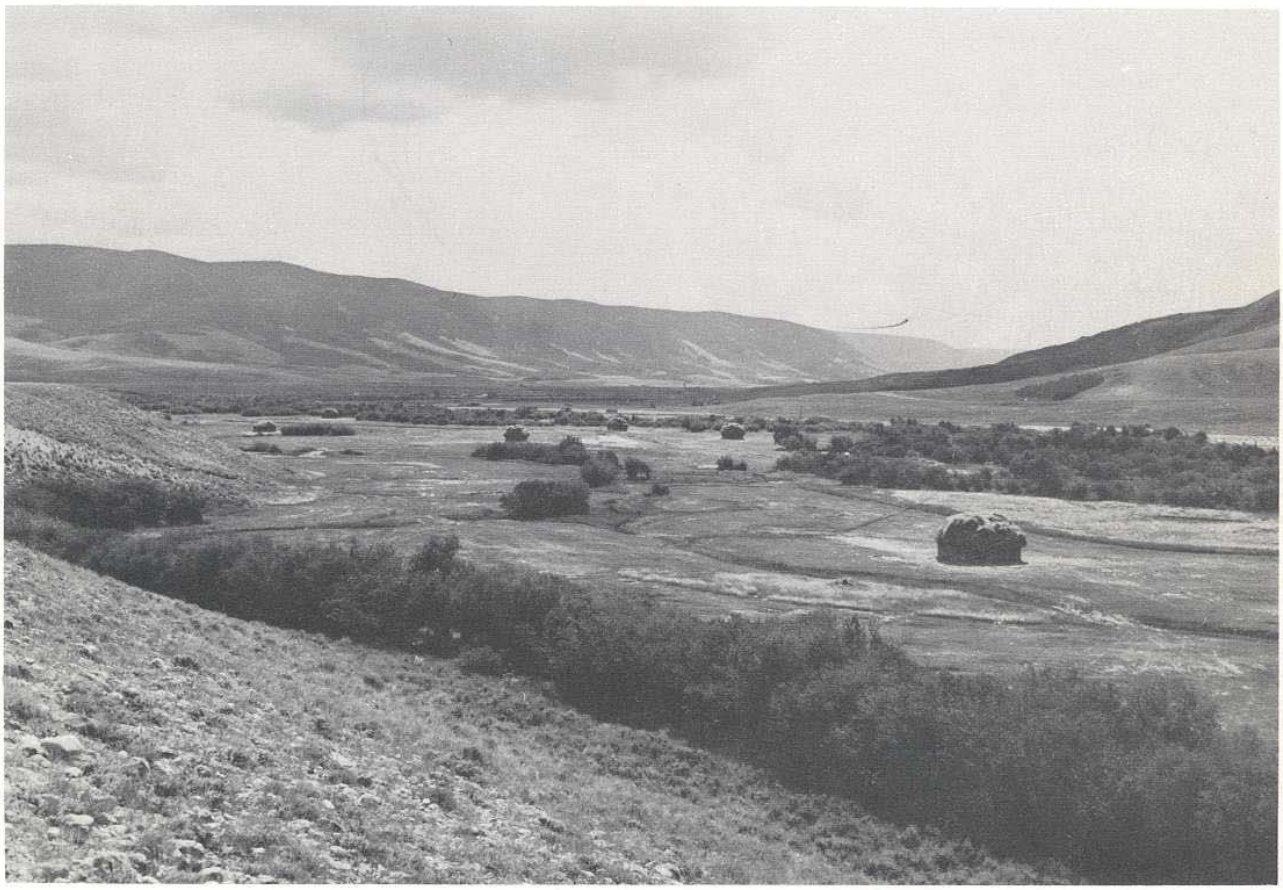
SOIL SURVEY OF

Larimer County Area, Colorado



United States Department of Agriculture
Soil Conservation Service and
Forest Service
in cooperation with
Colorado Agricultural Experiment Station

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

Major fieldwork for this soil survey was completed in the period 1962–74. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1975. This survey was made cooperatively by the Soil Conservation Service and Forest Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Fort Collins and Big Thompson Soil Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

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, or other structures; and in appraising the value of tracts of land for farming, industry, or recreation.

Locating Soils

All the soils of the Larimer County Area 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 to 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 "Index to Mapping Units" can be used to find information. It lists all the soils of the county in alphabetic order by map symbol and shows the page where each soil is described. The capability unit, range site, and windbreak suitability group to which the soil has been assigned is indicated in the mapping unit description.

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. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. 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 soil from the soil descriptions and from the discussions of the interpretative groupings.

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

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

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

Community planners and others can read about the soil properties that affect the choice of homesites, industrial sites, schools, and parks in the section "Engineering."

Engineers and builders can find, under "Soil Properties," "Soil and Water Features," and "Engineering," tables that give engineering descriptions of the soils and information about soil features that affect engineering practices and structures.

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

Students, teachers, and others can find information about soils and their management in various parts of the survey.

Newcomers in the Larimer County Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area," which gives additional information about the Area.

Cover: Landscape in the Laramie River valley. Blackwell-Newfork-Foxcreek association in center, Thiel-Driggs association at sides, and Redfeather-Schofield association in background.

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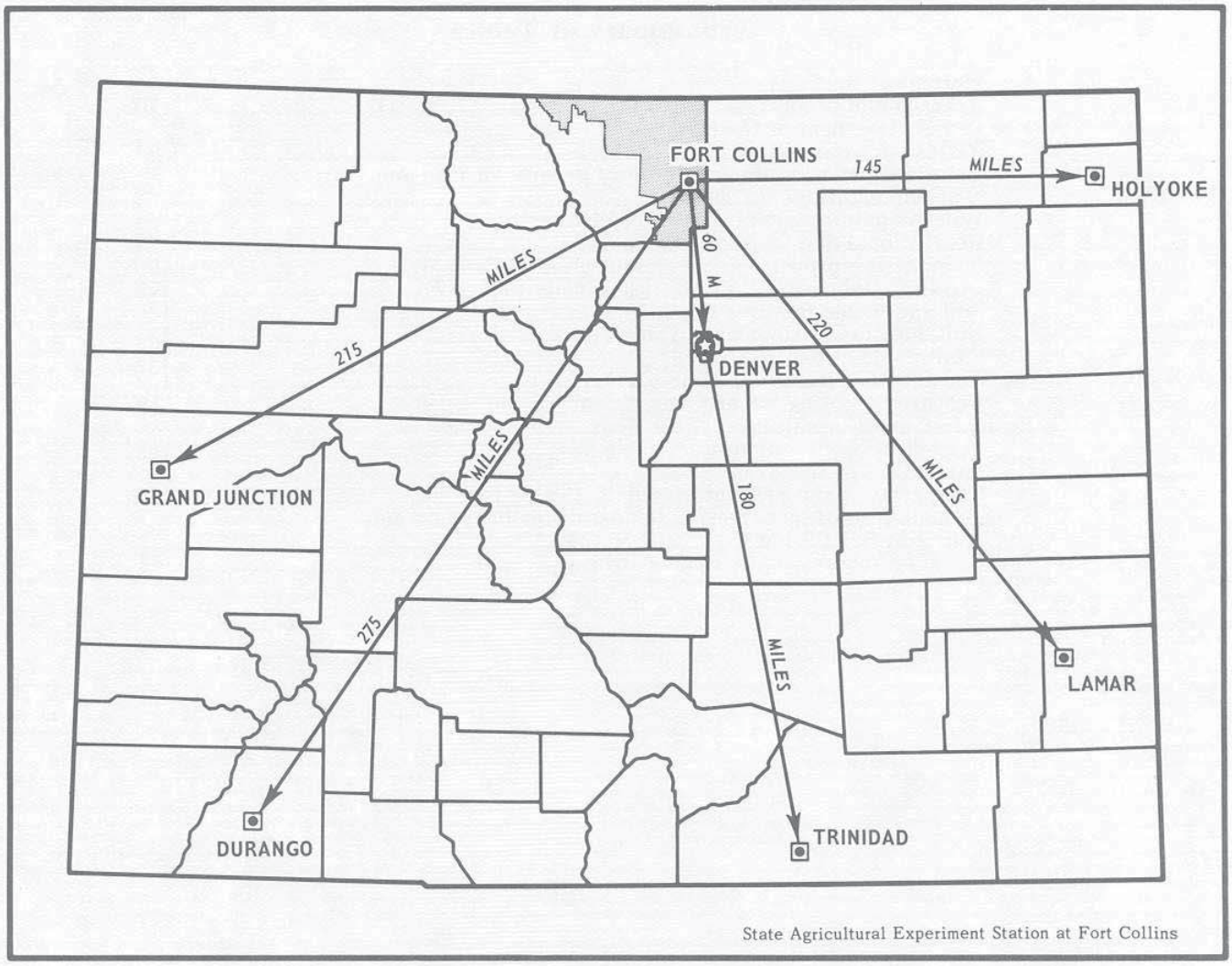

Location of Larimer County Area in Colorado.

SOIL SURVEY OF LARIMER COUNTY AREA, COLORADO

BY DONALD C. MORELAND, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY ORVILLE A. PARSONS, CHARLES P. PRENTISS, RAY L. MILES, AND DONALD C. MORELAND, SOIL CONSERVATION SERVICE

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

LARIMER COUNTY AREA is in the north-central part of Colorado (see map on facing page). The total area is about 954,240 acres. The eastern part of the Area consists of rolling plains and valleys. It is used mainly for irrigated and dryfarmed crops and native grassland, although in recent years much of the Area has become urbanized. The main crops are corn, sugar beets, alfalfa, dry beans, barley, and wheat.

The western part of the Area consists of foothills and mountains. It has been used for grazing, forestry, wildlife habitat, recreation, and watershed. In recent years more emphasis has been on use for wildlife habitat and recreation and less on use for grazing. Many of the woodland areas are used as sites for summer and year-round homes.

The survey area has a varied climate. The growing season ranges from about 150 days in the extreme eastern part to about 60 days in the mountains. The average annual precipitation ranges from 12 to 20 inches. Elevation ranges from about 4,870 feet to about 9,500 feet.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Larimer County Area, where they are located, and how they can be used. The soil scientists went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down 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. To use this publication efficiently, it is necessary to know the kinds of groupings most used in local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Fort Collins and LaPorte, 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 natural, undisturbed landscape.

Soils of one series can differ somewhat in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Fort Collins loam, 0 to 1 percent slopes, is one of several phases within the Fort Collins series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, the soil complex, is shown on the soil map of Larimer County Area.

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. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Renohill-Midway clay loams, 3 to 15 percent slopes, is a complex in Larimer County Area.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, or so severely eroded that it has not been classified by soil series. These places are shown on the soil map and are de-

scribed in the survey, but they are called land types and are given descriptive names. Rock outcrop is an example. Some places have soils so variable that they cannot be classified into series but have enough similar characteristics that they can be classified into broader groups of soils. Haplustolls is an example.

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

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

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

General Soil Map

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

A map showing the soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning recreational facilities, community developments, and such engineering works as transportation corridors. 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 other structure, because the soils in any one association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey area have been grouped into four general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described in the following pages.

Areas Dominated by Cold Soils on Mountains

These soils are on mountainsides, uplands, terraces, and flood plains in the western and northwestern parts of the survey area. They are shallow to deep, nearly level to steep, well drained to poorly drained, and moderately fine textured to moderately coarse textured. The average annual precipitation ranges from 12 to 20 inches. The frost-free season generally ranges from 60 to 85 days in most of the Area but is as much as 100 days in some places.

These soils are used mainly for range, forestry, recreation, and wildlife habitat. A few small areas are used for hay.

Four soil associations are in this group.

1. Redfeather-Schofield-Rock outcrop association

Shallow and moderately deep, strongly sloping to steep, well drained sandy loams that formed in materials weathered from granite, and Rock outcrop; on mountainsides and ridges

This association is mainly in the western and northwestern parts of the survey area. Elevation ranges from about 7,000 to 9,600 feet. Mean annual air temperature ranges from about 40° to 44° F, and annual precipitation ranges from about 15 to 20 inches. The native vegetation is mainly lodgepole pine, Engelmann spruce, and Douglas-fir on Redfeather and Schofield soils and mid grasses on the other soils.

The association makes up about 12 percent of the survey area. It is about 55 percent Redfeather soils, 15 percent Schofield soils, and 10 percent Rock outcrop. The remaining 20 percent is Breece, Boyle, Ratake, Naz, Blackwell, and Sunshine soils and Haploborolls.

Redfeather soils are strongly sloping to steep and are well drained. A thin layer of organic material is on the surface. The surface layer is sandy loam. The subsoil is gravelly sandy loam and gravelly sandy clay loam. Granite bedrock is at a depth of about 17 inches.

Schofield soils are strongly sloping to moderately steep and are well drained. A thin layer of organic material is on the surface. The surface layer is coarse sandy loam. The subsoil is gravelly coarse sandy clay loam. The underlying material is gravelly loamy coarse sand. Granite bedrock is at a depth of about 27 inches.

Rock outcrop is areas of bare or nearly bare bedrock. It is generally in the steeper parts of the association.

Breece and Naz soils are deep and are on fans and terraces. Boyle and Ratake soils are shallow, are gravelly or channery, and are on mountainsides and ridges. Blackwell soils are deep, poorly drained clay loams on terraces and bottom lands. Haploborolls are extremely variable soils on steep mountainsides. Sunshine soils are moderately deep over sandstone.

The soils in this association are used for forestry, cattle grazing, recreation, and wildlife habitat.

2. Thiel-Driggs association

Deep, nearly level to moderately steep, well drained gravelly sandy loams and loams that formed in alluvium, on high terraces and benches

This association is mostly on high terraces and benches along the Laramie River in the northwest cor-

ner of the survey area. Elevation ranges from 8,000 to 8,500 feet. Mean annual air temperature ranges from about 42° to 44° F, and annual precipitation ranges from about 13 to 17 inches. The native vegetation is mainly grasses and shrubs.

The association makes up about 2 percent of the survey area. It is about 50 percent Thiel soils and 25 percent Driggs soils. The remaining 25 percent is mainly Tine, Kildor, and Naz soils.

Thiel soils are strongly sloping to moderately steep. The surface layer is gravelly sandy loam. The subsoil is very gravelly coarse sandy loam and very gravelly loamy sand.

Driggs soils are nearly level to moderately steep. The surface layer is brown loam. The subsoil is clay loam to very gravelly clay loam. Sand and gravel are at a depth of about 30 inches.

Tine soils are gravelly or cobbly, are underlain by sand and gravel at a depth of less than 20 inches, and are on terraces. Kildor soils have a clay loam surface layer and a clay subsoil, are underlain by shale, and are on uplands. Naz soils are on terraces and side slopes.

The soils in this association are used mainly for grazing.

3. *Blackwell-Newfork-Foxcreek association*

Deep, nearly level to gently sloping, somewhat poorly drained or poorly drained clay loams, sandy loams, and loams, that formed in alluvium; on flood plains and low terraces

This association is on flood plains and terraces along the Laramie River and South Lone Pine Creek in the northwestern part of the survey area. Elevation ranges between 7,500 and 8,500 feet. Mean annual air temperature ranges from about 42° to 44° F, and annual precipitation ranges from about 12 to 18 inches. The native vegetation is mainly tall and mid grasses.

The association makes up about 1 percent of the survey area. It is about 30 percent Blackwell soils, 15 percent Newfork soils, and 15 percent Foxcreek soils. The remaining 40 percent is mainly Gapo, Naz, and Kildor soils and Riverwash.

Blackwell soils are nearly level to gently sloping. A thin layer of organic material is on the surface. The surface layer and subsoil are clay loam. Sand and gravel are at a depth of about 43 inches.

Newfork soils are nearly level. About one inch of organic material is on the surface. The surface layer is mottled sandy loam. The subsoil is sandy clay loam. Sand and gravel are at a depth of about 10 inches.

Foxcreek soils are nearly level. A thin layer of organic material is on the surface. The surface layer is mottled loam. The subsoil is silty clay loam and sandy clay loam. Sand and gravel are at a depth of about 36 inches.

Gapo soils are deep and are on flood plains and valleysides. Naz soils are deep and are on terraces and side slopes. Kildor soils are moderately deep over shale and are on uplands. Riverwash is sandy and gravelly water-deposited material, mainly near stream channels.

The soils in this association are used mainly for irrigated hay and cattle grazing.

4. *Pendergrass-Miracle-Clergern association*

Shallow to deep, nearly level to moderately steep, well drained or somewhat excessively drained fine sandy loams that formed in materials weathered from sandstone and in alluvium; on uplands and in valleys

This association is around Chimney Rock in the northwestern part of the survey area. Elevation ranges from about 7,800 to 8,400 feet. Mean annual air temperature ranges from about 42° to 46° F, and annual precipitation ranges from about 13 to 16 inches. The native vegetation is mainly grasses and shrubs.

The association makes up about 4 percent of the survey area. It is about 20 percent Pendergrass soils, 20 percent Miracle soils, and 15 percent Clergern soils. The remaining 45 percent is mainly Sunshine, Kildor, and Naz soils, Haploborolls, and Rock outcrop.

Pendergrass soils are strongly sloping or moderately steep and are well drained or somewhat excessively drained. The surface layer is fine sandy loam underlain by channery fine sandy loam. Sandstone is at a depth of about 14 inches.

Miracle soils are strongly sloping or moderately steep and are well drained. The surface layer is sandy loam. The subsoil is sandy clay loam. Sandstone is at a depth of about 24 inches.

Clergern soils are nearly level to strongly sloping and are well drained. The surface layer, and underlying material are fine sandy loam.

Sunshine and Kildor soils are on mountainsides and uplands and are moderately deep over sandstone or shale. Naz soils are deep and are on terraces and valleysides. Haploborolls are on steep mountainsides and are mostly loam or sandy loam, but they are variable in texture and other characteristics. Rock outcrop occurs throughout the association but is mainly on steep mountainsides.

All of the soils in this association are used for range. Some areas are used for wildlife habitat and recreation.

Areas Dominated by Cool Soils on Mountains

These soils are on mountainsides and valleysides in the west-central part of the survey area. They are shallow to deep, nearly level to very steep, well drained to excessively drained, and medium textured to moderately coarse textured. The average annual precipitation ranges from 14 to 18 inches. The frost-free season ranges from about 75 to 100 days.

These soils are used for range, forestry, recreation, and wildlife habitat. The native vegetation is mainly mid grasses and scattered ponderosa pine.

Two soil associations are in this group.

5. *Wetmore-Boyle-Rock outcrop association*

Shallow, nearly level to steep, well drained to excessively drained gravelly sandy loams that formed in materials weathered from granite, and Rock outcrop; on mountainsides

This association is mainly in the west-central part of the survey area. Elevation ranges from about 6,500 to 8,000 feet. Mean annual air temperature ranges from about 42° to 46° F, and annual precipitation

ranges from 14 to 18 inches. The native vegetation is mainly mid grasses and ponderosa pine.

The association makes up about 15 percent of the survey area. It is about 35 percent Wetmore soils, 20 percent Boyle soils, and 20 percent Rock outcrop. The remaining 25 percent is mainly Breece, Moen, Elbeth, Ratake, and Trag soils and Haploborolls.

Wetmore soils are strongly sloping to steep and are well drained. A thin layer of organic material is on the surface. The surface layer is gravelly sandy loam. The subsoil is gravelly loamy sand. Granite bedrock is at a depth of about 11 inches.

Boyle soils are nearly level to moderately steep and are well drained or excessively drained. The surface layer is gravelly sandy loam. The subsoil is gravelly sandy clay loam. The underlying material is weathered granite at a depth of about 13 inches.

Rock outcrop is areas of bare or nearly bare bedrock. It is generally in the steeper parts of the association.

Breece soils are deep and are on alluvial fans and in valleys. Moen soils are moderately deep and are on uplands and valleysides. Elbeth and Trag soils are deep and loamy and are on mountainsides and valleysides. Ratake soils are shallow and channery or gravelly and are on mountainsides. Haploborolls are extremely variable, steep, stony soils on mountainsides.

The soils in this association are used mainly for livestock grazing, forestry, recreation, and wildlife habitat.

6. *Haploborolls-Boyle-Ratake association*

Shallow to deep, nearly level to very steep, well drained to excessively drained mainly loams, sandy loams, gravelly sandy loams, or channery loams that formed in materials weathered from granite and schist; on mountainsides

This association is mainly in the central part of the survey area (fig. 1). Elevation ranges from about 7,000 to 8,500 feet. Mean annual air temperature ranges from about 42° to 46° F, and annual precipitation ranges from about 14 to 18 inches. The native vegetation is mainly short and mid grasses.

The association makes up about 17 percent of the survey area. It is about 25 percent Haploborolls, 20 percent Boyle soils, and 10 percent Ratake soils. The remaining 45 percent is mainly Breece, Farnuf, Moen, Elbeth, and Trag soils and Rock outcrop.

Haploborolls are mainly loam or sandy loam, but they are extremely variable, shallow to deep, steep and very steep soils.

Boyle soils are nearly level to moderately steep and are well drained or somewhat excessively drained. The surface layer is gravelly sandy loam. The subsoil is

Figure 1.—Area of Haploborolls-Boyle-Ratake association.

gravelly sandy clay loam. The underlying material is weathered granite at a depth of about 13 inches.

Ratake soils are nearly level to very steep and are well drained or somewhat excessively drained. The surface layer and subsoil are channery loam. Schist or granite is at a depth of about 15 inches.

Breece soils are deep and are on alluvial fans and in valleys. Farnuf, Elbeth, and Trag soils are deep and are on mountainsides and valleysides. Moen soils are moderately deep and are on uplands and valleysides. Rock outcrop is areas of exposed bedrock.

The soils in this association are used mainly for livestock grazing. Some areas are used for recreation and wildlife habitat.

Areas Dominated by Warm Soils on Foothills

These soils are on uplands, high terraces, and fans in the east-central and extreme northeastern parts of the survey area. They are shallow to deep, nearly level to steep, well drained, and moderately coarse textured to moderately fine textured. The average annual precipitation ranges from 13 to 18 inches. The frost-free season ranges from 115 to 150 days.

These soils are used for crops. The native vegetation is mainly short and mid grasses and a few scattered ponderosa pine in places.

Four soil associations are in this group.

7. *Kirtley-Purner-Haplustolls association*

Shallow to deep, nearly level to steep, well drained mainly loams, fine sandy loams, and clay loams that formed in materials weathered from sandstone; on uplands and fans

This association is in the foothills in the west-central part of the survey area. It extends from the Wyoming State line to the Boulder County line. Elevation ranges from about 5,400 to 7,000 feet. Mean annual air temperature ranges from about 47° to 50° F, and average annual precipitation ranges from about 13 to 15 inches. The native vegetation is short and mid grasses.

The association makes up about 10 percent of the survey area. It is about 15 percent Kirtley soils, 15 percent Purner soils, and 15 percent Haplustolls. The remaining 55 percent is mainly Barnum, Connerton, Garrett, Harlan, Otero, Larim, and Satanta soils and Rock outcrop.

Kirtley soils are gently sloping to moderately steep and are well drained. The surface layer and subsoil are loam. Sandstone is at a depth of about 26 inches.

Purner soils are nearly level to steep and are well drained. The surface layer and underlying material are fine sandy loam. Sandstone is at a depth of about 14 inches.

Haplustolls consists mainly of strongly sloping to steep loam and clay loam soils on uplands.

Barnum soils are deep and are along drainageways. Connerton and Otero soils are deep sandy loams and are on uplands and fans. Garrett soils are deep and are on terraces and fans. Harlan and Satanta soils are deep and are on uplands, terraces, and fans. Larim soils are deep and gravelly and are on uplands and old terraces.

The soils in this association are used mainly for range, but some areas are used for irrigated or dry-farmed crops.

8. *Haplustolls-Baller-Rock outcrop association*

Shallow to deep, strongly sloping to steep, well drained mainly loams, clay loams, and stony sandy loams that formed in material weathered from sandstone, and Rock outcrop; on uplands

This association is in the foothills, mainly in the east-central part of the survey area. Elevation ranges from 5,200 to 6,000 feet. Mean annual air temperature is 46° to 50° F, and annual precipitation ranges from about 15 to 17 inches. The native vegetation is mainly mid grasses and shrubs. Ponderosa pine are in some areas.

The association makes up about 5 percent of the survey area. It is about 25 percent Haplustolls, 20 percent Baller soils, and 20 percent Rock outcrop. The remaining 35 percent is Carnero, Pinata, Midway, and Renohill soils.

Haplustolls consist mainly of shallow to deep, strongly sloping to steep, loam and clay loam soils.

Baller soils are strongly sloping to steep and are well drained. The upper part of the surface layer is stony sandy loam. The lower part is very stony sandy loam. The underlying material is sandstone at a depth of about 11 inches.

Rock outcrop is areas of exposed sandstone bedrock. It is generally in the steeper parts of the association.

Carnero soils are moderately deep and are on uplands. Pinata soils are deep and stony and are on mountainsides and ridges. Renohill soils are moderately deep and are on uplands. Midway soils are shallow and are on uplands.

The soils in this association are used mainly for livestock grazing. Some areas are used for recreation and homesites.

9. *Larim-Bainville-Altvan association*

Deep and moderately deep, nearly level to steep, well drained gravelly sandy loams, silt loams, and loams that formed in alluvium or in materials weathered from siltstone; on high terraces and uplands

This association is in the northeastern part of the survey area (fig. 2). Elevation ranges from 6,000 to 7,000 feet. Mean annual air temperature ranges from 48° to 50° F, and annual precipitation ranges from 13 to 15 inches. The native vegetation is short and mid grasses.

The association makes up about 2 percent of the survey area. It is about 40 percent Larim soils, 15 percent Bainville soils, and 10 percent Altvan soils. The remaining 35 percent is Epping, Keith, Larimer, Midway, and Renohill soils.

Larim soils are strongly sloping to steep and are well drained. The surface layer is gravelly sandy loam. The subsoil is gravelly sandy clay loam. The underlying material is very gravelly loamy sand.

Bainville soils are nearly level to moderately steep

Figure 2.—Area of Larim-Bainville-Altvan association.

and are well drained. The surface layer and underlying material are silt loam. Soft siltstone is at a depth of about 24 inches.

Altvan soils are nearly level to strongly sloping and are well drained. The surface layer is loam. The subsoil is clay loam. The underlying material is gravelly loamy sand at a depth of about 36 inches.

Epping and Midway soils are shallow and are on uplands. Keith soils are deep and are on uplands and high terraces. Larimer soils are deep and are on high terraces and alluvial fans. Renohill soils are moderately deep and are on uplands.

The soils in this association are used mainly for range.

10. LaPorte-Kim-Minnequa association

Shallow to deep, nearly level to steep, well drained loams and silt loams that formed in materials weathered from limestone and in alluvium; on uplands and fans

This association is in the foothills in the east-central part of the survey area. It extends from the Wyoming State line on the north to the southern line of Larimer County. Elevation ranges from about 5,000 to 5,500 feet. Mean annual air temperature ranges from about 48° to 50° F, and annual precipitation ranges from 13 to 16 inches. The native vegetation is mainly short and mid grasses.

The association makes up about 2 percent of the survey area. It is about 25 percent LaPorte soils, 20 percent Kim soils, and 15 percent Minnequa soils. The remaining 40 percent is mainly Midway and Renohill soils and Rock outcrop.

LaPorte soils are gently sloping to steep and are well drained. The surface layer is loam. Limestone is at a depth of about 7 inches.

Kim soils are nearly level to moderately steep and are well drained. The surface layer and underlying material are loam.

Minnequa soils are gently sloping to moderately steep and are well drained. The surface layer is silt loam. The underlying material is silt loam. Limestone is at a depth of about 34 inches.

Midway soils are shallow and are on uplands. Renohill soils are moderately deep and are on uplands. Rock outcrop is areas of exposed bedrock.

The soils in this association are used mainly for range, but some areas are used for crops.

Areas Dominated by Warm Soils on Plains

These soils are on uplands, benches, fans, and ter-

races in the eastern part of the survey area. They are shallow to deep, nearly level to moderately steep, well drained to somewhat poorly drained, and moderately fine textured to moderately coarse textured. The average annual precipitation ranges from about 13 to 15 inches. The frost-free season ranges from 135 to 150 days.

These soils are mainly used for irrigated and dryfarmed crops, but some areas are used for range and pasture. The main irrigated crops are sugar beets, corn, barley, alfalfa, dry beans, and wheat. The main dryfarmed crop is wheat, but barley is also grown. The native vegetation is mainly short grasses.

Six soil associations are in this group.

11. Table Mountain-Paoli-Caruso association

Deep, nearly level, well drained to somewhat poorly drained loams, fine sandy loams, and clay loams that formed in alluvium; on flood plains, low terraces, and bottom lands

This association is mainly along Boxelder Creek, Cache La Poudre River, Big Thompson River, and Little Thompson River in the eastern part of the survey area. Elevation ranges from about 4,800 to 5,600 feet. Mean annual air temperature ranges from about 48° to 50° F, and annual precipitation ranges from about 13 to 15 inches. The native vegetation is mainly short and mid grasses.

The association makes up about 5 percent of the survey area. It is about 20 percent Table Mountain soils, 15 percent Paoli soils, and 10 percent Caruso soils. The remaining 55 percent is mainly Barnum, Connerton, Garrett, Longmont, Loveland, and Poudre soils and Fluvaquents, Riverwash, Marsh, and Gravel pits.

Table Mountain soils are nearly level and are well drained. The surface layer is loam. The underlying material is fine sandy loam.

Paoli soils are nearly level and are well drained. The surface layer and underlying material are fine sandy loam.

Caruso soils are nearly level and are somewhat poorly drained. The surface layer is clay loam. The underlying material is stratified loamy fine sand to clay loam.

Barnum soils are deep and stratified and are near stream channels. Connerton soils are deep, and they are associated with Barnum soils but are more sloping. Garrett soils are deep and well drained. Longmont soils are deep and poorly drained. Loveland soils are deep, are somewhat poorly drained, and have underlying material of sand and gravel. Poudre soils are deep and somewhat poorly drained or poorly drained. Fluvaquents range from clay loam to sand or gravel. Riverwash is areas of nearly clean gravel. Marsh consists of extremely wet areas that generally have water near the surface. In Gravel pits, underlying gravel deposits have been removed.

The soils in this association are used mainly for irrigated crops and pasture. Some areas are used for dryfarming and some are used for range. Areas near the major streams and gravel pits that are filled with water provide wildlife habitat.

12. Altvan-Larimer-Stoneham association

Deep, nearly level to strongly sloping, well drained loams and fine sandy loams that formed in alluvium and in upland deposits; on uplands, benches, and fans

This association is mainly in the northeastern part of the survey area north of Fort Collins. Elevation ranges from 5,100 to 6,200 feet. Mean annual air temperature ranges from 48° to 50° F, and annual precipitation ranges from 13 to 15 inches. The native vegetation is mainly short grasses.

The association makes up about 8 percent of the survey area. It is about 30 percent Altvan soils, 15 percent Larimer soils, and 10 percent Stoneham soils. The remaining 45 percent is mainly Cushman, Fort Collins, Keith, Kim, Renohill, Satanta, Thedalund, and Midway soils.

Altvan soils are nearly level to strongly sloping and are well drained. The surface layer is loam. The subsoil is loam and clay loam. The underlying material is gravelly loamy sand at a depth of about 36 inches.

Larimer soils are nearly level to strongly sloping and are well drained. The surface layer is fine sandy loam. The subsoil is loam. The underlying material is sand and gravel at a depth of about 30 inches.

Stoneham soils are nearly level to strongly sloping and are well drained. The surface layer is loam. The subsoil is clay loam. The underlying material is loam.

Cushman, Renohill, and Thedalund soils are moderately deep and are on uplands. Fort Collins, Keith, Kim, and Satanta soils are deep and are on terraces, fans, benches, and uplands. Midway soils are shallow and are on uplands.

The soils in this association are used mainly for range. Some areas are used for irrigated and dryfarmed crops.

13. Otero-Nelson-Tassel association

Shallow to deep, nearly level to moderately steep, well drained sandy loams and fine sandy loams that formed in materials weathered from sandstone and in alluvium modified by wind; on uplands and fans

This association is on uplands, mainly along the eastern edge of the central and southern parts of the survey area. Elevation ranges from 5,000 to 5,500 feet. Mean annual air temperature ranges from about 48° to 50° F, and annual precipitation ranges from about 13 to 15 inches. The native vegetation is mainly short and mid grasses and yucca.

The association makes up about 4 percent of the survey area. It is about 20 percent Otero soils, 15 percent Nelson soils, and 15 percent Tassel soils. The remaining 50 percent is mainly Ascalon, Cushman, Kim, Renohill, Satanta, and Thedalund soils.

Otero soils are nearly level to moderately steep and are well drained. The surface layer and underlying material are sandy loam.

Nelson soils are nearly level to moderately steep and are well drained. The surface layer and underlying material are fine sandy loam. Sandstone is at a depth of about 25 inches.

Tassel soils are gently sloping to moderately steep and are well drained. The surface layer is sandy loam.

The underlying material is sandy loam. Sandstone is at a depth of about 12 inches.

Ascalon soils are deep and are on uplands. Cushman, Renohill, and Thedalund soils are moderately deep and are on uplands. Kim and Satanta soils are deep and are on uplands and terraces.

The soils in this association are used mainly for irrigated and dryfarmed crops. Some areas are used for range.

14. Weld-Wiley association

Deep, nearly level to strongly sloping, well drained silt loams that formed in wind deposited materials; on uplands

This association is in small areas in the southeastern part of the survey area. Elevation ranges from 5,000 to 5,400 feet. Mean annual air temperature ranges from 48° to 50° F, and annual precipitation ranges from 13 to 15 inches. The native vegetation is mainly short grasses and cactus.

The association makes up about 2 percent of the survey area. It is about 35 percent Weld soils and 35 percent Wiley soils. The remaining 30 percent is mainly Fort Collins, Kim, Satanta, and Stoneham soils.

Weld soils are nearly level and are well drained. The surface layer is silt loam. The subsoil is silty clay loam and silty clay. The underlying material is silt loam.

Wiley soils are nearly level to gently sloping and are well drained. The surface layer is silt loam. The subsoil is silty clay loam. The underlying material is silt loam.

Fort Collins, Kim, Satanta, and Stoneham soils are deep, loamy soils on uplands and terraces or fans.

The soils in this association are used mainly for irrigated and dryfarmed crops.

15. Nunn-Fort Collins-Ulm association

Deep, nearly level to strongly sloping, well drained clay loams and loams that formed in alluvium; on fans, terraces, and side slopes

This association is in scattered areas east of the foothills, mainly in the southeastern part of the survey area (fig. 3). Elevation ranges from 5,000 to 5,400 feet. Mean annual air temperature ranges from about 48° to 50° F, and annual precipitation ranges from about 13 to 15 inches. The native vegetation is mainly short and mid grasses and cactus.

The association makes up about 5 percent of the survey area. It is about 40 percent Nunn soils, 30 percent Fort Collins soils, and 10 percent Ulm soils. The remaining 20 percent is mainly Altvan, Heldt, Satanta, and Stoneham soils.

Nunn soils are nearly level or gently sloping and are well drained. The surface layer, subsoil, and underlying material are clay loam.

Fort Collins soils are nearly level to strongly sloping and are well drained. The surface layer, subsoil, and underlying material are loam.

Ulm soils are nearly level or gently sloping and are

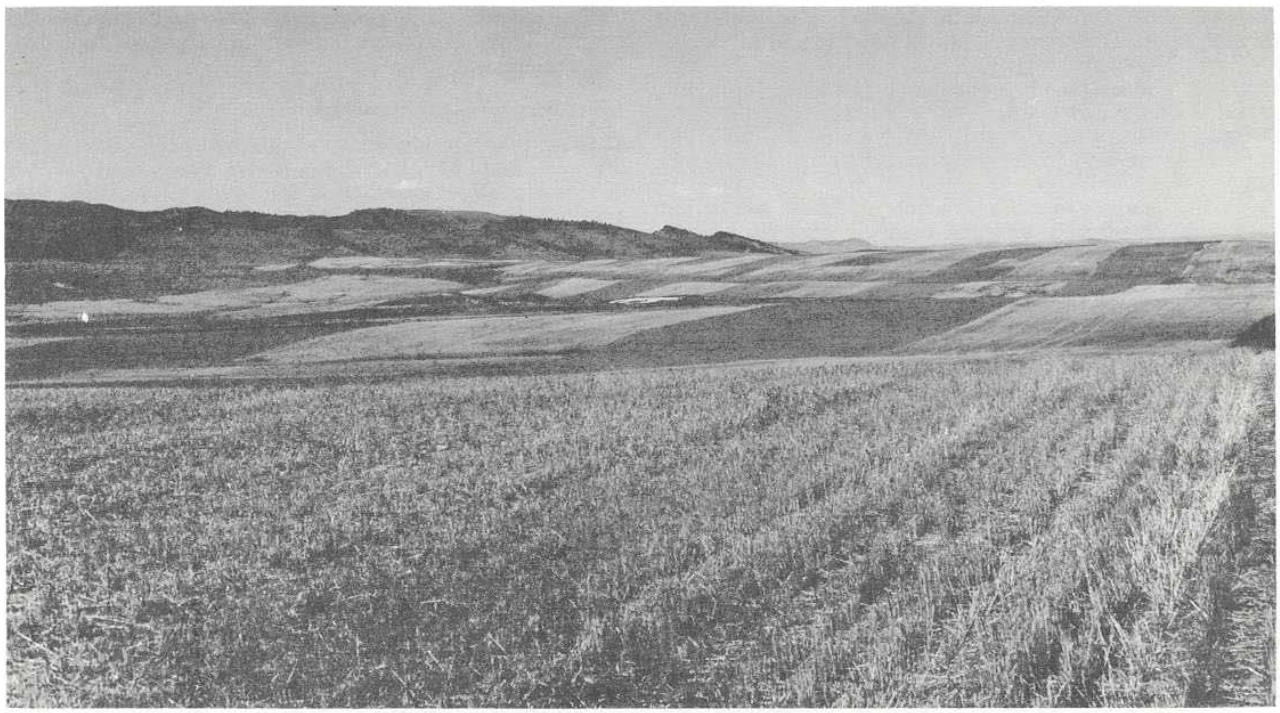

***Figure 3.*—Wheat-summer fallow stripcropping in Nunn-Fort Collins-Ulm association; Haplustolls-Baller-Rock outcrop association in left background.**

well drained. The surface layer and subsoil are clay loam. The underlying material is clay loam or silty clay loam.

Altvan soils are deep and are on benches and terraces. Heldt soils are deep and are on fans and valleysides. Satanta and Stoneham soils are deep and are on terraces and uplands.

The soils in this association are used mainly for irrigated crops. Some areas are used for dryfarmed crops and pasture.

16. *Heldt-Renohill-Kim association*

Deep and moderately deep, nearly level to moderately steep, well drained clay loams and loams that formed in alluvium and in materials weathered from shale; on fans and uplands

This association is in scattered areas east of the foothills in the eastern part of the survey area. Elevation ranges from 5,000 to 5,500 feet. Mean annual air temperature ranges from 48° to 50° F, and annual precipitation ranges from 13 to 15 inches.

The association makes up about 6 percent of the survey area. It is about 20 percent Heldt soils, 20 percent Renohill soils, and 15 percent Kim soils. The remaining 45 percent is mainly Cushman, Fort Collins, Longmont, Midway, Thedalund, and Ulm soils.

Heldt soils are nearly level to strongly sloping and are well drained. The surface layer is clay loam. The subsoil is clay loam and clay. The underlying material is clay.

Renohill soils are nearly level to moderately steep and are well drained. The surface layer is clay loam. The subsoil is clay loam and clay. The underlying material is clay loam. Shale is at a depth of about 29 inches.

Kim soils are nearly level to moderately steep and are well drained. The surface layer and underlying material are loam.

Cushman and Thedalund soils are moderately deep, over shale or sandstone, and are on uplands. Fort Collins soils are deep and are on high terraces. Longmont soils are deep and are in upland swales and valleys. Midway soils are shallow, over shale, and are on uplands. Ulm soils are deep and are on fans and valleysides.

The soils in this association are used for irrigated and dryfarmed crops and for pasture and range.

Descriptions of the Soils

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

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for dry soil unless otherwise stated. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

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

Preceding the name of the mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and windbreak suitability group to which the mapping unit has been assigned. The woodland group is also listed where applicable.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*3*).[1]

Altvan Series

The Altvan series consists of deep, well drained soils that formed in mixed alluvial deposits. These soils are on uplands, high terraces, and benches and are underlain by sand and gravel at a depth of 20 to 40 inches. Elevation ranges from 5,200 to 6,200 feet. Slopes are 0 to 9 percent. The native vegetation is mainly blue grama, western wheatgrass, sage, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown loam about 3 inches thick. The subsoil is about 18 inches thick; it is grayish brown loam in the upper part and brown, grayish brown, and pale brown clay loam in the lower part. Below this is about 15 inches of light brown clay loam that is underlain by brown and strong brown gravelly loamy sand.

Permeability is moderate above a depth of about 36 inches and rapid below that depth. The available water capacity is high. Reaction is neutral above a depth of 12 inches, mildly alkaline between depths of 12 and 17 inches, and moderately alkaline below a depth of 17 inches.

These soils are used for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Altvan loam, 0 to 3 percent slopes, in native grass, near the northeast corner of sec. 23, T. 11 N., R. 68 W.:

A1—0 to 3 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR

[1] Italic numbers in parentheses refer to Literature Cited, p. 172.

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

Soil	Acres	Percent
Altvan loam, 0 to 3 percent slopes	11,300	1.2
Altvan loam, 3 to 9 percent slopes	8,700	1.0
Altvan-Satanta loams, 0 to 3 percent slopes	3,500	.4
Altvan-Satanta loams, 3 to 9 percent slopes	1,700	.2
Aquepts, loamy	3,100	.3
Aquepts, ponded	900	.1
Ascalon sandy loam, 0 to 3 percent slopes	3,500	.4
Ascalon sandy loam, 3 to 5 percent slopes	3,100	.3
Bainville-Epping silt loams, 5 to 20 percent slopes	2,700	.3
Bainville-Keith complex, 2 to 9 percent slopes	5,200	.5
Baller-Carnero complex, 9 to 35 percent slopes	4,000	.4
Baller-Rock outcrop complex, 15 to 45 percent slopes	11,000	1.2
Blackwell clay loam, 0 to 5 percent slopes	5,300	.6
Boyle gravelly sandy loam, 3 to 9 percent slopes	13,200	1.4
Boyle gravelly sandy loam, 9 to 30 percent slopes	13,800	1.4
Boyle-Ratake gravelly sandy loams, 1 to 9 percent slopes	8,200	.9
Boyle-Ratake gravelly sandy loams, 9 to 25 percent slopes	9,700	1.0
Breece coarse sandy loam, 0 to 3 percent slopes	550	.1
Breece coarse sandy loam, 3 to 9 percent slopes	7,500	.8
Breece coarse sandy loam, 9 to 30 percent slopes	9,000	.9
Carnero loam, 3 to 9 percent slopes	2,500	.3
Caruso clay loam, 0 to 1 percent slopes	4,300	.5
Clergern fine sandy loam, 2 to 10 percent slopes	4,700	.5
Connerton-Barnum complex, 0 to 3 percent slopes	2,650	.2
Connerton-Barnum complex, 3 to 9 percent slopes	10,400	1.0
Cushman fine sandy loam, 0 to 3 percent slopes	730	.1
Cushman fine sandy loam, 3 to 9 percent slopes	3,400	.4
Driggs loam, 0 to 3 percent slopes	600	.1
Driggs loam, 3 to 25 percent slopes	4,800	.5
Elbeth-Moen loams, 5 to 30 percent slopes	11,600	1.2
Farnuf loam, 2 to 10 percent slopes	2,100	.2
Farnuf-Boyle-Rock outcrop complex, 10 to 25 percent slopes	19,200	2.0
Fluvaquents, nearly level	1,400	.1
Fort Collins loam, 0 to 1 percent slopes	2,000	.2
Fort Collins loam, 1 to 3 percent slopes	12,100	1.3
Fort Collins loam, 3 to 5 percent slopes	4,800	.5
Fort Collins loam, 5 to 9 percent slopes	1,200	.1
Foxcreek loam, 0 to 3 percent slopes	2,400	.3
Gapo clay loam, 0 to 5 percent slopes	720	.1
Garrett loam, 0 to 1 percent slopes	3,900	.4
Garrett loam, 1 to 3 percent slopes	1,100	.1
Gravel pits	1,800	.2
Haploborolls-Rock outcrop complex, steep	69,000	7.2
Haplustolls, hilly	5,500	.6
Haplustolls-Rock outcrop complex, steep	23,000	2.4
Harlan fine sandy loam, 1 to 3 percent slopes	2,000	.2
Harlan fine sandy loam, 3 to 9 percent slopes	3,800	.4
Heldt clay loam, 0 to 3 percent slopes	7,900	.8
Heldt clay loam, 3 to 6 percent slopes	4,400	.5
Keith silty clay loam, 0 to 3 percent slopes	2,200	.2
Kildor clay loam, 0 to 6 percent slopes	1,150	.1
Kildor-Shale outcrop complex, 5 to 30 percent slopes	6,100	.6
Kim loam, 1 to 3 percent slopes	8,360	.9
Kim loam, 3 to 5 percent slopes	7,900	.8
Kim loam, 5 to 9 percent slopes	3,620	0.4
Kim-Thedalund loams, 3 to 15 percent slopes	4,400	.5
Kirtley loam, 3 to 9 percent slopes	2,700	.3
Kirtley-Purner complex, 5 to 20 percent slopes	20,000	2.1
LaPorte-Rock outcrop complex, 3 to 30 percent slopes	4,100	.4
Larim gravelly sandy loam, 5 to 40 percent slopes	11,300	1.2
Larimer fine sandy loam, 1 to 3 percent slopes	1,200	.1
Larimer-Stoneham complex, 3 to 10 percent slopes	8,800	.9
Longmont clay, 0 to 3 percent slopes	6,900	.7
Loveland clay loam, 0 to 1 percent slopes	4,200	.4
Midway clay loam, 5 to 25 percent slopes	3,900	.4
Minnequa silt loam, 3 to 9 percent slopes	1,740	.2
Minnequa-LaPorte complex, 3 to 15 percent slopes	1,000	.1
Miracle sandy loam, 5 to 25 percent slopes	8,500	.9
Naz sandy loam, 1 to 3 percent slopes	1,400	.1
Naz sandy loam, 3 to 25 percent slopes	9,400	1.0
Nelson fine sandy loam, 3 to 9 percent slopes	700	.1
Newfork sandy loam, 0 to 3 percent slopes	1,300	.1
Nunn clay loam, 0 to 1 percent slopes	11,600	1.2
Nunn clay loam, 1 to 3 percent slopes	17,600	1.8
Nunn clay loam, 3 to 5 percent slopes	700	.1
Nunn clay loam, wet, 1 to 3 percent slopes	5,400	.6
Otero sandy loam, 0 to 3 percent slopes	1,500	.2
Otero sandy loam, 3 to 5 percent slopes	1,700	.2
Otero sandy loam, 5 to 9 percent slopes	2,400	.3
Otero-Nelson sandy loam, 3 to 25 percent slopes	5,500	.6
Paoli fine sandy loam, 0 to 1 percent slopes	7,500	.8
Pendergrass-Rock outcrop complex, 15 to 25 percent slopes	8,600	.9
Pinata-Rock outcrop complex, 15 to 45 percent slopes	2,200	.2
Poudre fine sandy loam, 0 to 1 percent slopes	1,700	.2
Purner fine sandy loam, 1 to 9 percent slopes	2,200	.2
Purner-Rock outcrop complex, 10 to 50 percent slopes	12,120	1.3
Ratake-Rock outcrop complex, 25 to 55 percent slopes	20,500	2.1
Redfeather sandy loam, 5 to 50 percent slopes	66,000	6.9
Renohill clay loam, 0 to 3 percent slopes	1,910	.2
Renohill clay loam, 3 to 9 percent slopes	6,000	.6
Renohill-Midway clay loams, 3 to 15 percent slopes	8,200	.9
Riverwash	2,500	.3
Rock outcrop	30,000	3.1
Satanta loam, 0 to 1 percent slopes	1,600	.2
Satanta loam, 1 to 3 percent slopes	9,900	1.0
Satanta loam, 3 to 5 percent slopes	14,750	1.5
Satanta loam, gullied, 3 to 9 percent slopes	800	.1
Satanta Variant clay loam, 0 to 3 percent slopes	1,300	.1
Schofield-Redfeather-Rock outcrop complex, 5 to 25 percent slopes	16,700	1.8
Stoneham loam, 0 to 1 percent slopes	900	.1
Stoneham loam, 1 to 3 percent slopes	9,100	1.0
Stoneham loam, 3 to 5 percent slopes	5,900	.6
Stoneham loam, 5 to 9 percent slopes	3,200	.3
Sunshine stony sandy loam, 5 to 15 percent slopes	2,900	.3
Table Mountain loam, 0 to 1 percent slopes	8,800	.9
Tassel sandy loam, 3 to 25 percent slopes	4,100	.4
Thedalund loam, 0 to 3 percent slopes	620	.1
Thedalund loam, 3 to 9 percent slopes	3,300	.3

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

Soil	Acres	Percent	Soil	Acres	Percent
Thiel gravelly sandy loam, 5 to 25 percent slopes	11,070	1.1	Wetmore-Boyle-Moen complex, 5 to 40 percent slopes	17,000	1.8
Tine gravelly sandy loam, 0 to 3 percent slopes	2,100	.2	Wetmore-Boyle-Rock outcrop complex, 5 to 60 percent slopes	113,800	11.9
Tine cobbly sandy loam, 15 to 40 percent slopes	600	.1	Wiley silt loam, 1 to 3 percent slopes	2,580	.3
Trag-Moen complex, 5 to 30 percent slopes	12,000	1.3	Wiley silt loam, 3 to 5 percent slopes	3,350	.4
Ulm clay loam, 0 to 3 percent slopes	3,600	.4	Water	19,400	2.0
Ulm clay loam, 3 to 5 percent slopes	1,100	.1			
Weld silt loam, 0 to 3 percent slopes	7,120	.7	Total	954,240	100.0

3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; noncalcareous; neutral; clear smooth boundary.

B1—3 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak moderate prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky; few patchy clay films on peds; noncalcareous; neutral; clear smooth boundary.

B21t—7 to 12 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; thin clay films on peds; slightly hard, firm, sticky; noncalcareous; neutral; clear smooth boundary.

B22tca—12 to 17 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky; thin clay films on peds; calcareous; mildly alkaline; clear smooth boundary.

B3ca—17 to 21 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to weak subangular blocky; slightly hard, friable, slightly sticky; few patchy clay films on peds; calcareous; moderately alkaline; clear smooth boundary.

C1ca—21 to 36 inches; light brown (7.5YR 6/3) clay loam, brown (7.5YR 5/3) moist; massive; slightly hard, friable, slightly sticky; 10 to 15 percent fine gravel; calcareous; moderately alkaline; clear wavy boundary.

IIC2ca—36 to 60 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/6) gravelly loamy sand; massive; friable; nonsticky; 35 to 45 percent gravel; calcareous; moderately alkaline.

The A horizon is loam or heavy sandy loam 7 to 12 inches thick in cultivated areas. It is neutral to mildly alkaline. The B horizon ranges from loam to clay loam. It is neutral to moderately alkaline. A B1 horizon is present in places. The A and B horizons are as much as 15 percent gravel. The IIC horizon typically is calcareous, but it is noncalcareous in places.

1—Altvan loam, 0 to 3 percent slopes. This nearly level soil is on terraces and benches (fig. 4). This soil has the profile described as representative of the series. Numerous mounds or hummocks are scattered throughout the mapped areas. On these mounds the soil has more gravel in the surface layer and subsoil than is typical.

Included with this soil in mapping are small areas of soils that are similar to this Altvan soil but that have a limy surface layer and subsoil and are redder. Also included are some small areas of Stoneham, Larimer, and Keith soils.

Runoff is slow, and the hazard of erosion is slight to moderate.

This soil is suited to wheat or barley under dryland management. If irrigated, it is also suited to alfalfa, corn, sugar beets, and dry beans. It is well suited to pasture and native grasses. Capability units IIIe–3, irrigated, and IIIe–6, dryland; Loamy Plains range site; windbreak suitability group 1.

2—Altvan loam, 3 to 9 percent slopes. This gently

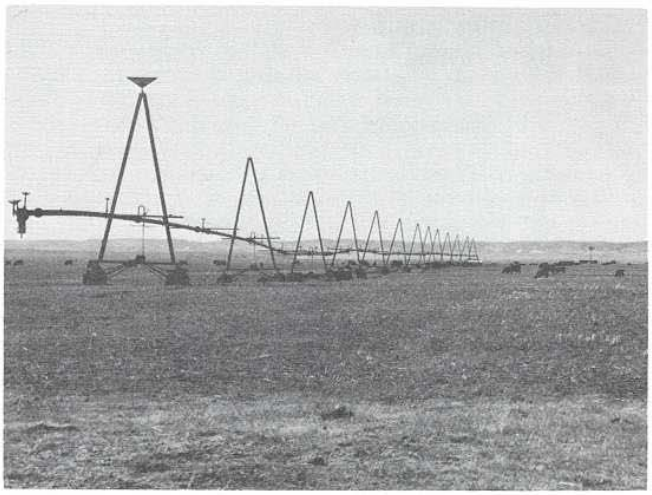

Figure 4.—**Center-pivot type sprinkler system on Altvan loam, 0 to 3 percent slopes.**

sloping to strongly sloping soil is on terrace edges, fans, and benches. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 18 to 19 inches.

Included with this soil in mapping are some areas of soils that are more sloping and some areas of soils that have a surface layer of sandy loam. Also included are small areas of Larimer, Stoneham, and Larim soils.

Runoff is medium, and the hazard of erosion is moderate to severe.

This soil is suited to wheat and barley under dryland management. If irrigated, it is also suited to alfalfa. It is well suited to pasture and native grasses. Capability units IVe–1, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

3—Altvan-Satanta loams, 0 to 3 percent slopes. This complex consists of nearly level soils on terraces and high benches. It is about 45 percent Altvan loam and about 30 percent Satanta loam. The soils are intermingled throughout the mapped areas, but Altvan loam commonly is more sloping and Satanta loam is more nearly level and is in some depressions. The Altvan soil has a profile similar to the one described as representative of the Altvan series, but the surface layer commonly is about 8 to 11 inches thick and is loam or sandy loam. The Satanta soil has a profile similar to the one described as representative of the Satanta series, but the surface layer is about 8 to 11 inches thick and is sandy loam in places. In places both soils are redder than is typical of their respective series.

Included with these soils in mapping is about 15 percent Nunn soils.

Runoff is slow to medium, and the hazards of wind and water erosion are slight to moderate.

If irrigated, these soils are suited to corn, sugar beets, dry beans, alfalfa, and small grain. Under dryland management they are suited mainly to wheat, but other small grain, such as barley and oats, is sometimes grown. The soils are also well suited to pasture and native grasses. Capability units IIIe–3, irrigated, and IIIe–6, dryland; Loamy Foothill range site; windbreak suitability group 1.

4—Altvan-Satanta loams, 3 to 9 percent slopes. This complex consists of gently sloping or strongly sloping soils on high terraces, benches, and fans. It is about 55 percent Altvan loam and 35 percent Satanta loam. Altvan loam is mainly more sloping, and Satanta loam is smoother. These soils have profiles similar to the ones described as representative of their respective series, but the surface layer is sandy loam and loam and the surface layer and subsoil are thinner. Many areas of both soils are redder than is typical of their respective series.

Included with these soils in mapping is about 10 percent Nunn and Larimer soils.

Runoff is medium to rapid, and the hazards of wind and water erosion are moderate.

If irrigated, these soils are well suited to alfalfa, small grain, and pasture. Under dryland management they are suited to wheat and barley. They are also suited to pasture and native grasses. Capability units IVe–1, irrigated, and IVe–3, dryland; Loamy Foothill range site; windbreak suitability group 1.

Aquepts, Loamy

5—Aquepts, loamy. These nearly level or gently sloping, poorly drained soils are in depressional areas on uplands, along drainageways, and on side slopes below large canals. The surface layer is fine sandy loam, loam, or clay loam. The underlying layer is mainly loam or clay loam extending to a depth of 40 to 60 inches or more. A water table is at or near the surface in spring and summer.

Included with these soils in mapping are a few small areas of Stoneham, Fort Collins, and Kim soils and Nunn clay loam, wet.

Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

These soils are suited to pasture and native grasses. A few areas are used for hay. If drained, the soils are suited to crops. The main irrigated crops are barley, corn, sugar beets, and wheat. Capability units IIIw–1, irrigated, and Vw–1, dryland; Wet Meadow range site; windbreak suitability group 5.

Aquepts, Ponded

6—Aquepts, ponded. These nearly level soils are near stream channels and drainageways. A water table is at or near the surface most of the year. The soils are extremely variable. The native vegetation is mainly cattails, sedges, and rushes.

These soils offer very little grazing but are suitable for wildlife habitat. Capability unit VIIIw–1, dryland; not assigned to a range site or windbreak suitability group.

Ascalon Series

The Ascalon series consists of deep, well drained soils that formed in mixed wind-deposited material. These soils are on uplands and foot slopes. Elevation ranges from 4,800 to 5,700 feet. Slopes are 0 to 5 percent. The native vegetation is mainly blue grama and other short grasses and forbs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is brown sandy loam about 6 inches thick. The subsoil is brown and pale brown sandy clay loam about 14 inches thick. The underlying material is pale brown or very pale brown sandy loam.

Permeability is moderate, and the available water capacity is medium to high. Reaction is neutral above a depth of about 16 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated and dryfarmed crops. Some small areas are used for native grasses.

Representative profile of Ascalon sandy loam, 0 to 3 percent slopes, in a cultivated area, about 400 feet east and 650 feet south of the northwest corner of sec. 36, T. 5 N., R. 68 W.:

Ap—0 to 6 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky struc-

ture; hard, very friable; neutral; clear smooth boundary.

B2t—6 to 16 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium angular and subangular blocky; very hard, friable; numerous thin clay films on aggregates; neutral; clear smooth boundary.

B3ca—16 to 20 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, very friable; thin patchy clay films; visible secondary calcium carbonate occurring as thin seams and streaks; strongly effervescent; moderately alkaline; clear smooth boundary.

C1ca—20 to 36 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; visible secondary calcium carbonate occurring as thin seams and streaks; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; slightly effervescent; moderately alkaline.

The A horizon ranges from fine sandy loam to sandy clay loam 5 to 12 inches thick. The B horizon ranges from 10 to 25 inches in thickness. It is neutral to moderately alkaline. The C horizon typically is sandy loam, but ranges from sandy loam to loam in places.

7—Ascalon sandy loam, 0 to 3 percent slopes. This nearly level soil is on uplands and high terraces. It has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils that have a surface layer of sandy clay loam. Also included are some small areas of soils in which sandstone is at a depth of 40 to 60 inches and small areas of Otero soils.

Runoff is slow. The hazard of wind erosion is moderate, and the hazard of water erosion is slight.

If irrigated, this soil is well suited to corn, beans, alfalfa, sugar beets, and barley. Under dryland management it is suited to wheat or barley. It is also well suited to pasture and native grasses. Capability units IIe–2, irrigated, and IIIe–8, dryland; Sandy Plains range site; windbreak suitability group 2.

8—Ascalon sandy loam, 3 to 5 percent slopes. This gently sloping soil is on uplands. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are some small areas of soils that are more sloping or less sloping. Also included are minor areas of Otero soils.

Runoff is medium, and the hazards of wind and water erosion are moderate.

If irrigated, this soil is suited to corn, alfalfa, beans, and small grain and, to a lesser extent, sugar beets. Under dryland management it is suited to wheat. It is also suited to pasture and native grasses. Capability units IIIe–4, irrigated, and IIIe–8, dryland; Sandy Plains range site; windbreak suitability group 2.

Bainville Series

The Bainville series consists of moderately deep, well drained soils that formed in material weathered from siltstone and shale. These soils are on uplands and are underlain by soft siltstone or silty shale at a depth of 20 to 40 inches. Elevation ranges from 5,600 to 6,400 feet. Slopes are 2 to 15 percent. The native vegetation is mainly blue grama, wheatgrasses, fringed sage, and other forbs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 47° to 50° F, and the frost-free season is 135 to 150 days.

In a representative profile the surface layer is brown silt loam about 5 inches thick. The underlying material is very pale brown silt loam to a depth of about 24 inches. Below this is soft siltstone.

Permeability is moderate, and the available water capacity is medium. Reaction is neutral above a depth of about 5 inches and mildly alkaline or moderately alkaline below that depth.

These soils are used for native grasses.

Representative profile of Bainville silt loam in an area of Bainville-Keith complex, 2 to 9 percent slopes, in native grass, about 50 feet west of benchmark near the southeast corner of sec. 13, T. 11 N., R. 68 W.:

A1—0 to 5 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

C1—5 to 12 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable; calcareous; mildly alkaline; clear smooth boundary.

C2—12 to 24 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; calcareous; moderately alkaline; clear smooth boundary.

C3r—24 to 60 inches; soft calcareous siltstone.

The A horizon is loam or silt loam 4 to 8 inches thick. The C horizon is silt loam or light silty clay loam 16 to 32 inches thick.

9—Bainville-Epping silt loams, 5 to 20 percent slopes. This complex consists of moderately sloping to strongly sloping soils on uplands. It is about 45 percent Bainville silt loam and about 35 percent Epping silt loam. Bainville silt loam is less sloping, and Epping silt loam is steeper.

Included with these soils in mapping is about 20 percent Keith and Larim soils and siltstone outcrop.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to pasture and native grasses. Capability unit VIe–1, dryland; Bainville soil in Loamy Foothill range site and Epping soil in Shallow Siltstone range site; not assigned to a windbreak suitability group.

10—Bainville-Keith complex, 2 to 9 percent slopes. This complex consists of nearly level to moderately sloping soils on uplands and high benches. It is about 50 percent Bainville silt loam and about 35 percent

Keith clay loam. Bainville silt loam is steeper, and Keith clay loam is more nearly level and is in depressions. The Bainville soil has the profile described as representative of the Bainville series. The Keith soil has a profile similar to the one described as representative of the Keith series, but the surface layer is clay loam.

Included with these soils in mapping is about 15 percent Larim and Epping soils.

Runoff is medium, and the hazard of erosion is moderate.

These soils are well suited to pasture and native grasses and are used mainly for these purposes. A few small areas are used for dryfarmed wheat. Capability unit IVe–3, dryland; Bainville soil in Loamy Foothill range site and Keith soil in Clayey Foothill range site; not assigned to a windbreak suitability group.

Baller Series

The Baller series consists of shallow, well drained soils that formed in material weathered from sandstone. These soils are on uplands and are underlain by bedrock at a depth of 10 to 20 inches. Elevation ranges from 5,400 to 6,800 feet. Slopes are 5 to 45 percent. The native vegetation is mainly big and little bluestem, blue grama, side-oats grama, mountainmahogany, and a few scattered ponderosa pine. Mean annual precipitation ranges from 15 to 17 inches, mean annual air temperature ranges from 47° to 49° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is dark grayish brown stony sandy loam about 6 inches thick. The subsurface layer is dark grayish brown very stony sandy loam about 5 inches thick. Below this is hard sandstone.

Permeability is moderately rapid, and the available water capacity is low. Reaction is neutral.

These soils are used for native grasses.

Representative profile of Baller stony sandy loam in an area of Baller-Rock outcrop complex, 15 to 45 percent slopes, in native grass, about 1,050 feet west and 1,650 feet north of the southeast corner of sec. 32, T. 7 N., R. 69 W.:

A1—0 to 6 inches; dark grayish brown (10YR 4/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak to moderate fine granular structure; soft, very friable; 25 percent stones and cobbles; noncalcareous; neutral; clear smooth boundary.

AC—6 to 11 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; 60 percent stones and cobbles; noncalcareous; neutral.

R—11 inches; hard sandstone bedrock.

The A horizon is sandy loam or fine sandy loam and contains 35 to 70 percent stones or cobbles, mainly of sandstone. Reaction ranges from slightly acid to mildly alkaline.

11—Baller-Carnero complex, 9 to 35 percent slopes. This complex consists of strongly sloping to steep soils on ridges. It is about 45 percent Baller stony sandy loam and about 35 percent Carnero loam. The soils are intermingled in an intricate pattern, but Baller stony sandy loam commonly is on the upper part of the ridges and Carnero loam is near the bottom of the slope and is less sloping. The Baller soil has a profile similar to the one described as representative of the Baller series. The Carnero soil has a profile similar to the one described as representative of the Carnero series, but more cobbles and stones are on the surface.

Included with these soils in mapping are about 20 percent areas of Rock outcrop and extremely stony soils that are similar to Carnero soils but in which sandstone is at a depth of less than 20 inches.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to native grasses. Capability unit VIIs–1, dryland; Baller soil in Shallow Foothill range site and Carnero soil in Loamy Foothill range site; not assigned to a windbreak suitability group.

12—Baller-Rock outcrop complex, 15 to 45 percent slopes. This complex consists of strongly sloping to steep soils on ridges and "hogbacks." It is about 50 percent Baller stony sandy loam and about 30 percent Rock outcrop. Baller stony sandy loam is mainly on east-facing side slopes on the ridges. Rock outcrop is mainly near ridgetops, but it is scattered throughout. The Baller soil has the profile described as representative of the Baller series.

Included with this complex in mapping is about 20 percent Carnero soils and areas of a soil that is similar to the Baller soil but that has a clayey subsoil.

Runoff is rapid, and the hazard of erosion is severe.

This complex is suited to native grasses. Capability unit VIIs–1, dryland; Baller soil in Shallow Foothill range site and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Barnum Series

The Barnum series consists of deep, well drained soils that formed in alluvium from reddish colored shale and sandstone. These soils are in upland valleys and bottom lands. Elevation ranges from 5,200 to 6,300 feet. Slopes are 0 to 5 percent. The native vegetation is mainly blue grama, wheatgrasses, and cactus. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 47° to 49° F, and the frost-free season ranges from 115 to 130 days.

In a representative profile the surface layer is brown loam about 10 inches thick. The underlying material is reddish brown loam stratified with thin layers of sandy loam and is about 50 inches thick.

Permeability is moderate, and the available water capacity is high. Reaction is moderately alkaline.

These soils are used for irrigated and dryfarmed crops and native grasses.

Representative profile of Barnum loam in an area of Connerton-Barnum complex, 0 to 3 percent slopes, in native grass, 1,650 feet south of center of sec. 30, T. 10 N., R. 69 W.:

A1—0 to 10 inches; brown (7.5YR 5/3) loam, brown (7.5YR 4/3) moist; weak medium subangular blocky and weak medium granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

C—10 to 60 inches; reddish brown (5YR 5/4) loam stratified with thin strata of sandy loam or clay loam, dark reddish brown (5YR 3/4) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; calcareous; moderately alkaline.

The A horizon is loam, heavy sandy loam, or sandy clay loam and it is stratified in places. The C horizon is mainly loam, but it is stratified with sandy loam, fine sandy loam, and light clay loam. The A and C horizons range from mildly alkaline to moderately alkaline and are generally calcareous, but some strata are noncalcareous.

Barnum soils are mapped only with Connerton soils in Larimer County Area.

Blackwell Series

The Blackwell series consists of deep, poorly drained soils that formed in material weathered from alluvium. These soils are on low terraces and flood plains. Elevation ranges from 7,000 to 8,500 feet. Slopes are 0 to 5 percent. The native vegetation is mainly bluegrass, little bluestem, cordgrass, and sedges and rushes. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 1-inch-thick layer of organic material is on the surface. The upper part of the surface layer is dark grayish brown clay loam about 9 inches thick, and the lower part is grayish brown clay loam about 8 inches thick. The subsoil is mottled, grayish brown clay loam about 18 inches thick. The underlying material is brown gravelly sandy loam about 8 inches thick that is underlain by sand and gravel.

Permeability is moderately slow, and the available water capacity is high. Reaction is slightly acid above a depth of 17 inches and neutral below that depth.

These soils are used for irrigated hay and pasture.

Representative profile of Blackwell clay loam, 0 to 5 percent slopes, in grass, about 1,800 feet south of ranch headquarters in the NE¼ sec. 10, T. 10 N., R. 76 W.:

O1—1 inch to 0; partly decayed grass roots and leaves.

A11—0 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak to moderate medium subangular blocky structure parting to weak fine granular; hard, friable; few medium distinct yellowish red (5YR 5/6) mottles; slightly acid; clear smooth boundary.

A12—9 to 17 inches; grayish brown (10YR 5/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium and fine subangular blocky structure; very hard, firm; few medium distinct yellowish red (5YR 5/6) mottles; slightly acid; gradual smooth boundary.

B2g—17 to 35 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, friable; common medium and coarse distinct yellowish red (5YR 5/6) mottles; neutral; clear smooth boundary.

IIC1g—35 to 43 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; massive; hard, very friable; common medium distinct yellowish red (5YR 5/6) mottles; neutral; clear wavy boundary.

IIIC2—43 to 60 inches; clean sand and gravel.

The A horizon is loam or clay loam 10 to 20 inches thick. A loam or clay loam B2g horizon is present in some places. Reaction is medium acid to neutral. Contrasting substrata occur in many profiles below a depth of 40 inches.

13—Blackwell clay loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on low terraces and bottom lands.

Included with this soil in mapping are small areas of soils that have dark colors deeper in the profile. Also included are small areas of Foxcreek and Newfork soils and a few gravel bars.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to hay and pasture. Capability unit VIw–1, irrigated; Mountain Meadow range site; not assigned to a windbreak suitability group.

Boyle Series

The Boyle series consists of shallow, well drained or excessively drained soils that formed in material weathered from granite. These soils are on uplands and mountainsides and are underlain by weathered granite at a depth of 10 to 20 inches. Elevation ranges from 7,000 to 8,200 feet. Slopes are 1 to 30 percent. The native vegetation is mainly blue grama, bluebunch wheatgrass, fescues, fringed sage, and other forbs and shrubs. Mean annual precipitation ranges from 14 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile the surface layer is brown gravelly sandy loam about 5 inches thick. The subsoil is brown and reddish brown gravelly or very gravelly sandy clay loam about 8 inches thick. Below this is weathered granite.

Permeability is moderate, and the available water capacity is low. Reaction is slightly acid to neutral.

These soils are used for native grasses.

Representative profile of Boyle gravelly loam in an area of Boyle-Ratake gravelly sandy loams, 1 to 9 percent slopes, in native grass, 1,100 feet south of state line and just west of Tie Siding Road in sec. 22, T. 12 N., R. 73 W.:

A1—0 to 5 inches; brown (7.5YR 5/2) gravelly sandy loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine granular; soft, very friable; 15 percent gravel; neutral; clear smooth boundary.

B21t—5 to 10 inches; brown (7.5YR 5/3) gravelly sandy clay loam, dark brown (7.5YR 3/3) moist; weak to moderate medium subangular blocky structure; very hard,

firm; thin patchy clay films on peds; 25 percent gravel; neutral; clear smooth boundary.

B22t—10 to 13 inches; reddish brown (5YR 5/4) very gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; very hard, friable; thin patchy clay films on peds; 70 percent gravel; neutral; gradual wavy boundary.

Cr—13 to 20 inches; weathered granite.

The A horizon is gravelly or very gravelly sandy loam 3 to 6 inches thick. The B horizon is gravelly or very gravelly sandy clay loam about 6 to 11 inches thick. The A and B horizons range from slightly acid to neutral. Content of rock fragments ranges from 15 to 80 percent but averages more than 35 percent.

14—Boyle gravelly sandy loam, 3 to 9 percent slopes. This gently sloping and moderately sloping soil is on uplands.

Included with this soil in mapping are a few small areas of soils that are more sloping, small areas of soils in which granite is at a depth of 20 to 24 inches, and small areas of Breece and Ratake soils. Also included are small areas of Rock outcrop.

Runoff is slow, and the hazard of water erosion is slight.

This soil is suited to native grasses. Scattered stands of ponderosa pine are in a few areas. Capability unit VIIs–1, dryland; Rocky Loam range site; not assigned to a windbreak suitability group.

15—Boyle gravelly sandy loam, 9 to 30 percent slopes. This strongly sloping to steep soil is on uplands and mountainsides. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 10 inches.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping. Also included are a few small areas of Breece and Ratake soils and a few areas of granite knobs and outcrops.

Runoff is medium, and the hazard of water erosion is moderate to severe. Gully erosion is active in a few areas.

This soil is suited to native grasses. Scattered stands of ponderosa pine are in a few areas. Capability unit VIIe–1, dryland; Rocky Loam range site; not assigned to a windbreak suitability group.

16—Boyle-Ratake gravelly sandy loams, 1 to 9 percent slopes. This complex consists of nearly level to strongly sloping soils on uplands. It is about 50 percent Boyle gravelly sandy loam and about 30 percent Ratake gravelly sandy loam. The soils are intricately intermingled throughout the mapped areas, but Boyle gravelly sandy loam commonly is more nearly level and Ratake gravelly sandy loam is steeper. The Boyle soil has the profile described as representative of the Boyle series. The Ratake soil has a profile similar to the one described as representative of the Ratake series, but the surface layer and subsoil are gravelly sandy loam, the underlying material is weathered granite, and the soil contains less mica.

Included with these soils in mapping is about 20 percent soils that are similar to Boyle and Ratake soils but in which granite is at a depth of 20 to 24 inches; granite knobs and outcrops occur with these included soils.

Runoff is slow, and the hazard of water erosion is slight.

These soils are suited to native grasses. Capability unit VIIs–1, dryland; Rocky Loam range site; not assigned to a windbreak suitability group.

17—Boyle-Ratake gravelly sandy loams, 9 to 25 percent slopes. This complex consists of strongly sloping soils on uplands. It is about 40 percent Boyle gravelly sandy loam and about 35 percent Ratake gravelly sandy loam. The soils are intricately intermingled throughout the mapped areas, but Boyle gravelly sandy loam commonly is less sloping and Ratake gravelly sandy loam is higher and steeper. The Boyle soil has a profile similar to the one described as representative of the Boyle series, but the combined thickness of the surface layer and subsoil is about 10 inches. The Ratake soil has a profile similar to the one described as representative of the Ratake series, but the surface layer and subsoil are gravelly sandy loam; they contain less mica; their combined thickness is about 10 inches; and the underlying material is granite.

Included with these soils in mapping is about 25 percent soils that are similar to Boyle and Ratake soils but in which granite is at a depth of 20 to 24 inches; granite knobs and outcrops occur with these included soils.

Runoff is medium to rapid, and the hazard of water erosion is moderate to severe. Deep gullies are in some areas.

These soils are suited to native grasses. Capability unit VIIe–1, dryland; Rocky Loam range site; not assigned to a windbreak suitability group.

Breece Series

The Breece series consists of deep, well drained soils that formed in alluvium, mainly from granite. These soils are on alluvial fans and valley side slopes. Elevation ranges from 6,800 to 7,800 feet. Slopes are 0 to 30 percent. The native vegetation is mainly needleandthread, blue grama, junegrass, forbs, and a few scattered pine. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile the surface layer is dark grayish brown coarse sandy loam about 18 inches thick over dark grayish brown gravelly coarse sandy loam about 18 inches thick. The underlying material is brown gravelly loamy coarse sand.

Permeability is rapid, and the available water capacity is medium. Reaction is neutral.

These soils are mainly used for native grasses. A few areas are used for irrigated hay.

Representative profile of Breece coarse sandy loam, 9 to 30 percent slopes, in native grass, about 0.1 mile east of the top of the hill and 0.3 mile northeast of the Forest Service sign on road at the edge of old borrow pit, in the SW¼ sec. 10, T. 10 N., R. 71 W.:

A11—0 to 18 inches; dark grayish brown (10YR 4/2) coarse sandy loam, very dark gray-

ish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; 10 to 15 percent gravel; neutral; gradual wavy boundary.

A12—18 to 36 inches; dark grayish brown (10YR 4/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; soft, very friable; 25 percent gravel; neutral; gradual wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable; 25 percent gravel; neutral.

The A horizon is sandy loam 20 to 55 inches thick. The C horizon is loamy sand or sandy loam. Reaction is slightly acid or neutral. Content of rock fragments, mainly fine granitic gravel, ranges from 0 to 35 percent.

18—Breece coarse sandy loam, 0 to 3 percent slopes. This nearly level soil is on terraces and in valleys. This soil has a profile similar to the one described as representative of the series, but the surface layer is slightly thicker.

Included with this soil in mapping are a few small areas of soils in which bedrock or a gravelly layer is at a depth of 40 to 60 inches. Some areas have more gravel or cobbles throughout the profile.

Runoff is slow, and the hazard of erosion is slight to moderate.

This soil is well suited to pasture and native grasses. A few small areas that can be irrigated are used for hay. Capability unit IVc–1, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

19—Breece coarse sandy loam, 3 to 9 percent slopes. This gently sloping to strongly sloping soil is on terraces and in valleys. This soil has a profile similar to the one described as representative of the series, but the dark surface layer is about 40 inches thick.

Included with this soil in mapping are small areas of soils in which bedrock is at a depth of 40 to 60 inches and a few small areas of soils in which gravel is at a depth of 40 to 60 inches. Also included are a few scattered areas of Rock outcrop on steeper areas.

Runoff is medium, and the hazard of erosion is moderate.

This soil is suited to native grasses. Capability unit IVe–6, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

20—Breece coarse sandy loam, 9 to 30 percent slopes. This strongly sloping to steep soil is on terraces and valleysides. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping. Also included are areas of soils in which bedrock or a gravelly layer is at a depth of 20 to 60 inches and a few small areas of Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is suited to native grasses. Capability unit VIe–6, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

Carnero Series

The Carnero series consists of moderately deep, well drained soils that formed in material weathered from sandstone. These soils are on upland ridges and are underlain by sandstone at a depth of 20 to 40 inches. Elevation ranges from 5,600 to 6,400 feet. Slopes are 3 to 30 percent. The native vegetation is mainly blue grama, western wheatgrass, some forbs and shrubs, and scattered ponderosa pine. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 47° to 49° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is brown clay loam and heavy clay loam about 20 inches thick. Below this is hard sandstone.

Permeability is moderately slow, and the available water capacity is medium. Reaction is neutral.

These soils are used mainly for native grasses. A few areas are used for dryfarmed crops.

Representative profile of Carnero loam, 3 to 9 percent slopes, in native grass, about 1,000 feet south and 2,200 feet east of the northwest corner of sec. 29, T. 7 N., R. 69 W.:

A1—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky and moderate fine granular structure; soft, very friable; neutral; clear wavy boundary.

B21t—10 to 15 inches; brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; weak medium prismatic structure parting to weak to moderate medium subangular blocky; slightly hard, friable; thin patchy clay films on peds; neutral; clear smooth boundary.

B22t—15 to 30 inches; brown (7.5YR 4/4) heavy clay loam, dark brown (7.5YR 3/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky structure; hard, firm; thin nearly continuous clay films on peds; neutral; abrupt wavy boundary.

R—30 inches; hard sandstone.

The A horizon is loam or fine sandy loam 7 to 11 inches thick. The B21t horizon is clay loam or heavy loam 5 to 9 inches thick. The B22t horizon is heavy clay loam or clay 10 to 20 inches thick. Reaction is neutral to mildly alkaline. The soil is generally noncalcareous, but some profiles have thin zones of lime accumulation immediately above the sandstone.

21—Carnero loam, 3 to 9 percent slopes. This gently sloping or strongly sloping soil is on uplands and valleysides.

Included with this soil in mapping are some small areas of soils in which bedrock is at a depth of 40 to 60 inches or less. Also included are some small areas of soils that have a subsoil of loam or light clay loam.

Runoff is medium, and the hazard of water erosion is moderate.

If irrigated, this soil is suited to barley, wheat, and pasture and, to some extent, alfalfa. Under dryland

management it is suited to wheat or barley. It is also well suited to pasture and native grasses. Capability units IVe–1, irrigated, and IVe–3, dryland; Loamy Foothill range site; not assigned to a windbreak suitability group.

Caruso Series

The Caruso series consists of deep, somewhat poorly drained soils that formed in mixed alluvium. These soils are on low terraces and bottom lands. Elevation ranges from 4,800 to 5,500 feet. Slopes are 0 to 1 percent. The native vegetation is mainly inland saltgrass, alkali sacaton, sedges, and other water-tolerant grasses. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown clay loam about 11 inches thick. The underlying material is stratified pale brown, light brown, and grayish brown clay loam, silty clay loam, fine sandy loam, and loamy fine sand. Below this is sand and gravel.

Permeability is moderately slow above a depth of about 25 inches and moderately rapid or rapid below that depth. The available water capacity is medium to high. Reaction is mildly alkaline or moderately alkaline above a depth of 25 inches and mildly alkaline below that depth.

These soils are mainly used for irrigated crops and pasture. A few areas are used for dryfarmed crops and pasture.

Representative profile of Caruso clay loam, 0 to 1 percent slopes, in dryland pasture, about 100 feet east of picnic area in the NE¼ sec. 34, T. 7 N., R. 68 W.:

A1—0 to 11 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; strongly effervescent; mildly alkaline; clear smooth boundary.

C1—11 to 17 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; common medium distinct brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; very hard, friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—17 to 25 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 4/4) moist; common fine faint reddish brown (5YR 4/4) mottles; weak fine subangular blocky structure; very hard, friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—25 to 35 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; common fine faint yellowish brown (10YR 5/4) mottles; massive; very hard, friable; faintly effervescent; mildly alkaline; clear smooth boundary.

C4—35 to 44 inches; grayish brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; hard, very friable; mildly alkaline; gradual smooth boundary.

IIC5—44 to 60 inches; stratified sand and gravel.

The A horizon is heavy loam or clay loam 8 to 18 inches thick. The underlying C horizon is sandy loam, loam, clay loam, or silty clay loam. It has thin layers of loamy fine sand in places, but is mainly loam or light clay loam. It is stratified and generally mottled and is underlain by clean sand and gravel below a depth of about 40 inches. Reaction ranges from mildly alkaline to moderately alkaline.

22—Caruso clay loam, 0 to 1 percent slopes. This level soil is on low terraces and bottom lands.

Included with this soil in mapping are a few areas of soils that are more sloping. Also included are small areas of Loveland soils and a few minor areas of gravel bars.

Runoff is slow, and the hazard of erosion is slight.

If irrigated, this soil is suited to barley and sugar beets and, to a lesser extent, corn. It is also well suited to pasture and native grasses. Capability units IIIw–1, irrigated, and Vw–1, dryland; Wet Meadow range site; windbreak suitability group 5.

Clergern Series

The Clergern series consists of deep, well drained soils that formed in alluvium and valley-filling material from reddish sandstone and shale. These soils are in valleys and on side slopes. Elevation ranges from 7,500 to 8,500 feet. Slopes are 0 to 10 percent. The native vegetation is mainly needleandthread, slender wheatgrass, bluebunch wheatgrass, fringed sage, and rabbitbrush. Mean annual precipitation ranges from 12 to 14 inches, mean annual air temperature ranges from 42° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile the surface layer is reddish brown fine sandy loam about 12 inches thick. The underlying material is reddish brown and light reddish brown fine sandy loam.

Permeability is moderately rapid, and the available water capacity is high. Reaction is neutral above a depth of about 12 inches and mildly alkaline below that depth.

These soils are used for native grasses.

Representative profile of Clergern fine sandy loam, 2 to 10 percent slopes, in native grass, about 800 feet south and 1,500 feet west of the northeast corner of sec. 27, T. 12 N., R. 75:

A11—0 to 6 inches; reddish brown (5YR 5/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak to moderate fine granular structure; soft, very friable; slightly effervescent; neutral; clear smooth boundary.

A12—6 to 12 inches; reddish brown (5YR 5/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable; slightly effervescent; neutral; clear smooth boundary.

C1—12 to 30 inches; reddish brown (5YR 5/4)

fine sandy loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, very friable; strongly effervescent; mildly alkaline; clear wavy boundary.

C2—30 to 60 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; strongly effervescent; mildly alkaline.

The A horizon is fine sandy loam, sandy loam, or light loam 10 to 18 inches thick. The C horizon is fine sandy loam or sandy loam. Content of rock fragments is 0 to 15 percent. The A and C horizons range from neutral to moderately alkaline. The soil is generally calcareous, but it does not have a definite zone of lime accumulation.

23—Clergern fine sandy loam, 2 to 10 percent slopes. This nearly level to strongly sloping soil is in valleys and on side slopes in the mountainous part of the survey area.

Included with this soil in mapping are some small areas of Miracle and Pendergrass soils. Also included are some small areas of lighter colored soils.

Runoff is medium, and the hazard of erosion is moderate to severe.

This soil is suited to native grasses and pasture. Capability unit VIe–6, dryland; Subalpine Loam range site; not assigned to a windbreak suitability group.

Connerton Series

The Connerton series consists of deep, well drained soils that formed in mixed alluvial material weathered from red sandstone and shale. These soils are on fans and valleysides. Elevation ranges from 5,000 to 6,000 feet. Slopes are 0 to 9 percent. The native vegetation is mainly blue grama and other short grasses. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 47° to 49° F, and the frost-free season ranges from 115 to 130 days.

In a representative profile the surface layer is reddish brown fine sandy loam about 8 inches thick. The underlying material is reddish brown and light reddish brown loam about 28 inches thick over yellowish red stratified loam and sandy loam.

Permeability is moderate, and the available water capacity is high. Reaction is moderately alkaline.

These soils are used mainly for dryfarmed crops and pasture. A few areas are used for irrigated crops.

Representative profile of Connerton fine sandy loam in an area of Connerton-Barnum complex, 3 to 9 percent slopes, in native grass, 1,810 feet north of the southeast corner of sec. 9, T. 10 N., R. 69 W.:

A1—0 to 8 inches; reddish brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure parting to moderate very fine granular; soft, very friable; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—8 to 20 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—20 to 36 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; very hard, very friable; violently effervescent; moderately alkaline; gradual smooth boundary.

C3—36 to 60 inches; yellowish red (5YR 5/6) loam and a few seams of sandy loam, yellowish red (5YR 4/6) moist; massive; hard, very friable; strongly effervescent; moderately alkaline.

The A horizon is loam or fine sandy loam 7 to 12 inches thick. The C horizon is loam, but is sandy loam in the lower part in places. The A and C horizons are mildly alkaline to strongly alkaline. The soil is generally calcareous, but the surface layer is leached in places.

24—Connerton-Barnum complex, 0 to 3 percent slopes. This complex consists of nearly level soils on terraces, bottom lands, and fans. It is about 50 percent Connerton fine sandy loam and about 40 percent Barnum loam. Connerton fine sandy loam is higher, and Barnum loam is near streams and drainageways. The Connerton soil has a profile similar to the one described as representative of the Connerton series. The Barnum soil has the profile described as representative of the Barnum series.

Included with these soils in mapping are some small areas of soils in which gravel is on the surface and at varying depths throughout the profile. Also included are about 10 percent areas of Garrett and Otero soils.

Runoff is slow, and the hazards of wind and water erosion are slight to moderate. Areas near stream channels are subject to cutting. The lower-lying areas of this complex are commonly flooded in spring or early summer.

If irrigated, these soils are suited to corn, sugar beets, beans, barley, alfalfa, and wheat. Under dryland management they are suited to wheat and barley. They are also suited to pasture or native grasses. Capability units IIe–2, irrigated, and IVe–5, dryland; Connerton soil in Loamy Foothill range site and Barnum soil in Overflow range site; windbreak suitability group 1.

25—Connerton-Barnum complex, 3 to 9 percent slopes. This complex consists of gently sloping to strongly sloping soils on terraces and fans. It is about 60 percent Connerton fine sandy loam and about 25 percent Barnum loam. Connerton fine sandy loam is higher and more sloping, and Barnum loam is on lower parts of fans and in areas near streams, swales, and drainageways. The Connerton soil has the profile described as representative of the Connerton series. The Barnum soil has a profile similar to the one described as representative of the Barnum series, but the surface layer is 6 to 8 inches thick.

Included with these soils in mapping are about 15 percent areas of Garrett and Otero soils and small gravelly or cobbly areas.

Runoff is medium, and the hazard of erosion is moderate to severe. Gullies in a few areas are active. Some areas of this complex are flooded during spring or

early summer, especially in areas near channels and drainageways.

If irrigated, these soils are suited to alfalfa, barley, wheat, and pasture. Under dryland management they are suited to pasture or native grasses. Capability units IVe–1, irrigated, and VIe–2, dryland; Connerton soil in Loamy Foothill range site and Barnum soil in Overflow range site; windbreak suitability group 1.

Cushman Series

The Cushman series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. These soils are on uplands and are underlain by soft sandstone or shale at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,800 feet. Slopes are 0 to 9 percent. The native vegetation is mainly blue grama, western wheatgrass, fringed sage, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is brown fine sandy loam about 2 inches thick. The subsoil is brown and pale brown clay loam about 11 inches thick. Below this is grayish brown sandy clay loam about 18 inches thick underlain by interbedded sandstone and shale.

Permeability is moderately slow, and the available water capacity is medium. Reaction is neutral above a depth of 9 inches and moderately alkaline below that depth.

These soils are used for irrigated and dryfarmed crops and pasture and for native grasses.

Representative profile of Cushman fine sandy loam, 3 to 9 percent slopes, in native grass, about 750 feet northeast of overpass in sec. 11, T. 10 N., R. 68 W.:

A1—0 to 2 inches; brown (10YR 5/2) fine sandy loam, dark brown (10YR 4/3) moist; weak fine and medium granular structure; soft, very friable; neutral; clear wavy boundary.

B2t—2 to 9 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; thin clay films on ped faces; neutral; clear smooth boundary.

B3ca—9 to 13 inches; pale brown (10YR 6/3) light clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, friable; strongly effervescent; visible calcium carbonate occurring as soft spots; moderately alkaline; clear smooth boundary.

C1ca—13 to 31 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; strongly calcareous; visible calcium carbonate occurring as soft spots and masses; moderately alkaline; clear smooth boundary.

C2r—31 to 42 inches; calcareous interbedded sandstone and shale.

In cultivated areas, the A horizon is fine sandy loam, loam, or light clay loam 8 to 11 inches thick. The B horizon is heavy loam or light clay loam. It is calcareous in the lower part. Depth to calcareous material is generally about 6 to 10 inches, but some pedons are slightly calcareous in the surface layer.

26—Cushman fine sandy loam, 0 to 3 percent slopes. This nearly level soil is on uplands. This soil has a profile similar to the one described as representative of the series, but the surface layer is commonly about 6 to 8 inches thick.

Included with this soil in mapping are small areas of soils that have a surface layer of loam or sandy clay loam. Also included are small areas of Stoneham and Tassel soils.

Runoff is slow. The hazard of wind erosion is moderate, and the hazard of water erosion is slight.

This soil is suited to wheat and barley under dryland management. If irrigated, it is suited to barley, wheat, and corn and, to a lesser extent, alfalfa. It is also well suited to pasture and native grasses. Capability units IIIe–5, irrigated, and IVe–5, dryland; Loamy Plains range site; windbreak suitability group 2.

27—Cushman fine sandy loam, 3 to 9 percent slopes. This gently sloping or strongly sloping soil is on uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have a surface layer of loam or sandy clay loam. A few areas of soils have sandstone fragments on or near the surface.

Runoff is medium, and the hazard of erosion is moderate to severe.

This soil is well suited to pasture or native grasses under dryland management. If irrigated it is also suited to pasture, wheat, or barley and, to a lesser extent, alfalfa. Capability units IVe–2, irrigated, and VIe–2, dryland; Loamy Plains range site; windbreak suitability group 2.

Driggs Series

The Driggs series consists of deep, well drained soils that formed in material weathered from mixed alluvium and outwash. These soils are on high terraces and benches and are underlain by sand and gravel at a depth of 20 to 40 inches. Elevation ranges from 7,800 to 8,500 feet. Slopes are 0 to 25 percent. The native vegetation is mainly slender and bluebunch wheatgrass, junegrass, sages, and other forbs. Mean annual precipitation ranges from 13 to 17 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is brown loam about 4 inches thick. The subsoil is brown clay loam and gravelly clay loam about 11 inches thick. The underlying material is very pale brown and pale brown gravelly loam and very gravelly clay loam about 15 inches thick over sand and gravel.

Permeability is moderate above a depth of about 30 inches and very rapid below that depth. The available water capacity is medium to high. Reaction is slightly acid above a depth of 4 inches, neutral between depths

of 4 and 15 inches, and moderately alkaline below a depth of 15 inches.

These soils are mainly used for native grasses. Some areas are used for irrigated hay.

Representative profile of Driggs loam, 0 to 3 percent slopes, in irrigated hayland, about 2,350 feet west and 1,350 feet north of the southeast corner of sec. 11, T. 11 N., R. 77 W.:

Ap—0 to 4 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak to moderate very fine granular structure; soft, very friable; 10 percent gravel; slightly acid; clear smooth boundary.

B1—4 to 9 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, friable; very thin and patchy clay films on ped faces; 10 percent gravel; neutral; clear smooth boundary.

B2t—9 to 15 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate fine and medium angular and subangular blocky; very hard, friable; thin patchy clay films on ped faces; 25 percent gravel; neutral; clear smooth boundary.

C1ca—15 to 22 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strongly effervescent; secondary calcium carbonate occurring as thin seams and streaks; 25 percent gravel; moderately alkaline; clear smooth boundary.

C2—22 to 30 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; massive; hard, friable; slightly effervescent; some visible calcium carbonate coating the undersides of gravel; 40 percent gravel; moderately alkaline; clear smooth boundary.

IIC3—30 to 60 inches; sand and gravel weakly cemented in the upper part with calcium carbonate.

The A horizon is loam or sandy loam 3 to 6 inches thick. The B horizon is clay loam or gravelly clay loam 8 to 16 inches thick. The C horizon ranges from loam to gravelly or very gravelly clay loam. The A and B horizons range from slightly acid to neutral.

28—Driggs loam, 0 to 3 percent slopes. This nearly level soil is on terraces and benches. It has the profile described as representative of the series.

Included with this soil in mapping are some small areas of soils that have a surface layer of clay loam or gravelly loam. Also included are some small areas of soils in which sand and gravel is at a depth of 40 to 60 inches.

Runoff is slow, and the hazard of water erosion is slight.

If irrigated, this soil is suited to hay. Under dryland management it is suited to pasture and native grasses. Capability units VIc–1, irrigated, and VIe–5, dryland; Dry Mountain Loam range site; not assigned to a windbreak suitability group.

29—Driggs loam, 3 to 25 percent slopes. This gently sloping to moderately steep soil is on high terraces and benches. This soil has a profile similar to the one described as representative of the series, but the surface layer is thinner.

Included with this soil in mapping are some small areas of soils that have a surface layer of sandy loam or clay loam. Also included are some small areas of soils in which sand and gravel is at a depth of 10 to 20 inches and also at a depth of 40 to 60 inches.

Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This soil is suited to pasture and native grasses. Capability unit VIe–5, dryland; Dry Mountain Loam range site; not assigned to a windbreak suitability group.

Elbeth Series

The Elbeth series consists of deep, well drained soils that formed in material weathered from granite, schist, and phyllite. These soils are on mountainsides. Elevation ranges from 6,200 to 7,800 feet. Slopes are 5 to 35 percent. The native vegetation is mainly ponderosa pine and a thin understory of grass and some shrubs. Mean annual precipitation ranges from 18 to 20 inches, mean annual air temperature ranges from 44° to 47° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile an organic layer about 1 inch thick is on the surface. The surface layer is dark grayish brown loam about 4 inches thick. The subsurface layer is pale brown loam about 4 inches thick. The subsoil is brown and strong brown clay loam and sandy clay loam about 48 inches thick. Below this is partly weathered granite.

Permeability is moderate, and the available water capacity is high. Reaction is neutral.

These soils are used for woodland, recreation, and wildlife and for limited grazing.

Representative profile of Elbeth loam in an area of Elbeth-Moen loams, 5 to 30 percent slopes, in woodland, about 3,750 feet west of the southeast corner of sec. 31, T. 8 N., R. 70 W.:

O1—1 inch to 0; partly decomposed needles, leaves, and twigs.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak and moderate fine granular structure; soft, very friable; neutral; clear wavy boundary.

A2—4 to 8 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak to moderate fine granular structure; slightly hard, very friable; neutral; clear wavy boundary.

B21t—8 to 13 inches; brown (10YR 5/3) clay loam, dark brown (7.5YR 4/4) moist; moderate fine angular and subangular blocky structure; very hard, firm; thin patchy clay films on peds; neutral; clear smooth boundary.

B22t—13 to 41 inches; brown (7.5YR 5/4) clay

loam, dark brown (7.5YR 4/4) moist; moderate to strong fine and medium subangular blocky structure; very hard, firm; thin nearly continuous clay films and organic staining on peds; neutral; gradual wavy boundary.

B3—41 to 56 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) moist; weak medium and coarse subangular blocky structure; hard, firm; thin patchy clay films on peds; neutral; gradual wavy boundary.

Cr—56 to 70 inches; partly weathered granite.

The A1 horizon is loam or sandy loam 3 to 5 inches thick. The A2 horizon is loam or sandy loam 3 to 12 inches thick. The B2t horizon is clay loam or sandy clay loam. The combined thickness of the A and B horizons ranges from 24 to 60 inches. Reaction ranges from slightly acid to neutral.

30—Elbeth-Moen loams, 5 to 30 percent slopes. This complex consists of strongly sloping to steep soils on mountainsides and valleysides. It is about 45 percent Elbeth loam and about 35 percent Moen loam. Elbeth loam is covered with forest and commonly is somewhat steeper, and Moen loam is in open, grassy areas. The Elbeth soil has the profile described as representative of the Elbeth series. The Moen soil has a profile similar to the one described as representative of the Moen series, but the combined thickness of the surface layer and subsoil is about 28 inches.

Included with these soils in mapping are about 20 percent areas of Trag, Wetmore, Boyle, and Ratake soils and Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

These soils are suited to woodland or native grasses. They are also used for recreation and wildlife habitat. Capability unit VIe–5, dryland; Moen soil in Loamy Park range site; Elbeth soil in woodland suitability group 6o1; not assigned to a windbreak suitability group.

Epping Series

The Epping series consists of shallow, well drained soils that formed in material weathered from siltstone and silty shale. These soils are on uplands and are underlain by siltstone or shale at a depth of 10 to 20 inches. Elevation ranges from 5,800 to 6,600 feet. Slopes are 2 to 20 percent. The native vegetation is mainly western wheatgrass, blue grama, skunkbush, rabbitbrush, and other forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 47° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light brownish gray silt loam about 4 inches thick. The underlying material is light gray light silty clay loam about 8 inches thick. Below this is siltstone.

Permeability is moderate, and the available water capacity is low. Reaction is moderately alkaline.

These soils are used for native grasses.

Representative profile of Epping silt loam in an area of Bainville-Epping silt loams, 5 to 20 percent slopes, in native grass, 2,200 feet west and 250 feet south of the northeast corner of sec. 35, T. 12 N., R. 69 W.:

A1—0 to 4 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate very fine granular structure; slightly hard, very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—4 to 12 inches; light gray (2.5Y 7/2) light silty clay loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, very friable; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2r—12 inches; weathered siltstone.

The A horizon is silt loam or loam 3 to 6 inches thick. The C horizon is loam, silt loam, or silty clay loam 8 to 16 inches thick. The lower part of the C horizon commonly has siltstone or shale fragments. The A and C horizons range from mildly alkaline to moderately alkaline.

Epping soils are mapped only with Bainville soils in Larimer County Area.

Farnuf Series

The Farnuf series consists of deep, well drained soils that formed in mixed windblown and alluvial material. These soils are in valley fills and on side slopes. Elevation ranges from 6,500 to 8,000 feet. Slopes are 2 to 25 percent. The native vegetation is mainly slender wheatgrass, western wheatgrass, blue grama, junegrass, and fringed sage. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from about 75 to 100 days.

In a representative profile the surface layer is dark brown loam about 4 inches thick. The subsoil is dark brown, yellowish brown, or light yellowish brown clay loam or loam about 17 inches thick. The underlying material is light yellowish brown or yellowish brown loam.

Permeability is moderate, and the available water capacity is high. Reaction is mildly alkaline above a depth of about 17 inches and moderately alkaline below that depth.

These soils are used mainly for native grasses.

Representative profile of Farnuf loam, 2 to 10 percent slopes, in native grass, 1,485 feet east and 560 feet north of the southwest corner of sec. 25, T. 11 N., R. 71 W.:

A1—0 to 4 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

B21t—4 to 10 inches; dark brown (10YR 4/3) light clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; few thin patchy clay films on ped faces; mildly alkaline; clear smooth boundary.

B22t—10 to 17 inches; yellowish brown (10YR 5/4) light clay loam, dark brown (10YR

4/3) moist; moderate coarse subangular blocky structure; very hard, friable; thin nearly continuous clay films on ped faces; mildly alkaline; clear wavy boundary.

B3ca—17 to 21 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, very friable; few thin patchy clay films on ped faces; violently effervescent; calcium carbonate as soft nodules; moderately alkaline; clear wavy boundary.

C1ca—21 to 31 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable; violently effervescent; calcium carbonate as soft nodules; moderately alkaline; clear smooth boundary.

C2—31 to 60 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable; strongly effervescent; moderately alkaline.

The solum ranges from 15 to 30 inches in thickness. Reaction ranges from neutral to moderately alkaline. The A horizon is loam or light clay loam 3 to 9 inches thick. The B2 horizon is heavy loam or light clay loam. Granitic material is below a depth of 40 inches in some profiles.

31—Farnuf loam, 2 to 10 percent slopes. This nearly level to strongly sloping soil is in valley fills and on side slopes. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small areas of Rock outcrop and small areas of soils that are similar to Farnuf soil but in which granite bedrock is at a depth of less than 40 inches.

Runoff is moderate, and the hazard of erosion is moderate.

This soil is suited to pasture and native grasses. Capability unit VIe–6, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

32—Farnuf-Boyle-Rock outcrop complex, 10 to 25 percent slopes. This moderately steep soil is on ridges and valleysides. It is about 40 percent Farnuf loam, about 30 percent Boyle gravelly sandy loam, and about 20 percent Rock outcrop. Farnuf loam is lower and more nearly level, Boyle gravelly sandy loam is higher and on ridges, and Rock outcrop is commonly steeper but is scattered throughout. The Farnuf soil has a profile similar to the one described as representative of the Farnuf series, but the combined thickness of the surface layer and subsoil is about 18 inches. The Boyle soil has a profile similar to the one described as representative of the Boyle series.

Included with this complex in mapping is about 10 percent areas of Breece soils and areas of soils that are similar to Farnuf soil but in which granite bedrock is at a depth of less than 40 inches.

Runoff is rapid, and the hazard of erosion is severe.

This soil is suited to native grasses. It is also used for wildlife habitat. Capability unit VIe–5, dryland; Farnuf soil in Loamy Park range site, Boyle soil in Rocky Loam range site, and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Fluvaquents, Nearly Level

33—Fluvaquents, nearly level. This soil is on flood plains, low terraces, and bottom lands. The surface and underlying layers are extremely variable, range from sandy loam to clay loam, and are commonly stratified with thin layers of sand or clay. In places the underlying material is sand and gravel. A water table is commonly at a depth of less than 12 inches at some time during spring and summer, and the soil is also flooded occasionally during spring and summer. Drainage is impractical or impossible because of a lack of suitable outlets.

Runoff is slight. The hazard of erosion is slight, although there is some cutting on areas near stream channels in places.

This soil is suited to pasture or native grasses. A few areas are used for hay. Capability unit Vw–1, dryland; Wet Meadow range site; windbreak suitability group 5.

Fort Collins Series

The Fort Collins series consists of deep, well drained soils that formed in alluvium. These soils are on terraces and fans. Elevation ranges from 4,800 to 5,500 feet. Slopes are 0 to 9 percent. The native vegetation is mainly blue grama and western wheatgrass and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light brownish gray loam about 5 inches thick. The subsoil is light brownish gray, brown, and pale brown loam about 19 inches thick. The underlying material is pale brown loam.

Permeability is moderate, and the available water capacity is high. Reaction is neutral above a depth of about 8 inches, mildly alkaline between depths of 8 and 18 inches, and moderately alkaline below a depth of 18 inches.

These soils are used for irrigated and dryfarmed crops and pasture.

Representative profile of Fort Collins loam, 0 to 1 percent slopes, in native grass, approximately 1 block north of LaPorte Avenue on North Shields Street and 500 feet west of North Shields Street in sec. 11, T. 7 N., R. 69 W.:

A1—0 to 5 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; noncalcareous; neutral; clear smooth boundary.

B1—5 to 8 inches, light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure parting to fine granular; hard, very friable; few patchy clay

films on peds; noncalcareous; neutral; clear smooth boundary.

B2—8 to 18 inches; brown (10YR 5/3) heavy loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, very friable; many thin patchy clay films on peds and in root channels and pores; noncalcareous; mildly alkaline; gradual smooth boundary.

B3ca—18 to 24 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, very friable; few thin patchy clay films on peds and in some root channels; some visible secondary calcium carbonate occurring mostly as concretions; calcareous; moderately alkaline; gradual smooth boundary.

Cca—24 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; hard, very friable; visible calcium carbonate occurring as concretions and in thin seams and streaks; calcareous; moderately alkaline; gradual smooth boundary.

The A horizon is loam or light clay loam 5 to 13 inches thick. The combined thickness of the A and B horizons is 15 to 30 inches. The B2 horizon is loam to light clay loam.

34—Fort Collins loam, 0 to 1 percent slopes. This level soil is on terraces and fans. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are more sloping. Also included are small areas of soils that have a surface layer of clay loam and small areas of Stoneham soils.

Runoff is slow, and the hazard of erosion is slight.

If irrigated (fig. 5), this soil is well suited to corn, sugar beets, alfalfa, barley, and dry beans. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability unit I, irrigated; Loamy Plains range site; windbreak suitability group 1.

35—Fort Collins loam, 1 to 3 percent slopes. This nearly level soil is on terraces and fans. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 22 inches.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping. Also included are some small areas of Stoneham and Kim soils and a few small areas of soils that have a gravelly layer below a depth of 40 inches.

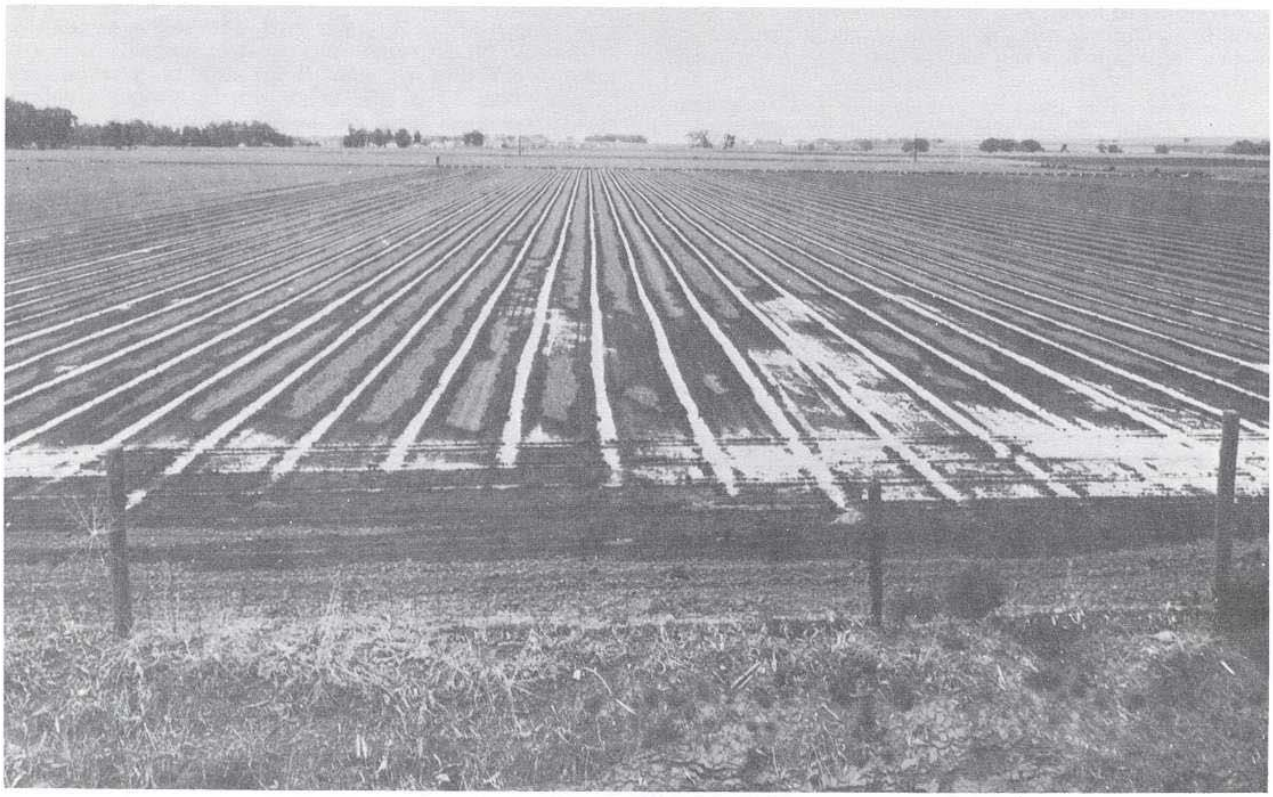

Figure 5.—**Furrow irrigation on Fort Collins loam, 0 to 1 percent slopes.**

Runoff is slow, and the hazards of wind and water erosion are slight to moderate.

If irrigated, this soil is well suited to corn, sugar beets, alfalfa, barley, and dry beans. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIe–1, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

36—Fort Collins loam, 3 to 5 percent slopes. This gently sloping soil is on the edges of terraces and fans. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 20 inches.

Included with this soil in mapping are a few areas of soils that are more sloping or less sloping. Also included are small areas of Stoneham and Kim soils and a few areas of soils that have a gravelly surface layer.

Runoff is moderate, and the hazards of wind and water erosion are moderate.

If irrigated, this soil is suited to corn, barley, and alfalfa and, to a lesser extent, sugar beets and dry beans. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIIe–2, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

37—Fort Collins loam, 5 to 9 percent slopes. This strongly sloping soil is on terrace edges and the steeper part of fans. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 18 inches.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping and a few small areas of soils that have a gravelly surface layer. Also included are small areas of Larimer, Stoneham, and Kim soils.

Runoff is rapid, and the hazards of wind and water erosion are severe.

If irrigated, this soil is suited to alfalfa and barley and other small grain or pasture. It is suited to pasture or native grasses under dryland management. Capability units IVe–1, irrigated, and VIe–1, dryland; Loamy Plains range site; windbreak suitability group 1.

Foxcreek Series

The Foxcreek series consists of deep, poorly drained soils that formed in alluvium. These soils are on low terraces and bottom lands and are underlain by sand and gravel at a depth of 20 to 40 inches. Elevation ranges from 7,800 to 8,800 feet. Slopes are 0 to 3 percent. The native vegetation is mainly timothy, redtop, sedges, and other water-tolerant grasses. Mean annual precipitation ranges from 12 to 16 inches, mean annual air temperature ranges from 42° to 46° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 1-inch-thick layer of organic material is on the surface. The surface layer is mottled dark brown loam about 5 inches thick. The subsoil is mottled dark grayish brown or brown silty clay loam about 17 inches thick. The underlying material is mottled brown sandy clay loam about 14 inches thick over sand and gravel.

Permeability is moderate above a depth of about 36 inches and very rapid below that depth. The available water capacity is medium to high. Reaction is slightly acid above a depth of about 22 inches and neutral below that depth.

These soils are mainly used for irrigated hay.

Representative profile of Foxcreek loam, 0 to 3 percent slopes, in irrigated hayland, 400 feet south of Hohnholtz Lake Road, west of the Laramie River in sec. 7, T. 11 N., R. 67 W.:

O—1 inch to 0; undecomposed and partly decomposed organic material.

A1g—0 to 5 inches; dark brown (7.5YR 3/2) loam, dark brown (7.5YR 3/2) moist; common fine distinct dark reddish brown (2.5YR 3/4) mottles; weak moderate subangular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B2g—5 to 17 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; common medium distinct red (2.5YR 4/6) mottles; weak medium subangular and angular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B3g—17 to 22 inches; brown (10YR 4/3) silty clay loam, brown (10YR 4/3) moist; common fine distinct yellowish red (5YR 4/6) mottles; weak to moderate medium subangular blocky structure; very hard, firm; slightly acid; clear smooth boundary.

C1g—22 to 36 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; common medium distinct yellowish red (5YR 4/6) mottles; massive; hard, friable; neutral; clear smooth boundary.

IIC2cag—36 to 60 inches; sand and gravel; very slightly effervescent; calcium carbonate on underside of pebbles.

The A horizon is loam, clay loam, or silty clay loam 3 to 8 inches thick. It is slightly acid to neutral. The Bg horizon is loam, light clay loam, or silty clay loam. It is slightly acid to neutral. The C and IIC horizons are generally neutral or mildly alkaline. The IIC horizon is very slightly effervescent to strongly effervescent and weak accumulations of calcium carbonate are mainly on the underside of pebbles.

38—Foxcreek loam, 0 to 3 percent slopes. This nearly level soil is on low terraces and bottom lands.

Included with this soil in mapping are a few small areas of Blackwell and Newfork soils. Also included are a few small areas of soils that have a cobbly and stony surface layer.

Runoff is slow, and the hazard of water erosion is slight.

If irrigated, this soil is suited to hay and meadow. It is also suited to pasture or native grasses. Capability unit VIw–1, irrigated; Mountain Meadow range site; not assigned to a windbreak suitability group.

Gapo Series

The Gapo series consists of deep, poorly drained

soils that formed in alluvium from clay shale. These soils are on flood plains and valleysides. Elevation ranges from 8,000 to 8,700 feet. Slopes are 0 to 5 percent. The native vegetation is mainly reedgrasses and sedges and other water-tolerant grasses and forbs. Mean annual precipitation ranges from 12 to 16 inches, mean air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 2-inch-thick layer of organic material is on the surface. The surface layer is mottled gray clay loam about 3 inches thick. The subsoil is mottled gray heavy clay loam about 11 inches thick. The underlying material is mottled gray clay.

Permeability is slow, and the available water capacity is high. Reaction is moderately alkaline.

These soils are mainly used for irrigated hay.

Representative profile of Gapo clay loam, 0 to 5 percent slopes, in irrigated hayland, about 2,900 feet east and 1,200 feet north of the southwest corner of sec. 35, T. 12 N., R. 77 W.:

O—2 inches to 0; very dark gray (10YR 3/1) moist mat of decomposed and partly decomposed organic material; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A1—0 to 3 inches; gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; slightly hard, friable; strongly effervescent; moderately alkaline; clear smooth boundary.

B2g—3 to 9 inches; gray (10YR 5/1) heavy clay loam, very dark gray (10YR 3/1) moist; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, firm; strongly effervescent; moderately alkaline; clear smooth boundary.

B3g—9 to 14 inches; gray (10YR 6/1) heavy clay loam, gray (10YR 5/1) moist; common fine and medium prominent strong brown (7.5YR 5/6) mottles; weak subangular blocky structure; hard, firm; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg—14 to 60 inches; gray (10YR 6/1) clay, grayish brown (10YR 5/2) moist; common medium prominent strong brown (7.5YR 5/6 and 5/8) mottles; weak medium and fine subangular blocky structure; very hard, very firm; strongly effervescent; moderately alkaline.

The A horizon is heavy loam or clay loam 3 to 12 inches thick. The B horizon is heavy clay loam or clay and has distinct or prominent mottling. The C horizon is heavy clay loam or clay. The IIC horizon of sand and gravel occurs below a depth of 40 inches in some profiles. Reaction ranges from neutral to moderately alkaline. The soil is calcareous but lacks a definite zone of lime accumulation.

39—Gapo clay loam, 0 to 5 percent slopes. This nearly level or gently sloping soil is on low terraces, bottom lands, and valleysides.

Included with this soil in mapping are a few small areas of Kildor soils and some areas of small gravel bars.

Runoff is slow to medium, and the hazard of water erosion is slight.

This soil is suited to irrigated hay and meadow. It is also suited to pasture and native grasses. Capability unit VIw–1, irrigated; Mountain Meadow range site; not assigned to a windbreak suitability group.

Garrett Series

The Garrett series consists of deep, well drained soils that formed in alluvium weathered from reddish shale and sandstone. These soils are on terraces and fans. Elevation ranges from 5,200 to 6,000 feet. Slopes are 0 to 3 percent. The native vegetation is mainly blue grama, slender wheatgrass, Indian ricegrass, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is reddish brown loam about 8 inches thick. The subsoil is reddish brown loam and light clay loam about 31 inches thick. The underlying material is pinkish gray loam and reddish brown sandy loam.

Permeability is moderate, and the available water capacity is high. Reaction is mildly alkaline above a depth of about 39 inches and moderately alkaline below that depth.

These soils are used for irrigated and dryfarmed crops and pasture.

Representative profile of Garrett loam, 1 to 3 percent slopes, in irrigated cropland, just south of center of sec. 14, T. 10 N., R. 69 W.:

Ap—0 to 8 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; weak thin platy and weak to moderate fine granular structure; slightly hard, very friable; slightly effervescent; mildly alkaline; clear smooth boundary.

B1—8 to 15 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; weak medium prismatic structure parting to weak to moderate subangular blocky; very hard, very friable; very thin very patchy clay films on peds; slightly effervescent; mildly alkaline; gradual smooth boundary.

B2t—15 to 39 inches; reddish brown (5YR 5/3) light clay loam, dark reddish brown (5YR 3/3) moist; weak medium prismatic structure parting to moderate subangular blocky; very hard, friable; thin patchy clay films on peds; slightly effervescent; mildly alkaline; gradual wavy boundary.

C1—39 to 48 inches; pinkish gray (5YR 6/2) loam, dark reddish gray (5YR 4/2) moist; massive; very hard, very friable; strongly effervescent; moderately alkaline; clear wavy boundary.

C2ca—48 to 60 inches; reddish brown (5YR 5/4) sandy loam, dark reddish brown (5YR

3/4) moist; massive; hard, very friable; violently effervescent; streaks and small specks of calcium carbonate; moderately alkaline.

Thickness of the mollic epipedon is 20 to 40 inches. The A horizon is loam, fine sandy loam, or sandy loam 5 to 12 inches thick. The B horizon is loam, light clay loam, or sandy clay loam. The A and B horizons range from neutral to mildly alkaline. They are leached of lime but are slightly effervescent in many places because of additions of lime by irrigation water. A sand and gravel substratum is below a depth of 40 inches in some places.

40—Garrett loam, 0 to 1 percent slopes. This level soil is on terraces and fans (fig. 6).

Included with this soil in mapping are a few small areas of soils that have gravel on the surface and a few areas of soils in which gravel is at a depth of 40 to 60 inches. Also included are small areas of Harlan, Otero, Connerton, and Barnum soils.

Runoff is slow. The hazard of erosion is slight, but some areas near stream channels have been cut in places. Lower areas near the channels are flooded at times in spring or early summer.

If irrigated, this soil is suited to corn, sugar beets, beans, barley, alfalfa, and wheat. It is also well suited to pasture. Under dryland management it is suited to wheat and barley and it is well suited to pasture and native grasses. Capability units IIw–1, irrigated, and IIIe–6, dryland; Overflow range site; windbreak suitability group 5.

41—Garrett loam, 1 to 3 percent slopes. This nearly level soil is on terraces and fans. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Harlan, Otero, Connerton, and Barnum soils. Also included are a few areas of soils in which gravel is on the surface and at a depth of 40 to 60 inches.

Runoff is medium, and the hazard of erosion is slight or moderate. Areas near the stream channel receive overflow at times and cutting occurs in places.

If irrigated, this soil is suited to corn, sugar beets, beans, barley, alfalfa, and wheat. Under dryland management it is suited to wheat and barley. It is also suited to pasture and native grasses (fig. 7). Capability units IIe–1, irrigated, and IIIe–6, dryland; Overflow range site; windbreak suitability group 1.

Gravel Pits

42—Gravel pits. This unit consists of areas where the soil and underlying gravel deposits have been removed. These areas have no value for farming and little value for grazing. Some areas are filled with water and provide habitat for fish and wildlife. Some areas are used for sanitary landfills. Also included are borrow pits and areas where material was removed in road construction, mainly along Interstate Highway 25. Capability unit VIIIs–1, dryland; not assigned to a range site or windbreak suitability group.

Haploborolls-Rock Outcrop Complex, Steep

43—Haploborolls-Rock outcrop complex, steep. This complex consists of steep and very steep, cool soils and Rock outcrop on mountainsides and fans (fig. 8). The soils are extremely variable; about 50 to 70 percent of the unit, however, is stony and cobbly, dark colored soils that range from shallow to deep. These soils mainly have a surface layer and subsurface layer of sandy loam or loam that contain 10 to 25 percent cobbles and 20 to 35 percent stones. Stones that are on the surface are mainly boulders of granite, gneiss, and schist. About 30 to 50 percent of the mapped area is Rock outcrop. It is mainly on the steeper parts of the area, but it is scattered throughout.

Runoff is rapid, and the hazard of water erosion is severe.

These soils are used for a limited amount of grazing and are also used for wildlife habitat and watershed. Capability unit VIIe–1, dryland; Haploborolls in Stony Loam range site and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Figure 6.—**Profile of Garrett loam, 0 to 1 percent slopes.**

Haplustolls, Hilly

44—Haplustolls, hilly. These strongly sloping to

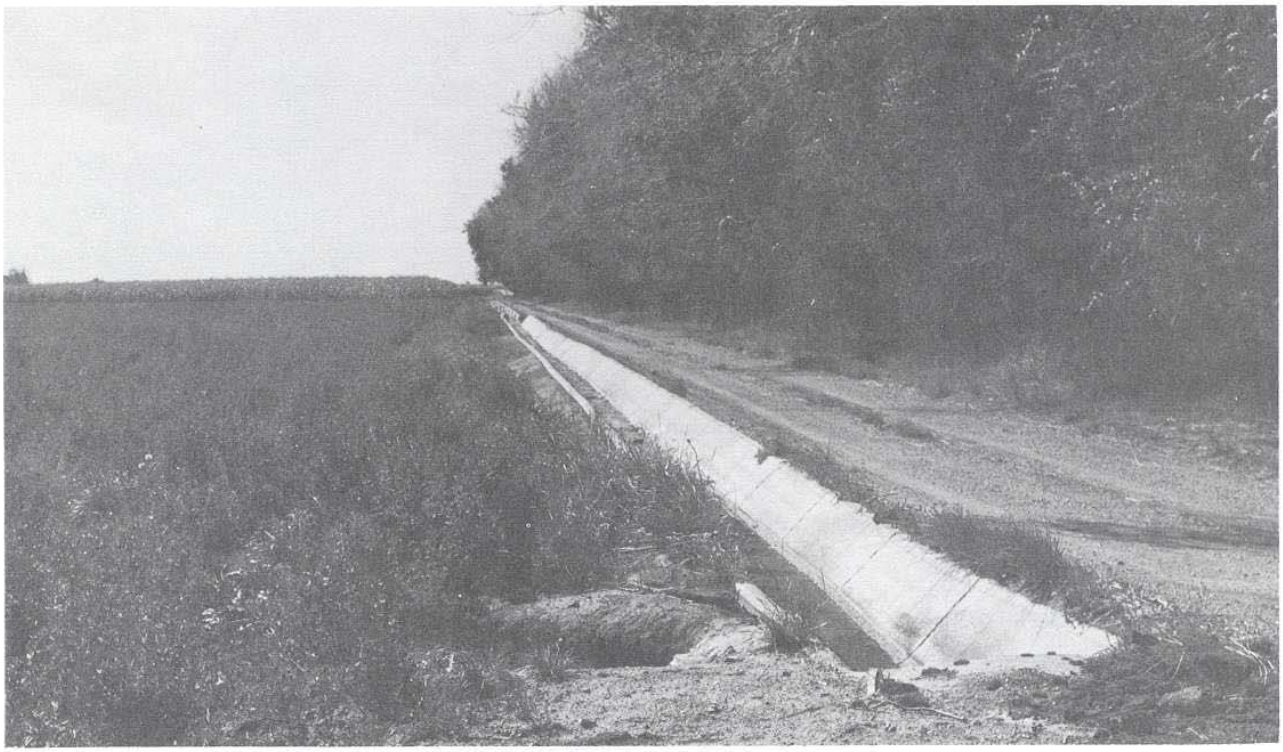

Figure 7.—**Area of Garrett loam, 1 to 3 percent slopes; field of alfalfa on left, and concrete lined irrigation ditch and windbreak on right.**

steep soils are on fans and lower side slopes of ridges in the foothills. The surface layer and subsurface layer are mainly loam or clay loam, but texture is extremely variable, often within short distances. Some areas of these soils have a cobbly and stony surface layer and subsurface layer. Content of cobbles ranges from 15 to 30 percent and content of stones ranges from 10 to 25 percent in these areas. Soil depth ranges from shallow to deep. A few areas of Rock outcrop are included in mapped areas.

Runoff is rapid, and the hazard of water erosion is moderate to severe. Gullies occur in places.

These soils are used for native grasses. Capability unit VIe–1, dryland; Loamy Foothill range site; not assigned to a windbreak suitability group.

Haplustolls-Rock Outcrop Complex, Steep

45—Haplustolls-Rock outcrop complex, steep. This complex consists of strongly sloping to steep soils and Rock outcrop. It is on colluvial slopes and hillsides. About 60 to 80 percent of the unit is extremely variable, dark colored soils that have a sandy loam, loam, or clay loam surface layer and subsurface layer. They contain about 10 to 20 percent cobbles and 10 to 20 percent stones. Sandstone boulders, 5 feet or more in diameter, cover about 10 to 35 percent of the surface in most areas. Depth to underlying material, generally sandstone or shale, ranges from 10 to 60 inches or more. About 20 to 40 percent of the mapped area is Rock outcrop. It is generally near the top and middle parts of the slopes, but it is intermingled throughout.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

These soils are suited to native grasses. They are also used for wildlife habitat. Capability unit VIIe–1, dryland; Haplustolls in Rocky Foothill range site and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Harlan Series

The Harlan series consists of deep, well drained soils that formed in alluvium weathered from reddish sandstone and shale. These soils are on terraces, fans, and valleysides. Elevation ranges from 5,200 to 6,000 feet. Slopes are 1 to 9 percent. The native vegetation is mainly blue grama, western and slender wheatgrass, Indian ricegrass, and fringed sage. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is dark reddish gray fine sandy loam about 7 inches thick. The subsoil is reddish brown light clay loam about 20 inches thick. The underlying material is light reddish brown loam.

Permeability is moderate, and the available water

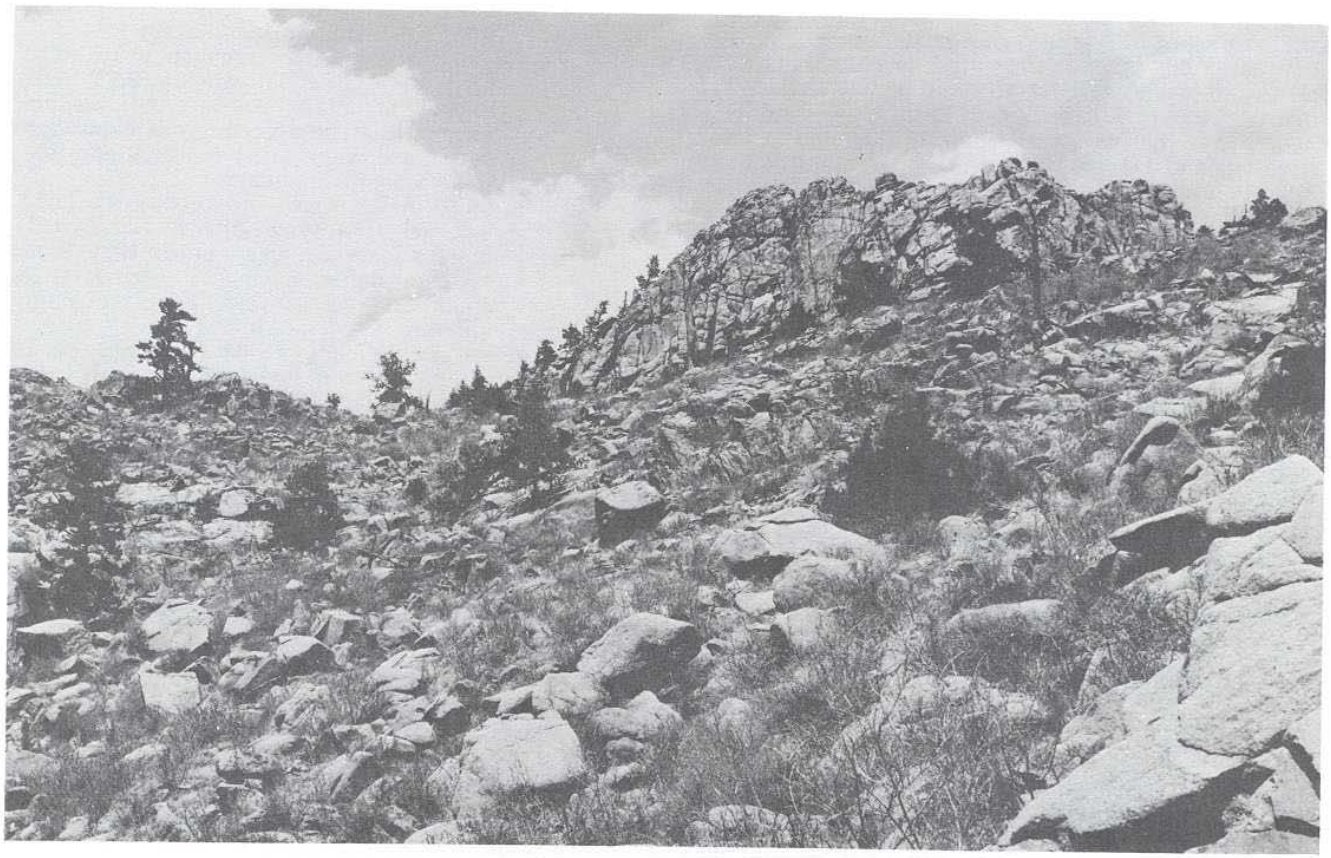

Figure 8.—**Area of Haploborolls-Rock outcrop complex, steep.**

capacity is high. Reaction is neutral above a depth of about 14 inches, mildly alkaline between depths of 14 and 27 inches, and moderately alkaline below a depth of 27 inches.

These soils are used mainly for irrigated and dry-farmed crops and pasture.

Representative profile of Harlan fine sandy loam, 1 to 3 percent slopes, in native grass, 2,500 feet east and 350 feet north of the southwest corner of sec. 32, T. 10 N., R. 70 W.:

A1—0 to 7 inches; dark reddish gray (5YR 4/2) fine sandy loam, dark reddish brown (5YR 3/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable; neutral; clear smooth boundary.

B2t—7 to 14 inches; reddish brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate and strong fine and medium subangular blocky; very hard, firm; thin nearly continuous clay films on ped faces; neutral; clear smooth boundary.

B3ca—14 to 27 inches; reddish brown (5YR 5/4) light clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; thin patchy clay films on ped faces; visible secondary calcium carbonate occurring as seams and spots; calcareous; mildly alkaline; clear smooth boundary.

Cca—27 to 60 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; visible secondary calcium carbonate occurring as seams and spots; calcareous; moderately alkaline.

Thickness of the mollic epipedon is 7 to 15 inches, and thickness of the solum is 15 to 40 inches. The A horizon is fine sandy loam or loam 3 to 10 inches thick. The B horizon is loam or light clay loam. The A and B horizons range from neutral to mildly alkaline. Depth to lime is 6 to 18 inches.

46—Harlan fine sandy loam, 1 to 3 percent slopes. This nearly level soil is on terraces, fans, and valley-sides. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that have a surface layer of loam or sandy clay loam and a few small areas that have a gravelly surface layer. Also included are a few small areas of Garrett, Otero, Connerton, and Barnum soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

If irrigated, this soil is suited to corn, barley, alfalfa, and wheat. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIe–2, irrigated, and IIIe–8, dryland; Loamy Foothill range site; not assigned to windbreak suitability group.

47—Harlan fine sandy loam, 3 to 9 percent slopes. This gently sloping to strongly sloping soil is on terraces, fans, and valleysides. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 20 to 24 inches.

Included with this soil in mapping are small areas of soils that have a surface layer of loam or sandy clay loam. Also included are a few small areas of soils that are more sloping or less sloping and a few small areas of Otero, Connerton, and Barnum soils.

Runoff is medium, and the hazard of erosion is moderate to severe.

If irrigated, this soil is well suited to pasture and, to a lesser extent, wheat, barley, and alfalfa. Under dryland management it is suited to pasture and native grasses and, to a lesser extent, wheat and barley. Capability units IVe–2, irrigated, and IVe–6, dryland; Loamy Foothill range site; not assigned to a windbreak suitability group.

Heldt Series

The Heldt series consists of deep, well drained soils that formed in alluvium from clay shale. These soils are on alluvial fans and valleysides. Elevation ranges from 4,800 to 5,500 feet. Slopes are 0 to 6 percent. The native vegetation is mainly western wheatgrass, blue grama, fringed sage, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown clay loam about 4 inches thick. The subsoil is grayish brown heavy clay loam and light brownish gray clay about 16 inches thick. The underlying material is light brownish gray clay.

Permeability is slow, and the available water capacity is high. Reaction is moderately alkaline above a depth of 6 inches and strongly alkaline below that depth.

These soils are mainly used for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Heldt clay loam, 0 to 3 percent slopes, in native grass, about 2,500 feet north of the southwest corner of sec. 14, T. 6 N., R. 68 W.:

A1—0 to 4 inches; grayish brown (2.5Y 5/2) heavy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

B1—4 to 6 inches; grayish brown (2.5Y 5/2) heavy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; slightly hard, firm; calcareous; moderately alkaline; clear smooth boundary.

B2—6 to 20 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate coarse and medium prismatic structure; many slickensides; very hard, very firm; strongly alkaline; clear smooth boundary.

Cca—20 to 60 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm; visible calcium carbonate occurring as spots and seams; calcareous; strongly alkaline.

The A horizon is clay loam or silty clay loam 4 to 10 inches thick. A B1 horizon is present in cultivated areas in some places. The B2 horizon is heavy clay loam to silty clay 10 to 35 inches thick. It has cracks up to one-half inch or more in size. The C horizon is clay or silty clay. Substrata of shale occur below a depth of 40 inches in some profiles, and some profiles are faintly mottled below a depth of 40 inches.

48—Heldt clay loam, 0 to 3 percent slopes. This nearly level soil is on fans and valleysides. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few areas of soils that are more sloping and a few areas of soils that have a surface layer of clay. Also included are small areas of Renohill and Ulm soils and a few small areas of soils in which shale is at a depth of 40 to 60 inches.

Runoff is medium. The hazard of wind erosion is slight, and the hazard of water erosion is slight to moderate.

If irrigated, this soil is suited to wheat, barley, alfalfa, and sugar beets and, to a lesser extent, corn and beans. Under dryland management it is suited to pasture and native grasses and, to a lesser extent, wheat and barley. Capability units IIIe–1, irrigated, and IVe–3, dryland; Clayey Plains range site; windbreak suitability group 3.

49—Heldt clay loam, 3 to 6 percent slopes. This gently sloping to strongly sloping soil is on fans and valleysides. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 18 inches.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping, a few small areas of soils that have a surface layer of clay, and a few areas of soils in which shale is at a depth of 40 to 60 inches. Also included are small areas of Renohill and Ulm soils.

Runoff is rapid. The hazard of wind erosion is moderate, and the hazard of water erosion is severe.

If irrigated, this soil is well suited to pasture and, to a lesser extent, wheat, barley, and alfalfa. Under dryland management it is suited to pasture or native grasses. Capability units IVe–1, irrigated, and VIe–1, dryland; Clayey Plains range site; windbreak suitability group 3.

Keith Series

The Keith series consists of deep, well drained soils

that formed in locally transported material weathered from siltstone. These soils are on uplands and high terraces. Elevation ranges from 5,800 to 6,200 feet. Slopes are 0 to 5 percent. The native vegetation is blue grama, western wheatgrass, and some forbs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown silty clay loam about 5 inches thick. The upper part of the subsoil is dark grayish brown light silty clay loam about 11 inches thick, and the lower part is light gray silt loam about 8 inches thick. The underlying material is light gray silt loam.

Permeability is moderate, and the available water capacity is high. Reaction is neutral above a depth of 16 inches, mildly alkaline between depths of 16 and 24 inches, and moderately alkaline below a depth of 24 inches.

These soils are mainly used for native grasses. A few areas are used for dryfarmed crops.

Representative profile of Keith silty clay loam, 0 to 3 percent slopes, in native grass, 660 feet south and 600 feet east of center of sec. 25, T. 12 N., R. 68 W.:

A1—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak thin platy and weak to moderate fine granular structure; hard, very friable; neutral; clear smooth boundary.

B1—5 to 9 inches; dark grayish brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; very thin patchy clay films on ped faces; neutral; clear smooth boundary.

B2t—9 to 16 inches; dark grayish brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; thin patchy clay films on ped faces; neutral; clear smooth boundary.

B3ca—16 to 24 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak to medium subangular blocky structure; slightly hard, very friable; few thin patchy clay films on ped faces; visible calcium carbonate as soft spots and seams; strongly effervescent; mildly alkaline.

Cca—24 to 60 inches; light gray silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; visible calcium carbonate as soft concretions and seams; strongly effervescent; moderately alkaline.

The A horizon is silt loam, silty clay loam, or clay loam 4 to 8 inches thick. The B horizon is silt loam or light silty clay loam 15 to 30 inches thick. Thickness of the mollic epipedon is 7 to 20 inches. Calcareous, soft siltstone occurs at a depth below 40 inches in some places.

50—Keith silty clay loam, 0 to 3 percent slopes. This nearly level soil is on uplands and high terraces.

Included with this soil in mapping are some small areas of soils that have a surface layer of silt loam or silty clay loam and a few areas of soils in which siltstone or shale is at a depth of 40 to 60 inches. Also included are a few small areas of soils that are more sloping, a few areas of Bainville and Altvan soils, and a few areas of wet soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for pasture and native grasses under dryland management. A few small areas are used for small grain, mainly wheat. Capability unit IIIe–6, dryland; Clayey Foothill range site; not assigned to a windbreak suitability group.

Kildor Series

The Kildor series consists of moderately deep, well drained soils that formed in material weathered from shale. These soils are on uplands and ridges and are underlain by soft shale at a depth of 20 to 40 inches. Elevation ranges from 7,500 to 9,500 feet. Slopes are 0 to 30 percent. The native vegetation is mainly slender wheatgrass, bluebunch wheatgrass, western wheatgrass, junegrass, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 18 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is grayish brown clay loam about 8 inches thick. The subsoil is light brownish gray clay about 16 inches thick. The underlying material is about 4 inches of clay that is underlain by shale.

Permeability is slow, and the available water capacity is low or medium. Reaction is mildly alkaline above a depth of 8 inches and moderately alkaline below that depth.

These soils are mainly used for native grasses. A few areas are used for irrigated hay.

Representative profile of Kildor clay loam, 0 to 6 percent slopes, in native grass, 300 feet northwest of the southeast corner of sec. 3, T. 11 N., R. 77 W.:

A1—0 to 8 inches; grayish brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak to moderate fine granular structure; soft, friable; very slightly effervescent; mildly alkaline; clear smooth boundary.

B2—8 to 24 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak to moderate medium and fine subangular blocky structure; very hard, very firm; strongly effervescent; moderately alkaline; clear smooth boundary.

C1ca—24 to 28 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm; visible calcium carbonate as soft spots; strongly effervescent; moderately alkaline; clear wavy boundary.

C2r—28 inches; weathered clay shale.

The A horizon is clay loam or clay 7 to 10 inches thick. The B horizon is heavy clay loam or light clay.

A Cca horizon is absent in some profiles. The A and B horizons range from neutral to moderately alkaline.

51—Kildor clay loam, 0 to 6 percent slopes. This nearly level to strongly sloping soil is on uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that have a surface layer of clay and small areas of soils in which gravel and cobbles are on the surface. Also included are a few small areas of soils in which shale is at a depth of less than 20 inches and at a depth of 40 to 60 inches and small areas of soils that are more sloping.

Runoff is medium, and the hazard of water erosion is moderate.

If irrigated, this soil is suited to pasture or hay. Under dryland management it is suited to pasture. It is also suited to native grasses. Capability units VIc–1, irrigated, and VIe–5, dryland; Mountain Shale range site; not assigned to a windbreak suitability group.

52—Kildor-Shale outcrop complex, 5 to 30 percent slopes. This complex consists of moderately sloping to steep soils on uplands. It is about 45 percent Kildor clay loam and about 35 percent Shale outcrop. Kildor clay loam is smoother and less sloping, and Shale outcrop is steeper. The Kildor soil has a profile similar to the one described as representative of the Kildor series, but the combined thickness of the surface layer and subsoil is about 20 inches.

Included with this soil in mapping are about 20 percent areas of soils that are similar to Kildor soil but in which shale is below a depth of 40 inches and areas of shallow soils in which shale is at a depth of less than 20 inches.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to pasture and native grasses. Capability unit VIIe–1, dryland; Kildor soil in Mountain Shale range site and Shale outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Kim Series

The Kim series consists of deep, well drained soils that formed in mixed alluvium. These soils are on fans and benches. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 15 percent. The native vegetation is mainly blue grama, western wheatgrass, and some forbs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light yellowish brown loam about 7 inches thick. The underlying material is pale yellow and light yellowish brown loam about 53 inches thick.

Permeability is moderate, and the available water capacity is high. Reaction is mildly alkaline above a depth of 7 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Kim loam, 5 to 9 percent slopes, in a cultivated area, about 100 feet west and 40 feet north of the southeast corner of the NE¼ sec. 36, T. 8 N., R. 69 W.:

Ap—0 to 7 inches; light yellowish brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) moist; moderate fine and very fine granular structure; soft, very friable; calcareous; mildly alkaline; clear smooth boundary.

C1—7 to 13 inches; pale yellow (2.5Y 7/3) loam, olive brown (2.5Y 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable; calcareous; moderately alkaline; gradual smooth boundary.

C2—13 to 40 inches; pale yellow (2.5Y 7/3) loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

C3—40 to 60 inches; light yellowish brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The A horizon is fine sandy loam, loam, or light clay loam 5 to 12 inches thick. The C horizon is loam or light clay loam. It is calcareous but lacks a zone of lime accumulation in most profiles. Sandstone bedrock is below a depth of 40 inches in some profiles.

53—Kim loam, 1 to 3 percent slopes. This nearly level soil is on uplands and fans. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 12 inches thick.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping, a few small areas of soils that have a surface layer of clay loam, and a few small areas of soils that have gravel on the surface. Also included are a few small areas of Fort Collins and Stoneham soils. A water table is within the root zone for part of the growing season in a few areas.

Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

If irrigated, this soil is suited to corn, sugar beets, beans, wheat, barley, and alfalfa. Under dryland management it is suited to pasture or native grasses and, to a lesser extent, wheat and barley. Capability units IIe–1, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

54—Kim loam, 3 to 5 percent slopes. This gently sloping soil is on uplands and fans. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 10 inches thick.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping and small areas of soils that have a surface layer of clay loam. A water table is within the root zone during the growing season in a few small areas. Also included are a few small areas of Fort Collins, Stoneham, and Thedalund soils.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to barley, alfalfa, and wheat and, to a lesser extent, corn and beans. Under

dryland management it is suited to pasture and native grasses. Capability units IIIe–2, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

55—Kim loam, 5 to 9 percent slopes. This strongly sloping soil is on uplands and fans. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that have a surface layer and subsoil of clay loam or silt loam and a few small areas of soils that have gravel on the surface. Also included are minor areas of Stoneham and Thedalund soils.

Runoff is rapid, and the hazard of erosion is severe.

If irrigated, this soil is well suited to pasture and, to a lesser extent, barley, alfalfa, and wheat. Under dryland management it is suited to pasture and native grasses. Capability units IVe–1, irrigated, and VIe–1, dryland; Loamy Plains range site; windbreak suitability group 1.

56—Kim-Thedalund loams, 3 to 15 percent slopes. This complex consists of gently sloping to moderately steep soils on uplands, fans, and valleysides. It is about 45 percent Kim loam and about 35 percent Thedalund loam. Kim loam is smoother and less sloping, and Thedalund loam is steeper. These soils have profiles similar to the ones described as representative of their respective series, but the surface layer is about 4 or 5 inches thick.

Included with these soils in mapping are a few small areas of Renohill and Midway soils, a few small outcrops and gravel knobs, and some small seep spots.

Runoff is rapid, and the hazard of erosion is severe.

These soils are mainly used for pasture and native grasses. Capability unit VIe–1, dryland; Loamy Plains range site; windbreak suitability group 1.

Kirtley Series

The Kirtley series consists of moderately deep, well drained soils that formed in material weathered from reddish brown sandstone and shale. These soils are on uplands and side slopes and are underlain by soft shale at a depth of 20 to 40 inches. Elevation ranges from 5,600 to 6,400 feet. Slopes are 3 to 15 percent. The native vegetation is mainly blue grama, side-oats grama, western wheatgrass, yucca, and rabbitbrush. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 47° to 50° F, and the frost-free season ranges from 115 to 130 days.

In a representative profile the surface layer is reddish brown loam about 4 inches thick. The subsoil is reddish brown heavy loam about 14 inches thick. Below this is light reddish brown loam about 8 inches thick that is underlain by soft sandstone and shale.

Permeability is moderate, and the available water capacity is medium. Reaction is mildly alkaline.

These soils are used mainly for native grasses.

Representative profile of Kirtley loam in an area of Kirtley-Purner complex, 5 to 20 percent slopes, in native grass, 70 feet south of access road in sec. 14, T. 10 N., R. 70 W.:

A1—0 to 4 inches; reddish brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, friable; mildly alkaline; abrupt smooth boundary.

B21t—4 to 11 inches; reddish brown (2.5YR 4/3) heavy loam, dark reddish brown (2.5YR 3/3) moist; moderate very fine subangular blocky structure; hard, friable; thin nearly continuous clay films; mildly alkaline; clear smooth boundary.

B22t—11 to 18 inches; reddish brown (2.5YR 5/4) heavy loam, dark reddish brown (5YR 3/4) moist; moderate fine prismatic structure parting to moderate medium subangular blocky; hard, friable; thin nearly continuous clay films; mildly alkaline; clear smooth boundary.

C1ca—18 to 26 inches; light reddish brown (2.5YR 6/4) loam, reddish brown (2.5YR 4/4) moist; massive; hard, friable; visible calcium carbonate as seams and streaks; strongly effervescent; 25 percent weathered red sandstone channers; moderately alkaline; abrupt smooth boundary.

C2r—26 to 60 inches; red sandstone.

Thickness of the mollic epipedon ranges from 7 to 15 inches. The A horizon is loam or fine sandy loam 3 to 6 inches thick. The B horizon is loam or light clay loam 9 to 20 inches thick. The A and B horizons range from neutral to mildly alkaline. Content of rock fragments ranges from 0 to 15 percent in the A and B horizons.

57—Kirtley loam, 3 to 9 percent slopes. This gently sloping or strongly sloping soil is on uplands and valleysides. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 20 inches and depth to sandstone is about 30 inches.

Included with this soil in mapping are some small areas of outcrops and some small areas of soils in which sandstone fragments are in the profile. Also included are small areas of soils that are more sloping or less sloping and small areas of Harlan and Purner soils.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is well suited to pasture and native grasses under dryland management. It is less well suited to wheat and barley. If irrigated, it is suited to barley, wheat, and alfalfa. It is also suited to pasture. Capability units IVe–1, irrigated, and IVe–3, dryland; Loamy Foothill range site; not assigned to a windbreak suitability group.

58—Kirtley-Purner complex, 5 to 20 percent slopes. This complex consists of strongly sloping to moderately steep soils on uplands and valleysides. It is about 45 percent Kirtley loam and about 40 percent Purner fine sandy loam. Kirtley loam is smoother and less sloping, and Purner soil is steeper. The Kirtley soil has the profile described as representative of the Kirtley series. The Purner soil has a profile similar to the one described as representative of the Purner series.

Included with these soils in mapping are some small

areas of soils that are similar to Kirtley and Purner soils but in which more sandstone fragments are in the profile. Also included are areas of Rock outcrop. These inclusions make up about 15 percent of the complex.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to pasture or native grasses. Capability unit VIe–1, dryland; Kirtley soil in Loamy Foothill range site and Purner soil in Shallow Foothill range site; not assigned to a windbreak suitability group.

LaPorte Series

The LaPorte series consists of shallow, well drained soils that formed in material weathered from limestone. These soils are on uplands and are underlain by limestone at a depth of 10 to 20 inches. Elevation ranges from 5,200 to 5,800 feet. Slopes are 3 to 30 percent. The native vegetation is mainly blue grama, western wheatgrass, needleandthread, yucca, and pricklypear cactus. Mean annual precipitation ranges from 13 to 16 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown loam about 9 inches thick. The underlying material is light brownish gray channery loam about 7 inches thick. Below this is limestone bedrock.

Permeability is moderate, and the available water capacity is low. Reaction is moderately alkaline.

These soils are used mainly for native grasses.

Representative profile of LaPorte loam in an area of LaPorte-Rock outcrop complex, 3 to 30 percent slopes, in native grass, about 1,712 feet north and 321 feet west of the southeast corner of sec. 1, T. 4 N., R. 70 W.:

A1—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine crumb structure; slightly hard, very friable; 5 percent limestone fragments; calcareous; moderately alkaline; clear smooth boundary.

Cca—9 to 16 inches; light brownish gray (10YR 6/2) channery loam; dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; some visible secondary calcium carbonate mostly as concretions; 30 percent limestone fragments; calcareous; moderately alkaline; gradual smooth boundary.

R—16 inches; weakly fractured limestone.

The A horizon is loam or fine sandy loam 5 to 16 inches thick. Content of rock fragments ranges from 5 to 35 percent.

59—LaPorte-Rock outcrop complex, 3 to 30 percent slopes. This complex consists of gently sloping to steep soils on uplands and ridges. It is about 45 percent LaPorte loam and about 35 percent Rock outcrop. LaPorte loam is commonly on the eastern side of ridges and is on the smoother parts of the western side, and Rock outcrop is commonly on ridgetops and on the western side, but is throughout the complex. Rock outcrop is mainly limestone or limy shale.

Included with this complex in mapping are about 20 percent areas of Kim, Minnequa, and Midway soils.

Runoff is rapid, and the hazard of erosion is severe.

This soil is suited to pasture and native grasses. It has been used to a large extent for strip mines because the underlying limestone is used in the manufacture of cement. Capability unit VIIe–1, dryland; LaPorte soil in Shallow Foothill range site, and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Larim Series

The Larim series consists of deep, well drained soils that formed in mixed alluvium. These soils are on fans, benches, and terrace edges and are underlain by very gravelly sand at a depth of 11 to 20 inches. Elevation ranges from 4,800 to 6,300 feet. Slopes are 5 to 40 percent. The native vegetation is mainly blue grama, needlegrasses, side-oats grama, snakeweed, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 47° to 49° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown gravelly sandy loam about 4 inches thick. The subsoil is brown gravelly sandy clay loam about 5 inches thick and pale brown very gravelly sandy loam about 6 inches thick. The underlying material is light yellowish brown very gravelly loamy sand.

Permeability is moderate above a depth of about 15 inches and very rapid below that depth. The available water capacity is low or medium. Reaction is neutral to mildly alkaline.

These soils are used for native grasses.

Representative profile of Larim gravelly sandy loam, 5 to 40 percent slopes, in native grass, 1,750 feet west and 2,500 feet north of the southeast corner of sec. 22, T. 12 N., R. 68 W.:

A1—0 to 4 inches; grayish brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable, nonsticky and nonplastic; 30 percent gravel; neutral; clear smooth boundary.

B2t—4 to 9 inches; brown (10YR 5/3) gravelly sandy clay loam, brown (10YR 4/3) moist; peds in upper part are coated with dark brown (10YR 3/3); weak medium subangular blocky structure; hard, friable; slightly sticky and slightly plastic; thin patchy clay films on peds; 35 percent gravel; neutral; clear wavy boundary.

B3ca—9 to 15 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few patchy clay films on peds; 45 percent gravel; calcareous; mildly alkaline; gradual smooth boundary.

IIC—15 to 60 inches; light yellowish brown

(10YR 6/4) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; nonsticky and nonplastic; 60 percent gravel; calcareous; mildly alkaline.

The A horizon is gravelly or very gravelly sandy loam or loam 3 to 5 inches thick. The B2 horizon is gravelly or very gravelly clay loam or sandy clay loam. The combined thickness of the A and B horizons ranges from 12 to 18 inches. Content of rock fragments in the solum ranges from 25 to 50 percent but is more than 35 percent in the B horizon. Reaction ranges from neutral to moderately alkaline.

60—Larim gravelly sandy loam, 5 to 40 percent slopes. This strongly sloping to steep soil is on fans, benches, and terrace edges.

Included with this soil in mapping are small areas of soils that have a surface layer and subsoil of gravelly loam to gravelly loamy sand. Also included are small areas of soils in which shale or sandstone is at a depth of 10 to 20 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is suited to pasture and native grasses. Some areas of this soil are used as sites for gravel pits. Capability unit VIe–4, dryland; Gravelly Foothill range site; windbreak suitability group 4.

Larimer Series

The Larimer series consists of deep, well drained soils that formed in material weathered from alluvium. These soils are on high terraces and fans and are underlain by sand and gravel at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,800 feet. Slopes are 1 to 10 percent. The native vegetation is mainly blue grama, western wheatgrass, needleandthread, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light brownish gray fine sandy loam about 4 inches thick. The subsoil is brown and light brown loam about 18 inches thick. The underlying material is about 8 inches of light gray gravelly sandy loam that is underlain by sand and gravel.

Permeability is moderate above a depth of about 22 inches and rapid or very rapid below that depth. The available water capacity is medium. Reaction is neutral above a depth of about 4 inches, mildly alkaline between depths of 4 and 18 inches, and moderately alkaline below a depth of 18 inches.

These soils are used mainly for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Larimer fine sandy loam, 1 to 3 percent slopes, in native grass, about 0.2 mile west and 600 feet south of the northeast corner of sec. 16, T. 9 N., R. 68 W.:

A1—0 to 4 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; strong very fine granular structure; soft, very friable; 5 percent gravel; neutral; clear smooth boundary.

B1—4 to 7 inches; brown (7.5YR 5/3) light loam, brown or dark brown (7.5YR 4/3) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable; 5 percent gravel; mildly alkaline; clear smooth boundary.

B2t—7 to 18 inches; brown (7.5YR 5/3) heavy loam, brown or dark brown (7.5YR 4/3) moist; moderate fine and medium prismatic structure parting to moderate medium and fine subangular blocky; hard, very friable; thin nearly continuous clay films on peds; 5 percent gravel; mildly alkaline; clear, wavy boundary.

B3ca—18 to 22 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, very friable; few thin patchy clay films on the horizontal and vertical faces of aggregates; 5 percent gravel; some visible calcium carbonate as concretions and as coatings on the gravel fragments; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—22 to 30 inches; light gray (10YR 7/2) gravelly sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; 20 percent gravel; visible secondary calcium carbonate as concretions, in thin seams and streaks, as coatings on the gravel fragments, and in finely divided forms; moderately alkaline; diffuse wavy boundary.

IIC2ca—30 to 60 inches; relatively clean gravel, cobbles, and sand, mainly of quartzite, gneiss, and granite; approximately 80 percent gravel and cobbles; small amount of calcium carbonate as coatings on the gravel and sand in the upper part; moderately alkaline.

The A horizon is loam, fine sandy loam, or sandy loam 3 to 11 inches thick. The B horizon is heavy loam or light clay loam. The A and B horizons range from neutral to moderately alkaline. Content of rock fragments ranges from 0 to 25 percent in the upper part of the profile and from 50 to 80 percent in the lower part.

61—Larimer fine sandy loam, 1 to 3 percent slopes. This nearly level soil is on terraces, fans, and benches. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of Altvan, Fort Collins, and Stoneham soils. Also included are a few small areas of soils that are more sloping or less sloping and a few small areas of soils that have a surface layer of loam or sandy clay loam. The surface layer is about 11 inches thick because deep plowing has mixed the surface layer and subsoil in irrigated areas.

Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

If irrigated, this soil is suited to barley, alfalfa, wheat, corn, and beans and, to a lesser extent, sugar

beets. Under dryland management it is well suited to pasture or native grasses and, to a lesser extent, wheat and barley. Capability units IIIe–5, irrigated, and IVe–5, dryland; Loamy Plains range site; windbreak suitability group 2.

62—Larimer-Stoneham complex, 3 to 10 percent slopes. This complex consists of gently sloping to strongly sloping soils on terraces, fans, and benches. It is about 35 percent Larimer fine sandy loam, about 25 percent Stoneham loam, and about 20 percent Cushman fine sandy loam. Larimer fine sandy loam is on side slopes and areas near terrace edges, Stoneham loam commonly has the more gentle slopes on terraces, and Cushman fine sandy loam is on side slopes.

Included with these soils in mapping are about 20 percent areas of Fort Collins, Larim, Altvan, and Satanta soils. Also included are some small areas of soils that are more sloping.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is well suited to pasture and native grasses under dryland management. If irrigated, it is suited to pasture and, to a lesser extent, barley, wheat, and alfalfa. Capability units IVe–1, irrigated, and VIe–2, dryland; Loamy Plains range site; windbreak suitability group 2.

Longmont Series

The Longmont series consists of deep, poorly drained soils that formed in alluvium mainly from clay shale. These soils are on flood plains, terraces, and valleys. Elevation ranges from 4,800 to 5,800 feet. Slopes are 0 to 3 percent. The native vegetation is mainly alkali sacaton, saltgrass, sedges, and other water-tolerant grasses. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light brownish gray clay about 17 inches thick. The underlying material is mottled pale olive clay.

Permeability is slow, and the available water capacity is high. Reaction is strongly alkaline above a depth of 40 inches and moderately alkaline below that depth.

These soils are used for native grasses.

Representative profile of Longmont clay, 0 to 3 percent slopes, in native grass, about 1,350 feet east and 50 feet north of the southwest corner of sec. 17, T. 6 N., R. 68 W.:

A11—0 to 7 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, very firm; strongly effervescent; strongly alkaline; clear smooth boundary.

A12—7 to 17 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, very firm; strongly effervescent; strongly alkaline; gradual wavy boundary.

C1cscag—17 to 40 inches; pale olive (5Y 6/3) clay, olive (5Y 4/3) moist; massive; very hard, very firm; common medium distinct mottles of yellowish brown (10 YR 5/6) moist; calcium sulfate accumulations in seams and streaks and calcium carbonate in spots; strongly effervescent; strongly alkaline; gradual wavy boundary.

C2cscag—40 to 60 inches; pale olive (5Y 6/3) clay, olive (5Y 5/3) moist; massive; very hard, very firm; common medium distinct mottles of olive (5Y 4/3 and 4/4) moist; calcium sulfate accumulations in seams and streaks and calcium carbonate in spots; strongly effervescent; moderately alkaline.

The A horizon is clay loam or clay 12 to 21 inches thick. The C horizon is heavy clay loam or clay. Reaction is strongly alkaline or very strongly alkaline in the surface layer but decreases with increasing depth. The water table is near the surface for part of every year.

63—Longmont clay, 0 to 3 percent slopes. This nearly level soil is on flood plains and upland valleys.

Included with this soil in mapping are some small areas of soils that are more sloping and a few small areas of soils that have a surface layer and subsurface layer of clay loam. Also included are a few small areas of soils in which gravel is at a depth of 40 to 60 inches.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to pasture or native grasses (fig. 9). Capability unit VIw–2, dryland; Salt Meadow range site; windbreak suitability group 4.

Loveland Series

The Loveland series consists of deep, somewhat poorly drained soils that formed in material weathered from alluvium. These soils are on terraces and flood plains and are underlain by sand and gravel at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,500 feet. Slopes are 0 to 1 percent. The native vegetation is mainly blue grama, bluegrass, and sedges. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is mottled dark grayish brown or grayish brown clay loam about 15 inches thick. The underlying material is 17 inches of grayish brown clay loam over sand, gravel, and cobbles.

Permeability is moderately slow above a depth of about 32 inches and very rapid below that depth. The available water capacity is medium to high. Reaction is mildly alkaline above a depth of about 8 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated and dry-farmed crops and for pasture.

Representative profile of Loveland clay loam, 0 to 1 percent slopes, in grass, 2,250 feet north and 600 feet west of the southeast corner of sec. 10, T. 6 N., R. 68 W.:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; weak to moderate fine gran-

Figure 9.—**Area of Longmont clay, 0 to 3 percent slopes.**

ular structure; hard, friable; common faint mottles; slightly effervescent; mildly alkaline; clear smooth boundary.

A12g—8 to 15 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, firm; common medium distinct light reddish brown (5YR 6/4) mottles; strongly effervescent; moderately alkaline; gradual smooth boundary.

C1g—15 to 32 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm; common medium distinct light reddish brown (5YR 6/4) mottles; strongly effervescent; moderately alkaline; gradual smooth boundary.

IIC2g—32 to 60 inches; mixed sand, gravel, and cobbles; light reddish brown (5YR 6/4) mottles.

The A horizon is loam or clay loam 12 to 20 inches thick. It is mottled in the lower part. The C1 horizon is loam or light clay loam. The A and C horizons range from neutral to moderately alkaline. Content of rock fragments is 0 to 15 percent in the upper part of the profile and 35 to 60 percent in the lower part.

64—Loveland clay loam, 0 to 1 percent slopes. This level soil is on low terraces and flood plains.

Included with this soil in mapping are a few small areas of soils that are more sloping, small areas of soils in which gravel is at a depth of 40 to 60 inches, and a few small areas of soils that have a surface layer of loam. Also included are small areas of Poudre soils.

Runoff is slow, and the hazard of water erosion is slight.

If irrigated, this soil is suited to barley and pasture. If drained, it is suited to corn and, to a lesser extent, sugar beets. Under dryland management it is well suited to pasture and native grasses. Capability units IIIw–1, irrigated, and Vw–1, dryland; Wet Meadow range site; windbreak suitability group 5.

Midway Series

The Midway series consists of shallow, well drained soils that formed in material weathered from shale. These soils are on uplands and are underlain by soft shale at a depth of 10 to 20 inches. Elevation ranges from 4,800 to 5,800 feet. Slopes are 5 to 25 percent. The native vegetation is blue grama, buffalograss, western wheatgrass, cactus, and fringed sage. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light olive brown clay loam about 4 inches thick. The sub-

surface layer is light olive brown heavy clay loam about 4 inches thick. The underlying material is light yellowish brown clay about 11 inches thick. Below this is soft shale.

Permeability is slow, and the available water capacity is low. Reaction is moderately alkaline.

Representative profile of Midway clay loam, 5 to 25 percent slopes, in native grass, about 1,000 feet north and 650 feet west of the southeast corner of sec. 3, T. 6 N., R. 69 W.:

A1—0 to 4 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; weak thick platy and moderate fine subangular blocky structure; slightly hard, firm; strongly effervescent; moderately alkaline; clear smooth boundary.

AC—4 to 8 inches; light olive brown (2.5Y 5/4) heavy clay loam, dark grayish brown (2.5Y 4/2) moist; weak to moderate medium subangular blocky structure; hard, firm; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—8 to 19 inches; light yellowish brown (2.5Y 6/4) clay, olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; very hard, very firm; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2r—19 to 60 inches; partly weathered, laminated shale.

The A horizon is clay loam to silty clay 4 to 10 inches thick. The C horizon is heavy clay loam to clay or silty clay. The A and C horizons range from mildly alkaline to strongly alkaline.

65—Midway clay loam, 5 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands.

Included with this soil in mapping are a few small areas of soils that have a surface layer of clay and a few small areas of soils that have gravel on the surface. Also included are small areas of Shale outcrop and Renohill soils.

Runoff is rapid, and the hazard of erosion is severe.

This soil is suited to pasture and native grasses. Capability unit VIe–3, dryland; Shaly Plains range site; windbreak suitability group 4.

Minnequa Series

The Minnequa series consists of moderately deep, well drained soils that formed in material weathered from limestone, marl, and limy shale. These soils are on uplands and are underlain by marl or soft limestone. Elevation ranges from 4,800 to 5,800 feet. Slopes are 3 to 15 percent. The native vegetation is mainly blue grama, wheatgrasses, buffalograss, snakeweed, and yucca. Mean annual precipitation ranges from 13 to 17 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is light brownish gray silt loam 3 inches thick. The underlying material is pale brown silt loam about 27 inches thick. Below this is marl, soft limestone, or limy shale.

Permeability is moderate, and the available water capacity is medium. Reaction is moderately alkaline.

These soils are used mainly for native grasses.

Representative profile of Minnequa silt loam, 3 to 9 percent slopes, in native grass, about 550 feet north and 1,500 feet west of the southeast corner of sec. 17, T. 5 N., R. 69 W.:

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable; calcareous; much disseminated calcium carbonate; moderately alkaline; clear smooth boundary.

AC—4 to 7 inches; light brownish gray (10YR 6/2) heavy silt loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak to moderate medium subangular blocky; slightly hard, friable; calcareous; much disseminated calcium carbonate; moderately alkaline; clear smooth boundary.

C1—7 to 34 inches; pale brown (10YR 6/3) heavy silt loam, brown (10YR 5/3) moist; weak medium and fine subangular blocky structure; slightly hard, friable; calcareous; much disseminated calcium carbonate and a few soft limestone fragments; moderately alkaline; gradual smooth boundary.

C2r—34 to 60 inches; partly weathered soft limestone and shale.

The A1 horizon is loam, silt loam, or light silty clay loam 3 to 5 inches thick. The C horizon is silt loam or light silty clay loam. Content of rock fragments, mainly small limestone fragments, is 0 to 5 percent.

66—Minnequa silt loam, 3 to 9 percent slopes. This gently sloping to strongly sloping soil is on uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that contain many gravel-sized limestone fragments. Also included are small areas of soils that have a surface layer and subsurface layer of silty clay loam, small areas of soils that are less sloping, and small areas of LaPorte and Kim soils.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of wind erosion is severe.

If irrigated, this soil is well suited to pasture and, to a lesser extent, barley, wheat, and alfalfa. Under dryland management it is suited to pasture and native grasses. Capability units IVe–1, irrigated, and VIe–1, dryland; Loamy Foothill range site; not assigned to a windbreak suitability group.

67—Minnequa-LaPorte complex, 3 to 15 percent slopes. This complex consists of gently sloping to strongly sloping soils on uplands and ridges. It is about 55 percent Minnequa silt loam and 30 percent LaPorte loam. Minnequa soils are smoother, and LaPorte soils are on ridgetops and are steeper.

Included with these soils in mapping are about 15 percent areas of Kim soils and limestone outcrops.

Runoff is medium to rapid, and the hazard of erosion is severe.

These soils are best suited to pasture and native grasses. Capability unit VIe–1, dryland; Minnequa soil in Loamy Foothill range site and LaPorte soil in Shallow Foothill range site; not assigned to a windbreak suitability group.

Miracle Series

The Miracle series consists of moderately deep, well drained soils that formed in material weathered from reddish brown sandstone. These soils are on uplands and are underlain by hard sandstone bedrock at a depth of 20 to 40 inches. Elevation ranges from 7,800 to 8,800 feet. Slopes are 5 to 25 percent. The native vegetation is mainly slender wheatgrass, fescues, junegrass, antennaria, and sages. Mean annual precipitation ranges from 13 to 16 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is reddish gray sandy loam about 6 inches thick. The subsoil is reddish brown sandy clay loam about 18 inches thick. Below this is hard sandstone.

Permeability is moderate, and the available water capacity is low. Reaction is neutral.

These soils are used for native grasses.

Representative profile of Miracle sandy loam, 5 to 25 percent slopes, in native grass, in SE¼ sec. 16, T. 11 N., R. 75 W.:

A1—0 to 6 inches; reddish gray (5YR 5/2) sandy loam, dark reddish brown (5YR 3/2) moist; moderate very fine granular structure; soft, very friable; 10 percent fine gravel; neutral; clear smooth boundary.

B1—6 to 10 inches; reddish brown (2.5YR 5/3) light sandy clay loam, dark reddish brown (2.5YR 3/4) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable; few thin patchy clay films on peds; 10 percent fine gravel; neutral; clear smooth boundary.

B2t—10 to 24 inches; reddish brown (2.5YR 5/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; thin nearly continuous clay films on peds; 15 percent fine gravel; neutral; gradual smooth boundary.

R—24 to 30 inches; hard, noncalcareous sandstone.

The A horizon is loam, sandy loam, or light sandy clay loam 4 to 9 inches thick. The B horizon is sandy clay loam. Thin C horizons are present in some places. Reaction is neutral or mildly alkaline. The soil is generally noncalcareous but has a thin calcareous C horizon immediately above the bedrock in some profiles.

68—Miracle sandy loam, 5 to 25 percent slopes. This strongly sloping to moderately steep soil is on uplands.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping and small areas of soils that have a surface layer of loam. Also included are small areas of soils that have a gravelly or stony surface layer and small areas of Pendergrass and Clergern soils.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is suited to pasture and native grasses. Capability unit VIe–6, dryland; Mountain Loam range site; not assigned to a windbreak suitability group.

Moen Series

The Moen series consists of moderately deep, well drained soils that formed in material weathered from granite and schist. These soils are on uplands and valleysides and are underlain by granite at a depth of 20 to 40 inches. Elevation ranges from 6,800 to 7,800 feet. Slopes are 5 to 30 percent. The native vegetation is mainly junegrass, slender wheatgrass, bluebunch wheatgrass, fescues, and some shrubs and scattered ponderosa pine. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is brown clay loam about 18 inches thick. Below this is granite bedrock.

Permeability is moderately slow, and the available water capacity is medium. Reaction is slightly acid above a depth of about 5 inches and neutral below that depth.

These soils are used mainly for native grasses and for recreation.

Representative profile of Moen loam in an area of Trag-Moen complex, 5 to 30 percent slopes, in native grass, near the center of sec. 25, T. 12 N., R. 72 W.:

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

B21t—5 to 10 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, firm; thin patchy clay films on peds; neutral; gradual smooth boundary.

B22t—10 to 23 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; moderate medium and fine subangular blocky structure; very hard, firm; thin patchy clay films on peds; as much as 20 percent rock fragments in lower 3 or 4 inches; neutral; gradual wavy boundary.

R—23 to 30 inches; granite bedrock.

The A horizon is fine sandy loam or loam 4 to 9 inches thick. The B2 horizon is heavy loam to clay loam. The A and B horizons range from slightly acid to neutral. Content of rock fragments, mainly granite, gravel, and cobbles, ranges from more than 10 to 25 percent but averages about 15 percent.

Moen soils are mapped only with Elbeth, Trag, and Wetmore soils in Larimer County Area.

Naz Series

The Naz series consists of deep, well drained soils that formed in material weathered mainly from granite. These soils are on terraces and valleysides. Elevation ranges from 7,500 to 9,000 feet. Slopes are 1 to 25 percent. The native vegetation is mainly scattered pine and an understory of junegrass, Idaho fescue, sagebrush, and other shrubs and forbs. Mean annual precipitation ranges from 15 to 20 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is very dark grayish brown and dark grayish brown sandy loam about 22 inches thick. The underlying material is brown sandy loam about 38 inches thick.

Permeability is moderately rapid, and the available water capacity is medium. Reaction is slightly acid above a depth of 22 inches and neutral below that depth.

These soils are used mainly for native grasses.

Representative profile of Naz sandy loam, 3 to 25 percent slopes, in native grass, about one mile west of the upper Cherokee Park Road in the southwest quarter of sec. 9, T. 11 N., R. 73 W.:

A11—0 to 5 inches; very dark grayish brown (10YR 3/2) sandy loam, very dark grayish brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; slightly acid; gradual smooth boundary.

A12—5 to 22 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; soft, very friable; slightly acid; gradual smooth boundary.

C—22 to 60 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; very weak and weak coarse subangular blocky structure; soft, very friable; 15 percent gravel; neutral.

The A horizon is sandy loam or light loam 9 to 30 inches thick. The C horizon is sandy loam or coarse sandy loam. Bedrock is at a depth of 40 to 60 inches in some places. Content of rock fragments, mainly granitic gravel, ranges to as much as 15 percent.

69—Naz sandy loam, 1 to 3 percent slopes. This nearly level soil is on terraces. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 25 inches thick.

Included with this soil in mapping are some small areas of soils that are more sloping and some small areas of soils that have a gravelly layer at a depth of 40 to 60 inches. Also included are a few small areas of soils in which bedrock is at a depth of 40 to 60 inches.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to pasture and native grasses. Some small areas are used for irrigated hay. Capability units VIc–1, irrigated, and VIe–6, dryland; Mountain Loam range site; not assigned to a windbreak suitability group.

70—Naz sandy loam, 3 to 25 percent slopes. This gently sloping to strongly sloping soil is on terraces and valleysides. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils in which granite bedrock is at a depth of 30 to 60 inches. Also included are a few small areas of soils in which gravel is at a depth of 40 to 60 inches and a few small areas of granite outcrop.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is suited to pasture and native grasses. Capability unit VIe–6, dryland; Mountain Loam range site; not assigned to a windbreak suitability group.

Nelson Series

The Nelson series consists of moderately deep, well drained soils that formed in material weathered from sandstone. These soils are on uplands and are underlain by soft sandstone at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,500 feet. Slopes are 0 to 15 percent. The native vegetation is mainly blue grama, side-oats grama, yucca, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light brownish gray fine sandy loam about 5 inches thick. The underlying material is light yellowish brown fine sandy loam about 20 inches thick. Below this is soft sandstone.

Permeability is moderately rapid, and the available water capacity is low. Reaction is moderately alkaline.

These soils are used mainly for native grasses, but some areas are used for irrigated and dryfarmed crops and for pasture.

Representative profile of Nelson fine sandy loam, 3 to 9 percent slopes, in native grass, about 450 feet east and 175 feet south of the northwest corner of sec. 23, T. 8 N., R. 68 W.:

A1—0 to 5 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to moderate very fine granular; soft, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1ca—5 to 16 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable; calcareous; visible secondary calcium carbonate as thin seams, streaks, and spots; moderately alkaline; clear wavy boundary.

C2ca—16 to 25 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, very friable; 10 percent partly disintegrated sandstone fragments; calcareous; visible secondary calcium carbonate as streaks and seams and on undersides of rock fragments; moderately alkaline; gradual smooth boundary.

C3r—25 to 60 inches; calcareous soft sandstone.

The A horizon is light loam or sandy loam 4 to 12 inches thick. The C horizon is sandy loam or fine

sandy loam. Depth to calcareous material is 0 to 4 inches.

71—Nelson fine sandy loam, 3 to 9 percent slopes. This gently sloping to moderately sloping soil is on uplands.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping. Also included are some small areas of Otero and Tassel soils.

Runoff is medium, and the hazard of erosion is severe.

If irrigated, this soil is suited to pasture and, to a lesser extent, barley and wheat. Under dryland management it is suited to pasture or native grasses. Capability units IVe–2, irrigated, and VIe–2, dryland; Sandy Plains range site; windbreak suitability group 2.

Newfork Series

The Newfork series consists of deep, somewhat poorly drained soils that formed in alluvium. These soils are on low terraces and flood plains and are underlain by sand and gravel at a depth of 10 to 20 inches. Elevation ranges from 7,800 to 8,800 feet. Slopes are 0 to 3 percent. The native vegetation is mainly timothy, redtop, sedges, rushes, and water-tolerant grasses. Mean annual precipitation ranges from 12 to 16 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 1-inch-thick layer of organic material is on the surface. The surface layer is mottled grayish brown sandy loam about 4 inches thick. The subsoil is mottled dark brown heavy sandy loam 6 inches thick. Below this is mottled sand and gravel.

Permeability is moderately rapid above a depth of about 10 inches and very rapid below that depth. The available water capacity is low. Reaction is slightly acid.

These soils are used for irrigated hay.

Representative profile of Newfork sandy loam, 0 to 3 percent slopes, in native grass, about 1,500 feet west and 1,300 feet south of the northeast corner of sec. 18, T. 11 N., R. 76 W.:

O1—1 inch to 0; undecomposed and partly decomposed organic material.

A1g—0 to 4 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; common medium distinct yellowish red (5YR 4/6) mottles; weak medium subangular blocky structure parting to weak fine and medium granular structure; slightly hard, very friable; 5 percent gravel; slightly acid; clear smooth boundary.

B2g—4 to 10 inches; dark brown (7.5YR 4/2) heavy sandy loam, dark brown (7.5YR 3/2) moist; moderate fine distinct red (2.5YR 5/8) mottles; moderate medium subangular blocky structure; hard, very friable; 10 percent gravel; slightly acid; gradual wavy boundary.

IICg—10 to 60 inches; sand and gravel; many medium distinct bright colored mottles; slightly acid.

The A horizon is loam, sandy loam, or sandy clay loam 3 to 10 inches thick. The B2g horizon is sandy loam or light sandy clay loam. The A and B horizons range from slightly acid to neutral. Content of rock fragments ranges from 0 to 15 percent in the upper part of the profile and from 35 to 70 percent in the lower part.

72—Newfork sandy loam, 0 to 3 percent slopes. This nearly level soil is on low terraces, flood plains, and fans.

Included with this soil in mapping are small areas of gravel bars. Also included are a few small areas of soils in which gravel and sand is at a depth of 20 to 40 inches and a few small areas of Foxcreek soils.

Runoff is slow, and the hazard of erosion is slight.

If irrigated, this soil is suited to hay or pasture. Capability unit VIw–1, irrigated; Mountain Meadow range site; not assigned to a windbreak suitability group.

Nunn Series

The Nunn series consists of deep, well drained soils that formed in alluvium. These soils are on terraces and alluvial fans. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 5 percent. The native vegetation is mainly blue grama, buffalograss, needlegrass, and wheatgrasses. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown light clay loam about 6 inches thick. The subsoil is grayish brown or pale brown clay loam about 23 inches thick. The underlying material is light yellowish brown clay loam.

Permeability is slow, and the available water capacity is high. Reaction is neutral above a depth of 10 inches, mildly alkaline between depths of 10 and 24 inches, and moderately alkaline below a depth of 24 inches.

These soils are used mainly for irrigated and dryfarmed crops and for pasture. A few areas are used for native grasses.

Representative profile of Nunn clay loam, 1 to 3 percent slopes, in grass, near the east quarter-corner of sec. 5, T. 6 N., R. 68 W.:

A1—0 to 6 inches; grayish brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable; noncalcareous; neutral; clear smooth boundary.

B1—6 to 10 inches; grayish brown (10YR 5/2) clay loam, very grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, very friable, plastic and sticky; few thin patchy clay films on peds; noncalcareous; neutral; clear smooth boundary.

B2t—10 to 24 inches; pale brown (10YR 6/3) heavy clay loam, dark brown (10YR

4/3) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky and very plastic; thin nearly continuous clay films on peds; noncalcareous; mildly alkaline; clear smooth boundary.

B3ca—24 to 29 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; very hard, firm, very plastic; few thin patchy films on ped faces; visible calcium carbonate occurring as small nodules; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—29 to 47 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, firm, sticky and plastic; visible calcium carbonate occurring as nodules, thin seams, and streaks; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—47 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; very hard, firm, sticky and plastic; some visible calcium carbonate but less than in the C1ca horizon; calcareous; moderately alkaline.

The A horizon is light clay loam or clay loam 10 to 12 inches thick in cultivated areas. The combined thickness of the A and B horizons ranges from 16 to 40 inches. The B2t horizon is heavy clay loam or light clay. Depth to calcareous material ranges from 10 to 30 inches. Sand and gravel are below a depth of 40 inches in some profiles. Some profiles have substrata with a redder hue.

73—Nunn clay loam, 0 to 1 percent slopes. This level soil is on high terraces and fans. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 35 inches.

Included with this soil in mapping are small areas of soils that are more sloping. Also included are a few small areas of Satanta, Fort Collins, and Ulm soils and a few small areas of soils that have a surface layer and subsoil of silty clay loam.

Runoff is slow, and the hazard of erosion is slight.

If irrigated, this soil is suited to corn, sugar beets, beans, barley, wheat, and alfalfa. Under dryland management it is suited to wheat or barley. It is also suited to pasture and native grasses. Capability units IIs–1, irrigated, and IIIc–1, dryland; Clayey Foothill range site; windbreak suitability group 1.

74—Nunn clay loam, 1 to 3 percent slopes. This nearly level soil is on high terraces and fans. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping and a few small areas of soils that have a surface layer and subsoil of silty clay loam. Also included are small areas of Satanta, Fort Collins, and Ulm soils.

Runoff is slow to medium, the hazard of wind erosion is slight, and the hazard of water erosion is moderate.

If irrigated, this soil is suited to corn, sugar beets, beans, barley, alfalfa, and wheat. Under dryland management it is suited to wheat and barley. It is also well suited to pasture or native grasses (fig. 10).

Figure 10.—Alfalfa bales on Nunn clay loam, 1 to 3 percent slopes.

Capability units IIe–1, irrigated, and IIIe–6, dryland; Clayey Foothill range site; windbreak suitability group 1.

75—Nunn clay loam, 3 to 5 percent slopes. This gently sloping soil is on high terraces and fans. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 24 inches.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping and a few small areas of soils that have a surface layer of light clay. Also included are a few small areas of Satanta and Ulm soils.

Runoff is medium. The hazard of water erosion is moderate, and the hazard of wind erosion is slight.

If irrigated, this soil is suited to barley, alfalfa, and wheat and, to a lesser extent, corn, sugar beets, and beans. Under dryland management it is suited to wheat or barley. It is also well suited to pasture and native grasses. Capability units IIIe–2, irrigated, and IIIe–7, dryland; Clayey Foothill range site; windbreak suitability group 1.

76—Nunn clay loam, wet, 1 to 3 percent slopes. This nearly level, somewhat poorly drained soil is on low terraces and alluvial fans, commonly adjacent to drainageways. This soil has a profile similar to the one described as representative of the series, but a seasonal high water table is at a depth of 20 to 30 inches during part of the growing season.

Included with this soil in mapping are a few small areas of soils that have a strongly alkaline surface layer and a few small areas of soils that are moderately well drained. Also included are a few areas of soils that have a surface layer of loam or clay and a few areas of soils that are less sloping.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to pasture and hay. If the water table is lowered by management practices, corn, sugar beets, wheat, and barley can be grown. Capability unit IIIw–1, irrigated; Wet Meadow range site; windbreak suitability group 5.

Otero Series

The Otero series consists of deep, well drained soils that formed in alluvium and wind-deposited material. These soils are on alluvial fans and terraces. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 15 percent. The native vegetation is mainly blue grama, needlegrass, bluestems, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is brown sandy loam about 4 inches thick. The underlying material is pale brown sandy loam about 13 inches thick over light brownish gray sandy loam.

Permeability is rapid, and the available water capacity is medium. Reaction is mildly alkaline above a depth of about 4 inches and moderately alkaline below that depth.

These soils are used mainly for native grasses and for dryfarmed crops. A few areas are used for irrigated crops.

Representative profile of Otero sandy loam in an area of Otero-Nelson sandy loams, 3 to 25 percent slopes, in native grass, about 300 feet south and 1,420 feet west of the northeast corner of sec. 11, T. 10 N., R. 68 W.:

A1—0 to 4 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable; calcareous; mildly alkaline; clear smooth boundary.

C1ca—4 to 17 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; hard, very friable; calcareous; visible calcium carbonate as few soft spots; moderately alkaline; gradual smooth boundary.

C2ca—17 to 60 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable; calcareous; visible calcium carbonate as few soft spots; moderately alkaline.

The A horizon is sandy loam or fine sandy loam 8 to 12 inches thick in cultivated areas. The C horizon is sandy loam or fine sandy loam. The soil is generally calcareous throughout, but the surface layer is leached in places. Distribution of lime in the profile is erratic. Soft sandstone is at a depth of 40 to 60 inches in some profiles.

77—Otero sandy loam, 0 to 3 percent slopes. This nearly level soil is on uplands and fans. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 10 to 12 inches thick.

Included with this soil in mapping are some small areas of soils that have a surface layer of loam or fine sandy loam. Also included are some areas of soils that are redder and a few small areas of Ascalon, Nelson, and Kim soils.

Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate.

If irrigated, this soil is suited to corn, barley, sugar beets, wheat, and beans. Under dryland management it is suited to pasture and native grasses and, to a lesser extent, wheat and barley. Capability units IIIe–5, irrigated, and IVe–5, dryland; Sandy Plains range site; windbreak suitability group 2.

78—Otero sandy loam, 3 to 5 percent slopes. This gently sloping soil is on uplands and fans. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 8 inches thick.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping. Also included are some small areas of soils in which sandstone is at a depth of 40 to 60 inches and a few small areas of Ascalon, Nelson, and Kim soils.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to barley, wheat, alfalfa, and pasture and, to a lesser extent, corn and beans. Under dryland management it is well suited to pasture and native grasses. Capability units IIIe–4, irrigated, and VIe–2, dryland; Sandy Plains range site; windbreak suitability group 2.

79—Otero sandy loam, 5 to 9 percent slopes. This strongly sloping soil is on uplands and fans.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping. Also included are a few small areas of Nelson, Kim, and Tassel soils.

Runoff is rapid, and the hazard of erosion is severe.

If irrigated, this soil is well suited to pasture and, to a lesser extent, wheat, barley, or alfalfa. Under dryland management it is suited to pasture or native grasses. Capability units IVe–2, irrigated, and VIe–2, dryland; Sandy Plains range site; windbreak suitability group 2.

80—Otero-Nelson sandy loam, 3 to 25 percent slopes. This complex consists of gently sloping to moderately steep soils on uplands. It is about 50 percent Otero sandy loam and 35 percent Nelson sandy loam. Otero sandy loam is less sloping at the top and near the base of the slope, and Nelson sandy loam is steeper. The Otero soil has the profile described as representative of the Otero series. The Nelson soil has a profile similar to the one described as representative of the Nelson series, but the surface layer is sandy loam.

Included with these soils in mapping are about 15 percent areas of Tassel soils and Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is severe.

These soils are suited to pasture or native grasses. Capability unit VIe–2, dryland; Sandy Plains range site; windbreak suitability group 3.

Paoli Series

The Paoli series consists of deep, well drained soils that formed in alluvium. These soils are on terraces and bottom lands. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 1 percent. The native vegetation is blue grama, bluestems, needlegrass, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 42 inches thick. The underlying material is brown fine sandy loam.

Permeability is moderately rapid, and the available water capacity is high. Reaction is mildly alkaline above a depth of 22 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated crops. Some areas are in native grass.

Representative profile of Paoli fine sandy loam, 0 to 1 percent slopes, in native grass, about 2,000 feet south and 100 feet east of the northeast corner of sec. 24, T. 5 N., R. 69 W.:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular and weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; calcareous; mildly alkaline; clear smooth boundary.

A12—8 to 30 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; calcareous; mildly alkaline; clear smooth boundary.

A13—30 to 42 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; calcareous; few streaks of visible secondary calcium carbonate and few calcium sulfate seams; moderately alkaline; clear smooth boundary.

Cca—42 to 60 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; calcareous; visible secondary calcium carbonate as seams and streaks; moderately alkaline.

The A horizon is sandy loam or fine sandy loam, but it is loam in some places. The C horizon is sandy loam to heavy loamy sand. Thickness of the mollic epipedon ranges from 20 to 50 inches. Reaction ranges from neutral to moderately alkaline.

81—Paoli fine sandy loam, 0 to 1 percent slopes. This level soil is on low terraces.

Included with this soil in mapping are a few small areas of soils that are more sloping. Also included are a few small areas of Caruso and Table Mountain soils and some gravel spots.

Runoff is slow. The hazard of water erosion is slight, and the hazard of wind erosion is moderate. This soil is flooded in places, especially near stream channels.

If irrigated, this soil is suited to corn, sugar beets, beans, barley, alfalfa, and wheat. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIs–2, irrigated, and IIIe–8, dryland; Overflow range site; windbreak suitability group 2.

Pendergrass Series

The Pendergrass series consists of shallow, well drained to somewhat excessively drained soils that formed in material weathered from reddish brown sandstone. These soils are on uplands and are underlain by hard sandstone at a depth of 10 to 20 inches. Elevation ranges from 7,800 to 8,800 feet. Slopes are 5 to 25 percent. The native vegetation is mainly wheatgrasses, junegrass, sage, and mountainmahogany. Mean annual precipitation ranges from 12 to 15 inches, mean annual air temperature ranges from 42° to 45° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is reddish brown fine sandy loam about 5 inches thick. The underlying material is reddish brown channery fine sandy loam about 10 inches thick. Below this is hard sandstone.

Permeability is rapid, and the available water capacity is low. Reaction is neutral.

These soils are used mainly for native grasses.

Representative profile of Pendergrass fine sandy loam in an area of Pendergrass-Rock outcrop complex, 15 to 25 percent slopes, in native grass, 1,000 feet west of the northwest corner of sec. 27, T. 12 N., R. 75 W.:

A1—0 to 5 inches; reddish brown (2.5YR 4/4)

fine sandy loam, dark reddish brown (2.5YR 3/4) moist; weak fine granular structure; soft, very friable; 10 percent sandstone fragments; calcareous; neutral; clear smooth boundary.

C1—5 to 9 inches; reddish brown (2.5YR 5/4) channery fine sandy loam, reddish brown (2.5YR 4/4) moist; weak fine granular and weak medium subangular blocky structure; slightly hard, very friable; 30 percent sandstone fragments; calcareous; neutral; gradual smooth boundary.

C2—9 to 15 inches; reddish brown (2.5YR 5/4) channery fine sandy loam, reddish brown (2.5YR 4/4) moist; massive; slightly hard, very friable; 50 percent sandstone fragments and flagstones; calcareous; neutral; clear smooth boundary.

R—15 inches; sandstone.

The A horizon is fine sandy loam or light loam 3 to 6 inches thick. The C horizon is fine sandy loam, sandy loam, or light loam. Content of rock fragments, mostly channery or larger, averages 35 to 70 percent. Reaction ranges from neutral to moderately alkaline.

82—Pendergrass-Rock outcrop complex, 15 to 25 percent slopes. This complex consists of moderately steep soils on uplands. It is about 50 percent Pendergrass fine sandy loam and about 35 percent Rock outcrop. Pendergrass fine sandy loam is near the top of side slopes and the less sloping areas near the base of side slopes, and Rock outcrop is steeper.

Included with this complex in mapping are about 15 percent areas of Miracle and Clergern soils. Also included are some small areas of soils that are similar to the Pendergrass soil but in which bedrock is somewhat deeper and vegetation is mixed conifers.

Runoff is rapid, and the hazard of erosion is severe.

This complex is suited to native grasses. Capability unit VIIs–1, dryland; Pendergrass soil in Rocky Loam range site and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Pinata Series

The Pinata series consists of deep, well drained soils that formed in material weathered from sandstone and shale. These soils are on mountainsides and ridges. Elevation ranges from 5,800 to 6,500 feet. Slopes are 15 to 45 percent. The native vegetation is mainly ponderosa pine and some juniper and oak brush. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 46° to 48° F, and the frost-free season ranges from 120 to 135 days.

In a representative profile a 1-inch-thick layer of organic material is on the surface. The surface layer is dark brown stony sandy loam about 2 inches thick. The subsurface layer is pinkish gray stony light sandy loam about 8 inches thick. The subsoil is reddish brown stony clay about 12 inches thick and yellowish red stony clay loam about 20 inches thick. Below this is hard sandstone.

Permeability is slow, and the available water capacity is medium. Reaction is neutral.

These soils are used for recreation, building sites, quarry sites, and limited grazing.

Representative profile of Pinata stony sandy loam in an area of Pinata-Rock outcrop complex, 15 to 45 percent slopes, in forest, about 1,500 feet west of the center of sec. 34, T. 5 N., R. 70 W.:

O1—1 inch to 0; partly decayed pine needles and leaves.

A1—0 to 2 inches; dark brown (7.5YR 4/2) stony sandy loam, very dark brown (7.5YR 2/2) moist; weak medium subangular blocky and weak fine granular structure; soft, very friable; about 35 percent stones and gravel; neutral; clear smooth boundary.

A2—2 to 10 inches; pinkish gray (7.5YR 6/2) stony light sandy loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; about 35 percent stones; neutral; clear smooth boundary.

B2t—10 to 22 inches; reddish brown (5YR 5/4) stony clay, reddish brown (5YR 4/4) moist; moderate medium and coarse subangular blocky structure; very hard, very firm; thin nearly continuous clay films on peds; about 40 percent stones; neutral; clear wavy boundary.

B3—22 to 42 inches; yellowish red (5YR 5/6) stony clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; very hard, firm; thin patchy clay films on peds; about 45 percent stones; neutral; gradual smooth boundary.

R—42 to 60 inches; hard sandstone.

The A1 horizon is sandy loam or heavy loamy sand 1 to 4 inches thick. The A2 horizon is light sandy loam or loamy sand 6 to 12 inches thick. The B2t horizon is heavy clay loam or clay. Depth to bedrock ranges from 40 to 60 inches or more. Content of rock fragments, mainly flagstone, ranges from 35 to 80 percent.

83—Pinata-Rock outcrop complex, 15 to 45 percent slopes. This complex consists of moderately steep to steep soils on mountainsides and ridges. It is about 50 percent Pinata stony sandy loam and about 35 percent Rock outcrop. Pinata stony sandy loam is smoother and less sloping, and Rock outcrop is commonly steeper and on west-facing slopes but occurs throughout.

Included with this complex in mapping are about 15 percent areas of Purner soils and soils that are similar to the Pinata soil but in which bedrock is at a depth of less than 40 inches.

Runoff is rapid, and the hazard of erosion is severe.

This complex is used for forest and for limited grazing for cattle. Many areas are used as building sites and as sites for quarrying building stone. Capability unit VIIs–1, dryland; Pinata soil in woodland suitability group 6x1; not assigned to a range site or windbreak suitability group.

Poudre Series

The Poudre series consists of deep, somewhat poorly

drained or poorly drained soils that formed in alluvium. These soils are on terraces, flood plains, and drainageways. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 1 percent. The native vegetation is sedges, bluegrass, timothy, and other water-tolerant grasses and forbs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is gray and grayish brown fine sandy loam about 30 inches thick. The subsoil is light brownish gray fine sandy loam about 30 inches thick.

Permeability is moderately rapid, and the available water capacity is high. Reaction is moderately alkaline.

These soils are used mainly for hay and grazing. A few areas are used for irrigated crops and pasture.

Representative profile of Poudre fine sandy loam, 0 to 1 percent slopes, in native grass, about 100 feet east of the west quarter corner of sec. 34, T. 8 N., R. 69 W.:

A11—0 to 10 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, very friable; nonsticky and nonplastic; crushed soil surface feels slippery and soaplike; many medium and large mica flakes; calcareous; moderately alkaline; clear wavy boundary.

A12—10 to 30 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; common medium distinct dark yellowish brown (10YR 4/4 and 4/6) moist mottles; weak medium subangular blocky structure parting to coarse granular; crushed soil surface feels slippery and soaplike; many fine to large mica flakes; calcareous; moderately alkaline; gradual smooth boundary.

B2g—30 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; many large prominent light yellowish brown (10YR 6/4) moist mottles; massive; slightly hard, friable; nonsticky and nonplastic; crushed soil surface feels slippery and soaplike; many fine to large mica flakes; calcareous; moderately alkaline.

The A horizon ranges from fine sandy loam to sandy loam 20 to 40 inches thick. Thickness of the mollic epipedon is 24 to 50 inches. Content of rock fragments ranges from 0 to 15 percent. Reaction ranges from mildly alkaline to moderately alkaline. Gravel is at a depth of 40 to 60 inches in some profiles.

84—Poudre fine sandy loam, 0 to 1 percent slopes. This level soil is on low terraces and flood plains.

Included with this soil in mapping are a few small areas of soils that are more sloping. Also included are a few areas of soils in which gravel is at a depth of less than 40 inches, a few gravel bars, and a few small areas of Loveland, Caruso, and Paoli soils.

Runoff is slow, and the hazard of erosion is slight.

If irrigated, this soil is suited to pasture and hay. Barley, alfalfa, corn, and sugar beets can be grown if the water table is lowered. The soil is also well suited to pasture and native grasses. Capability unit IVw–1, irrigated; Wet Meadow range site; windbreak suitability group 5.

Purner Series

The Purner series consists of shallow, well drained soils that formed in material weathered from reddish brown sandstone. These soils are on uplands and are underlain by sandstone at a depth of 10 to 20 inches. Elevation ranges from 5,800 to 6,400 feet. Slopes are 1 to 30 percent. The native vegetation is mainly blue grama, wheatgrasses, mountainmahogany, and some other forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 47° to 49° F, and the frost-free season ranges from 115 to 130 days.

In a representative profile the surface layer is reddish brown fine sandy loam about 7 inches thick. The underlying material is light reddish brown fine sandy loam about 7 inches thick. Below this is hard reddish brown sandstone.

Permeability is moderate, and the available water capacity is low. Reaction is mildly alkaline above a depth of about 7 inches and moderately alkaline below that depth.

These soils are used mainly for native grasses.

Representative profile of Purner fine sandy loam, 1 to 9 percent slopes, in native grass, about 1,000 feet north and 650 feet west of the southwest corner of sec. 22, T. 10 N., R. 70 W.:

A1—0 to 7 inches; reddish brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular and weak to moderate medium granular structure; slightly hard, very friable; calcareous; mildly alkaline; clear smooth boundary.

Cca—7 to 14 inches; light reddish brown (5YR 6/3) fine sandy loam, reddish brown (5YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable; calcareous; visible secondary calcium carbonate as seams and streaks and finely divided forms; moderately alkaline; clear smooth boundary.

R—14 to 60 inches; hard reddish brown sandstone.

The A horizon is sandy loam or fine sandy loam 6 to 12 inches thick. Content of rock fragments, mainly gravel-size sandstone, ranges from 0 to 15 percent. The A horizon is leached of lime for a few inches in places. The zone of lime accumulation is immediately above or in the upper part of the bedrock in places.

85—Purner fine sandy loam, 1 to 9 percent slopes. This nearly level to strongly sloping soil is on uplands and ridges. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small areas of soils that have a surface layer of loam. Also included are small areas of soils that have more stones in the surface layer, small areas of Rock outcrop, and a few small areas of Kirtley soils.

Runoff is rapid, and the hazard of erosion is severe.

This soil is suited to pasture and native grasses.

Capability unit VIe–3, dryland; Shallow Foothill range site; not assigned to a windbreak suitability group.

86—Purner-Rock outcrop complex, 10 to 50 percent slopes. This complex consists of moderately steep or steep soils on uplands and ridges. It is about 55 percent Purner fine sandy loam and about 30 percent Rock outcrop. Purner fine sandy loam is smoother and less sloping, and Rock outcrop is steeper commonly on the western side of ridges.

Included with this soil in mapping is about 15 percent areas of Kirtley soils.

Runoff is rapid, and the hazard of erosion is severe.

This soil is suited to native grasses. Capability unit VIIe–1, dryland; Purner soil in Shallow Foothill range site and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Ratake Series

The Ratake series consists of shallow, well drained or somewhat excessively drained soils that formed in material weathered from granite, schist, or phyllite. These soils are on upland ridges and mountainsides and are underlain by weathered phyllite, schist, or weathered granite at a depth of 10 to 20 inches. Elevation ranges from 6,800 to 8,500 feet. Slopes are 1 to 60 percent. The native vegetation is mainly blue grama, side-oats grama, slender wheatgrass, bluebunch wheatgrass, mountainmahogany, and sage. Mean annual precipitation ranges from 14 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile the surface layer is reddish gray channery loam about 10 inches thick. The subsoil is reddish brown very channery loam about 5 inches thick. The underlying material is weathered phyllite or phyllite schist.

Permeability is moderate, and the available water capacity is low. Reaction is neutral.

These soils are mainly used for native grasses.

Representative profile of Ratake channery loam in an area of Ratake-Rock outcrop complex, 25 to 55 percent slopes, in native grass, about 2,350 feet east of the southwest corner of sec. 5, T. 8 N., R. 70 W.:

A1—0 to 10 inches; reddish gray (5YR 5/2) channery loam, dark reddish brown (5Y 3/2) moist; strong fine granular and crumb structure; soft, very friable; 20 percent soft phyllite channers; very high mica content; neutral; clear smooth boundary.

B2—10 to 15 inches; reddish brown (5YR 5/3) very channery loam, reddish brown (5YR 4/3) moist; moderate fine subangular blocky structure parting to strong fine granular; soft, very friable; 60 percent phyllite channers; very high mica content; neutral; diffuse boundary.

Cr—15 to 25 inches; weathered phyllite or phyllitic schist; coarse fragments are weathered and can be crushed in the hand with some difficulty but without significant contributions to the fine parts of the soil on first and second breakages; horizon can be penetrated with a spade with difficulty; very high mica content.

The A horizon is loam or sandy loam 7 to 20 inches thick. The B2 horizon is absent in some profiles. Content of rock fragments, mainly phyllite, schist, or granite ¼ inch to 2 inches in size, ranges from 35 to 80 percent.

87—Ratake-Rock outcrop complex, 25 to 55 percent slopes. This complex consists of steep or very steep soils on mountainsides and ridges. It is about 60 percent Ratake channery loam and about 30 percent Rock outcrop. Ratake channery loam is less steep, and Rock outcrop is throughout the complex but commonly is near ridgetops and is steeper.

Included with this soil in mapping is about 10 percent areas of Breece soils along drainageways.

Runoff is rapid, and the hazard of water erosion is severe.

This soil is suited to native grasses. Capability unit VIIe–1, dryland; Rocky Loam range site; not assigned to a windbreak suitability group.

Redfeather Series

The Redfeather series consists of shallow, well drained soils that formed in material weathered from granite. These soils are on ridges and mountainsides and are underlain by granite bedrock at a depth of 10 to 20 inches. Elevation ranges from 8,500 to 9,500 feet. Slopes are 5 to 50 percent. The native vegetation is mainly forest of lodgepole pine, spruce, and some aspen and a thin understory of grass. Mean annual precipitation ranges from 15 to 20 inches, mean annual air temperature ranges from 40° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 2-inch-thick layer of organic material is on the surface. The surface layer is dark grayish brown and light brownish gray sandy loam about 8 inches thick. The subsoil is brown gravelly sandy loam about 4 inches thick and reddish brown gravelly sandy clay loam about 5 inches thick. Below this is hard granite bedrock.

Permeability is moderately rapid, and the available water capacity is low. Reaction is medium acid above a depth of about 1 inch, strongly acid to a depth of about 12 inches, and medium acid below a depth of 12 inches.

These soils are used mainly for forest and recreation.

Representative profile of Redfeather sandy loam, 5 to 50 percent slopes, in forest, approximately 1,300 feet south and 1,000 feet west of the northeast corner of sec. 21, T. 11 N., R. 74 W.:

O1—2 inches to 1 inch; undecomposed organic material, mainly needles, bark, and twigs and remains of understory plants.

O2—1 inch to 0; partly decomposed organic material like that in the O1 horizon.

A1—0 to 1 inch; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; noncalcareous; more than 10 percent gravel and stones; medium acid; clear smooth boundary.

A2—1 inch to 8 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish

brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; about 15 percent gravel and stones; strongly acid; abrupt smooth boundary.

A&B—8 to 12 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable; few patchy clay films on peds; about 30 percent gravel and stones; strongly acid; clear wavy boundary.

B2t—12 to 17 inches; reddish brown (5YR 5/4) gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; slightly hard, firm; thin patchy clay films on peds; about 35 percent gravel and 10 percent cobbles; medium acid; gradual wavy boundary.

R—17 to 24 inches; hard granite bedrock.

The A1 horizon is sandy loam or gravelly sandy loam 1 inch to 3 inches thick. The A2 horizon is sandy loam or gravelly sandy loam 5 to 10 inches thick. The B2t horizon is gravelly or very gravelly sandy clay loam. Content of rock fragments, mainly fine granitic gravel and cobbles, in the solum ranges from 35 to 80 percent. Reaction ranges from strongly acid to slightly acid.

88—Redfeather sandy loam, 5 to 50 percent slopes. This strongly sloping to steep soil is on mountainsides and ridges.

Included with this soil in mapping are some small areas of shallow soils that have a darker colored surface layer. Also included are a few small areas of Schofield and Naz soils and areas of Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is suited to woodland and forestry purposes and to recreation. Some areas are used as sites for summer homes. Capability unit VIIs–1, dryland; woodland suitability group 6d2; not assigned to a range site or windbreak suitability group.

Renohill Series

The Renohill series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. These soils are on uplands and are underlain by soft shale at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 15 percent. The native vegetation is mainly blue grama, buffalograss, western wheatgrass, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is pale brown clay loam about 3 inches thick. The subsoil is pale brown heavy clay loam about 4 inches thick and light yellowish brown clay about 12 inches thick. The underlying material is light yellowish brown clay loam about 10 inches thick. Below this is soft shale.

Permeability is slow, and the available water capacity is medium. Reaction is mildly alkaline above a depth of 12 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Renohill clay loam, 3 to 9 percent slopes, in grass, 200 feet north and 700 feet west of the southeast corner of sec. 12, T. 6 N., R. 69 W.:

A1—0 to 3 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

B1—3 to 7 inches; pale brown (10YR 6/3) heavy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; very hard, friable; mildly alkaline; clear smooth boundary.

B2t—7 to 12 inches; light yellowish brown (2.5Y 6/3) clay, olive brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; thin nearly continuous clay films on ped faces; mildly alkaline; clear smooth boundary.

B3ca—12 to 19 inches; light yellowish brown (2.5Y 6/3) light clay, light olive brown (2.5Y 5/3) moist; weak medium angular and subangular blocky structure; extremely hard, very firm; thin patchy clay films on ped faces; calcareous; visible secondary calcium carbonate as soft spots; moderately alkaline; gradual smooth boundary.

C1ca—19 to 29 inches; light yellowish brown (2.5Y 6/3) heavy clay loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure; very hard, friable; calcareous; visible secondary calcium carbonate as soft spots; moderately alkaline; gradual smooth boundary.

C2r—29 to 60 inches; calcareous clay shale.

The A horizon is clay loam or silty clay loam 6 to 11 inches thick in cultivated areas. A B1 horizon is present in some places. The B2t horizon is heavy clay loam, heavy silty clay loam, clay, or silty clay. The combined thickness of the A and B horizons ranges from 15 to 30 inches. Depth to calcareous material generally ranges from 6 to 20 inches, but some pedons are weakly calcareous throughout.

89—Renohill clay loam, 0 to 3 percent slopes. This nearly level soil is on uplands. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 22 inches.

Included with this soil in mapping are a few small areas of soils that are more sloping and a few small areas of soils that have gravel on the surface. Also included are a few small areas of Ulm, Heldt, and Midway soils.

Runoff is medium, and the hazard of erosion is slight to moderate.

If irrigated, this soil is well suited to pasture and,

to a lesser extent, wheat, barley, beans, and corn. Under dryland management it is suited to pasture and native grasses and, to a lesser extent, wheat and barley. Capability units IIIe–1, irrigated, and IVe–3, dryland; Clayey Plains range site; windbreak suitability group 3.

90—Renohill clay loam, 3 to 9 percent slopes. This gently sloping to strongly sloping soil is on uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small areas of soils that are more sloping or less sloping and some small areas of soils that have a gravelly surface layer. Also included are small areas of Ulm, Heldt, Midway, and Thedalund soils.

Runoff is rapid, and the hazard of water erosion is severe.

If irrigated, this soil is suited to pasture and, to a lesser extent, wheat, barley, and alfalfa. Under dryland management it is suited to pasture and native grasses. Capability units IVe–1, irrigated, and VIe–1, dryland; Clayey Plains range site; windbreak suitability group 3.

91—Renohill-Midway clay loams, 3 to 15 percent slopes. This complex consists of gently sloping to moderately steep soils on uplands and ridges. It is about 55 percent Renohill clay loam and about 30 percent Midway clay loam. Renohill clay loam is smoother near the base of the slope, and Midway clay loam is steeper near ridgetops.

Included with these soils in mapping are about 15 percent areas of Ulm and Heldt soils, Shale outcrop, and gravel knobs.

Runoff is rapid, and the hazard of water erosion is severe.

These soils are suited to pasture or native grasses. Capability unit VIe–1, dryland; Renohill soil in Clayey Plains range site and Midway soil in Shaly Plains range site; both soils in windbreak suitability group 3.

Riverwash

92—Riverwash. This unit is highly variable, mixed, water-washed sand and gravel deposits, commonly next to stream channels. These areas are flooded each year, generally in spring or summer. In some places willow trees protect the soil against erosion along the streambanks. Forage production is little and there is little value for grazing. These areas provide some shelter and habitat for wildlife. Capability unit VIIIw–1, dryland; not assigned to a range site or windbreak suitability group.

Rock Outcrop

93—Rock outcrop. This mapping unit is bare or nearly bare rock. Included in mapping are areas of shallow and very shallow soils, mainly around the edges of the mapped areas.

Runoff is rapid. The hazard of water erosion is severe on the included soils and in adjacent areas that receive runoff.

This unit is used mainly for wildlife habitat and esthetic purposes. Capability unit VIIIs–1, dryland; not assigned to a range site or windbreak suitability group.

Satanta Series

The Satanta series consists of deep, well drained soils that formed in mixed alluvial and wind-deposited material. These soils are on uplands and high terraces. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 9 percent. The native vegetation is mainly blue grama, buffalograss, western wheatgrass, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is brown clay loam and pale brown loam about 16 inches thick. The underlying material is very pale brown loam about 21 inches thick over very pale brown fine sandy loam.

Permeability is moderate, and the available water capacity is high. Reaction is mildly alkaline above a depth of 18 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated and dryfarmed crops and for pasture.

Representative profile of Satanta loam, 1 to 3 percent slopes, in cropland, about 50 feet west and 50 feet north of the southeast corner of sec. 4, T. 5 N., R. 69 W.:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

B1—7 to 12 inches; brown (10YR 5/3) heavy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; mildly alkaline; clear smooth boundary.

B2t—12 to 18 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm; thin patchy clay films on peds; mildly alkaline; clear smooth boundary.

B3ca—18 to 23 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, friable; fine thin patchy clay films; effervescent; visible secondary calcium carbonate as soft masses and spots; moderately alkaline; clear smooth boundary.

C1ca—23 to 44 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable; violently effervescent; visible secondary calcium carbonate as spots and seams; moderately alkaline; gradual smooth boundary.

C2ca—44 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; violently effervescent; visible secondary calcium carbonate as seams and streaks; moderately alkaline.

The A horizon is loam or light clay loam 4 to 11 inches thick. The B horizon is loam or light clay loam. Thickness of the mollic epipedon ranges from 7 to 18 inches. Reaction ranges from neutral to moderately alkaline. Depth to calcareous material ranges from 15 to 20 inches.

94—Satanta loam, 0 to 1 percent slopes. This level soil is on terraces and uplands. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 24 inches.

Included with this soil in mapping are a few areas of soils that are more sloping. Also included are small areas of Fort Collins and Nunn soils.

Runoff is slow, and the hazard of erosion is slight.

If irrigated, this soil is well suited to corn, sugar beets, beans, alfalfa, barley, and wheat. Under dryland management it is suited to wheat and barley. It is also well suited to pasture or native grasses. Capability units I, irrigated, and IIIc–1, dryland; Loamy Foothill range site; windbreak suitability group 1.

95—Satanta loam, 1 to 3 percent slopes. This nearly level soil is on terraces and uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping. Also included are a few small areas of Fort Collins, Nunn, and Altvan soils.

Runoff is slight, and the hazard of erosion is slight to moderate.

If irrigated, this soil is suited to corn, sugar beets, beans, alfalfa, barley, and wheat. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIe–1, irrigated, and IIIe–6, dryland; Loamy Foothill range site; windbreak suitability group 1.

96—Satanta loam, 3 to 5 percent slopes. This gently sloping soil is on terraces and uplands. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 18 inches.

Included with this soil in mapping are some small areas of soils that are more sloping or less sloping. Also included are small areas of Fort Collins, Nunn, and Altvan soils.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to barley, wheat, and alfalfa and, to a lesser extent, corn, sugar beets, and beans. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIIe–2, irrigated, and IIIe–7, dryland; Loamy Foothill range site; windbreak suitability group 1.

97—Satanta loam, gullied, 3 to 9 percent slopes. This gently sloping to strongly sloping soil is on uplands and side slopes. It receives runoff from adjacent, higher-lying, shallow soils. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 15 inches.

Included with this soil in mapping are a few areas of soils that have gravel on the surface. Also included are a few small areas of Carnero and Kim soils, many gullies as much as 15 feet wide and 10 to 12 feet deep, and many smaller gullies between.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is best suited to pasture and native grasses. If runoff from adjacent areas can be diverted, wheat and barley can be grown. Capability unit IVe–4, dryland; Loamy Foothill range site; not assigned to a windbreak suitability group.

Satanta Variant

This variant consists of deep, somewhat poorly drained soils that formed in alluvium. These soils are on terraces and are underlain by material high in content of calcium sulfate at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 3 percent. The native vegetation is saltgrass, bluegrass, sedges, and other water-tolerant grasses. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is dark grayish brown clay loam about 9 inches thick. The subsoil is grayish brown, light brownish gray, and light gray clay loam about 17 inches thick. The underlying material is white loam about 9 inches thick and light gray sandy loam about 25 inches thick.

Permeability is moderate, and the available water capacity is high. Reaction is moderately alkaline.

These soils are used for irrigated and dryfarmed crops and for pasture.

Representative profile of Satanta Variant clay loam, 0 to 3 percent slopes, in irrigated cropland, 1,000 feet east and 1,150 feet south of the northwest corner of sec. 1, T. 6 N., R. 68 W.:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

B1—9 to 14 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; hard, friable; thin patchy clay films on peds; calcareous; moderately alkaline; clear smooth boundary.

B2t—14 to 22 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate fine and medium angular and subangular blocky; hard, friable; thin patchy clay films on peds; calcareous; moderately alkaline; clear smooth boundary.

B3cs—22 to 26 inches; light gray (10YR 7/2)

clay loam, grayish brown (10YR 5/2) moist; weak medium platy and moderate fine subangular blocky structure; hard, friable; calcareous; moderately alkaline; calcium sulfate as many crystals and nodules; clear smooth boundary.

C1cacs—26 to 35 inches; white (10YR 8/2) loam, light gray (10YR 7/2) moist; massive; slightly hard, friable; many calcium sulfate crystals and nodules; visible secondary calcium carbonate as spots and seams; calcareous; moderately alkaline; clear smooth boundary.

C2cacs—35 to 60 inches; light gray (2.5Y 7/2) sandy loam, light yellowish brown (2.5Y 6/4) moist; few faint light brownish red mottles; massive; slightly hard, very friable; common calcium sulfate crystals and nodules; visible secondary calcium carbonate as spots and seams; calcareous; moderately alkaline.

The A horizon is light clay loam 6 to 12 inches thick. The B2t horizon is light clay loam 6 to 15 inches thick. The lower part of the B horizon and the C horizon have accumulations of secondary sulfate.

98—Satanta Variant clay loam, 0 to 3 percent slopes. This nearly level soil is on terraces.

Included with this soil in mapping are a few small areas of soils that have a surface layer and subsurface layer of loam. Also included are a few small areas of Nunn clay loam, wet, and areas of Caruso and Loveland soils.

Runoff is slow. The hazard of erosion is slight to moderate, except in areas near stream channels where cutting occurs.

If irrigated, this soil is suited to corn, barley, alfalfa, wheat, and pasture. Under dryland management it is suited to pasture and native grasses and, to a lesser extent, wheat and barley. Capability units IIe–1, irrigated, and IVe–3, dryland; Overflow range site; windbreak suitability group 3.

Schofield Series

The Schofield series consists of moderately deep, well drained soils that formed in material weathered from granite, gneiss, and schist. These soils are on ridges and mountainsides and are underlain by bedrock at a depth of 20 to 40 inches. Elevation ranges from 7,500 to 9,000 feet. Slopes are 5 to 25 percent. The native vegetation is mainly lodgepole pine, Engelmann spruce, and Douglas fir and a few grasses and shrubs. Mean annual precipitation ranges from 15 to 20 inches, mean annual air temperature ranges from 40° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 1½-inch-thick layer of organic material is on the surface. The surface layer is dark gray coarse sandy loam about 2 inches thick. The subsurface layer is light brownish gray coarse sandy loam about 10 inches thick. The subsoil is brown gravelly sandy clay loam 8 inches thick. The underlying material is brown gravelly loamy sand about 7 inches thick. Below this is granite bedrock.

Permeability is moderate, and the available water capacity is low. Reaction is medium acid above a depth of 12 inches and slightly acid below that depth.

These soils are used mainly for forest and recreation.

Representative profile of Schofield coarse sandy loam in an area of Schofield-Redfeather-Rock outcrop complex, 5 to 25 percent slopes, in forest, about 3,500 feet north and 1,500 feet east of the southwest corner of sec. 20, T. 9 N., R. 73 W.:

O1—1½ inches to ½ inch; undecomposed organic matter consisting of needles, twigs, and leaves.

O2—½ inch to 0; partly decomposed organic material similar to that in the O1 horizon.

A1—0 to 2 inches; dark gray (10YR 4/1) coarse sandy loam, black (10YR 2/1) moist; moderate medium and fine granular structure; slightly hard, very friable; 10 percent gravel; medium acid; clear smooth boundary.

A2—2 to 12 inches; light brownish gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; 10 percent gravel; medium acid; gradual smooth boundary.

B2t—12 to 20 inches; brown (10YR 5/3) gravelly sandy clay loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure; very hard, firm; thin patchy clay films on peds; 15 percent gravel; slightly acid; clear smooth boundary.

C—20 to 27 inches; brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; 25 percent gravel; slightly acid; clear smooth boundary.

R—27 to 31 inches; granite bedrock.

The A1 horizon is sandy loam 0 to 3 inches thick. The A2 horizon is sandy loam or loamy sand 4 to 12 inches thick. The B2t horizon is sandy clay loam 7 to 15 inches thick. A C horizon is present in some places, and some profiles have mixed A and B horizons. Reaction ranges from medium acid to neutral.

99—Schofield-Redfeather-Rock outcrop complex, 5 to 25 percent slopes. This complex consists of strongly sloping to moderately steep soils on mountainsides and ridges. It is about 40 percent Schofield coarse sandy loam, about 30 percent Redfeather sandy loam, and about 20 percent Rock outcrop. Schofield coarse sandy loam is near the base of the slope. Redfeather sandy loam is on the upper parts of the slopes, and Rock outcrop occurs throughout but is commonly near ridgetops and is steeper.

Included with this complex in mapping are about 10 percent areas of Naz soils.

Runoff is medium to rapid, and the hazard of erosion is severe.

These soils are used for woodland and recreation and for a limited amount of cattle grazing. Capability unit VIe–6, dryland; woodland suitability group 6x2;

not assigned to a range site or windbreak suitability group.

Stoneham Series

The Stoneham series consists of deep, well drained soils that formed in mixed alluvial and wind-deposited material. These soils are on uplands and old terraces. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 9 percent. The native vegetation is mainly blue grama, western wheatgrass, green needlegrass, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is pale brown loam about 4 inches thick. The subsoil is brown clay loam about 6 inches thick and pale brown loam about 4 inches thick. The underlying material is very pale brown loam.

Permeability is moderate, and the available water capacity is high. Reaction is neutral above a depth of about 10 inches and moderately alkaline below that depth.

These soils are used mainly for native grasses and for irrigated and dryfarmed crops.

Representative profile of Stoneham loam, 1 to 3 percent slopes, in native grass, 400 feet west and 30 feet north of the south quarter-corner of sec. 36, T. 10 N., R. 69 W.:

A1—0 to 4 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable; about 5 percent fine gravel; neutral; clear smooth boundary.

B2t—4 to 10 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; weak to moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; thin patchy clay films on ped faces; neutral; clear smooth boundary.

B3ca—10 to 14 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, friable; few patchy clay films on ped faces; calcareous; visible secondary calcium carbonate as seams, as streaks, and on undersides of gravel; 5 percent gravel; moderately alkaline; gradual smooth boundary.

Cca—14 to 60 inches; very pale brown (10YR 7/4) loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; calcareous; visible secondary calcium carbonate as seams, as streaks, and on undersides of gravel; 5 percent gravel; moderately alkaline.

The A horizon is loam 8 to 10 inches thick in cultivated areas. The B2t horizon is loam or light clay loam 3 to 7 inches thick. The combined thickness of the A and B horizons is 10 to 15 inches. Reaction ranges from neutral to moderately alkaline. Depth to calcareous material ranges from 3 to 10 inches, but some profiles are slightly calcareous in the surface layer. Sand and gravel seams are below a depth of 40 inches in some places.

100—Stoneham loam, 0 to 1 percent slopes. This level soil is on uplands, high terraces, and benches. This soil has a profile similar to the one described as representative of the series, but the surface layer and the upper part of the subsoil have been mixed by plowing and the resulting surface layer is about 8 to 10 inches thick.

Included with this soil in mapping are small areas of Fort Collins and Kim soils.

Runoff is slight, and the hazard of erosion is slight.

If irrigated, this soil is suited to corn, sugar beets, beans, wheat, barley, and alfalfa. It is also well suited to pasture. Capability unit I, irrigated; Loamy Plains range site; windbreak suitability group 1.

101—Stoneham loam, 1 to 3 percent slopes. This nearly level soil is on uplands, high terraces, and benches. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping. Also included are small areas of Fort Collins, Larimer, and Kim soils.

Runoff is medium, and the hazards of wind and water erosion are moderate.

If irrigated, this soil is suited to corn, sugar beets, beans, wheat, barley, and alfalfa. Under dryland management it is well suited to pasture or native grasses and, to a lesser extent, wheat and barley. Capability units IIe–1, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

102—Stoneham loam, 3 to 5 percent slopes. This gently sloping soil is on uplands and benches. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 12 inches.

Included with this soil in mapping are a few small areas of soils that have a surface layer of sandy loam and some areas of soils in which shale or sandstone is at a depth of 40 to 60 inches. Also included are a few small areas of Fort Collins, Kim, and Larimer soils and some areas of soils that have a subsoil and underlying material redder than typical of Stoneham soils.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to barley, alfalfa, and wheat and, to a lesser extent, corn, sugar beets, and beans. Under dryland management it is suited to pasture or native grasses. Capability units IIIe–2, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

103—Stoneham loam, 5 to 9 percent slopes. This strongly sloping soil is on uplands and high terraces and benches, mainly near the edge. This soil has a profile similar to the one described as representative of the series, but the combined surface layer and subsoil is about 10 to 12 inches thick.

Included with this soil in mapping are small gravel

spots and small areas of soils that are redder and have a surface layer of sandy loam. Also included are small areas of Fort Collins, Kim, and Larimer soils.

Runoff is rapid, and the hazard of erosion is severe.

If irrigated, this soil is well suited to pasture and, to a lesser extent, wheat, barley, and alfalfa. Under dryland management it is suited to pasture or native grasses. Capability units IVe–1, irrigated, and VIe–1, dryland; Loamy Plains range site; windbreak suitability group 1.

Sunshine Series

The Sunshine series consists of moderately deep, well drained soils that formed in material weathered from sandstone. These soils are on mountainsides and ridges and are underlain by sandstone at a depth of 20 to 40 inches. Elevation ranges from 8,500 to 9,500 feet. Slopes are 5 to 15 percent. The native vegetation is mainly Arizona fescue, bluebunch wheatgrass, mountain muhly, and big sage. Mean annual precipitation ranges from 15 to 17 inches, mean annual air temperature ranges from 40° to 44° F, and the average frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is grayish brown stony sandy loam about 10 inches thick. The subsurface layer is light gray stony sandy loam about 5 inches thick and brown very stony clay loam that is mixed with light gray fine sandy loam and is about 4 inches thick. The subsoil is brown very stony clay about 9 inches thick. The underlying material is weathered and fractured sandstone.

Permeability is slow, and the available water capacity is low. Reaction is neutral.

These soils are used for native grasses.

Representative profile of Sunshine stony sandy loam, 5 to 15 percent slopes, in native grass, about 30 feet west of road and 0.2 mile north of fence in SE¼ sec. 9, T. 11 N., R. 77 W.:

A1—0 to 10 inches; grayish brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky and moderate fine granular structure; soft, very friable; 10 percent stones; neutral; clear smooth boundary.

A2—10 to 15 inches; light gray (10YR 7/2) stony sandy loam, grayish brown (10YR 5/2) moist; weak fine subangular structure parting to weak fine granular; slightly hard, very friable; 30 percent stones; neutral; gradual wavy boundary.

A&B—15 to 19 inches; brown (7.5YR 5/4) very stony clay loam, dark brown (7.5YR 4/4) moist; moderate fine angular blocky structure; hard, friable; this horizon consists of clayey material similar to that of the B2t horizon which is mixed with lighter colored fine sandy loam similar to the A2 horizon; thin patchy clay films on ped faces; 40 percent stones; neutral; diffuse wavy boundary.

B2t—19 to 28 inches; brown (7.5YR 5/4) very stony clay, dark brown (7.5YR 4/4) moist; strong medium subangular blocky structure; hard, firm; thin nearly continuous clay films on ped faces; 40 percent stones; neutral.

Cr—28 to 40 inches; fragmental sandstone.

The A1 horizon is sandy loam to loam 6 to 12 inches thick. The A2 horizon is sandy loam to light loam 3 to 6 inches thick. The B2t horizon is clay or heavy clay loam. Reaction ranges from slightly acid to neutral. Content of rock fragments, mainly flagstones and stones, ranges from 35 to 80 percent.

104—Sunshine stony sandy loam, 5 to 15 percent slopes. This strongly sloping to moderately steep soil is on ridges and mountainsides.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping. Also included are a few small areas of Pendergrass and Naz soils.

Runoff is medium, and the hazard of water erosion is severe.

This soil is suited to pasture and native grasses. Capability unit VIe–6, dryland; Subalpine Loam range site; not assigned to a windbreak suitability group.

Table Mountain Series

The Table Mountain series consists of deep, well drained soils that formed in alluvium. These soils are on low terraces and flood plains. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 1 percent. The native vegetation is mainly blue grama, bluegrass, bromegrass, and some forbs and shrubs. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown loam about 36 inches thick. The underlying material is brown fine sandy loam about 10 inches thick and yellowish brown fine sandy loam about 5 inches thick. Below this is sand and gravel.

Permeability is moderate, and the available water capacity is high. Reaction is neutral above a depth of 36 inches and moderately alkaline below that depth.

These soils are used mainly for irrigated and dry-farmed crops. A few areas are in native grasses.

Representative profile of Table Mountain loam, 0 to 1 percent slopes, in a cultivated area, about 850 feet east of the west quarter-corner of sec. 20, T. 5 N., R. 68 W.:

Ap—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

A1—4 to 36 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; hard, friable; neutral; clear smooth boundary.

C1ca—36 to 46 inches; brown (10YR 5/3) heavy fine sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very

friable; calcareous; few spots and seams of secondary calcium carbonate; moderately alkaline; gradual smooth boundary.

C2ca—46 to 51 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; very hard, friable; calcareous; few spots and seams of secondary calcium carbonate; few medium distinct mottles; moderately alkaline; gradual wavy boundary.

IIC3—51 to 60 inches; sand, gravel, and cobbles.

The A horizon is loam or light clay loam 20 to 40 inches thick. The C horizon is fine sandy loam, loam, or light clay loam. Reaction ranges from neutral to moderately alkaline. Content of rock fragments, mainly gravel or cobbles, ranges from 0 to 15 percent.

105—Table Mountain loam, 0 to 1 percent slopes. This level soil is on low terraces and bottom lands.

Included with this soil in mapping are some small areas of soils that have a surface layer of sandy loam and some small areas of soils in which slopes are more than 1 percent. Also included are a few small areas of Caruso and Paoli soils and small areas of soils in which sand and gravel layers are at a depth of about 40 inches.

Runoff is slow, and the hazard of erosion is slight. This soil is flooded or receives overflow in places.

If irrigated, this soil is well suited to corn, sugar beets, beans, alfalfa, wheat, and barley. It is also well suited to wheat or barley under dryland management. Capability units I, irrigated, and IIIc–1, dryland; Overflow range site; windbreak suitability group 1.

Tassel Series

The Tassel series consists of shallow, well drained soils that formed in material weathered from sandstone. These soils are on uplands and are underlain by soft sandstone at a depth of 10 to 20 inches. Elevation ranges from 4,800 to 5,800 feet. Slopes are 3 to 25 percent. The native vegetation is blue grama, little bluestem, green needlegrass, and yucca. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is light brownish gray sandy loam about 3 inches thick. The underlying material is pale brown sandy loam about 9 inches thick over soft sandstone.

Permeability is moderately rapid, and the available water capacity is low. Reaction is moderately alkaline.

These soils are used mainly for native grasses.

Representative profile of Tassel sandy loam, 3 to 25 percent slopes, in native grass, 1,000 feet south and 2,160 feet west of the northeast corner of sec. 11, T. 10 N., R. 68 W.:

A1—0 to 3 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1—3 to 12 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, very friable; calcareous; moderately alkaline; gradual wavy boundary.

C2r—12 to 60 inches; gray calcareous soft sandstone.

The A1 horizon is sandy loam or fine sandy loam 2 to 5 inches thick. The C horizon is sandy loam or fine sandy loam 8 to 14 inches thick. Depth to calcareous material ranges from 0 to 4 inches. Reaction ranges from mildly alkaline to moderately alkaline.

106—Tassel sandy loam, 3 to 25 percent slopes. This gently sloping to moderately steep soil is on uplands (fig. 11).

Included with this soil in mapping are some small areas of soils that have sandstone fragments on the surface and outcrops of sandstone. Also included are small areas of Nelson soils.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is suited to pasture or native grasses. Capability unit VIe–3, dryland; Sandstone Breaks range site; windbreak suitability group 3.

Thedalund Series

The Thedalund series consists of moderately deep, well drained soils that formed in material weathered from sandstone and shale. These soils are on uplands and are underlain by soft sandstone and shale at a depth of 20 to 40 inches. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 9 percent. The native vegetation is blue grama, buffalograss, sage, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown loam about 6 inches thick. The subsurface layer is light olive brown loam 8 inches thick. The underlying material is light yellowish brown loam about 23 inches thick over soft shale and sandstone.

Permeability is moderate, and the available water capacity is medium. Reaction is neutral above a depth of about 6 inches, mildly alkaline between depths of 6 and 14 inches, and moderately alkaline below a depth of 14 inches.

These soils are used mainly for native grasses and dryfarmed crops. A few areas are used for irrigated crops.

Representative profile of Thedalund loam, 3 to 9 percent slopes, in native grass, 1,150 feet east and 1,400 feet south of the northwest corner of sec. 33, T. 11 N., R. 68 W.:

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 4/2) moist; weak medium and fine granular structure; soft, friable; neutral; clear smooth boundary.

AC—6 to 14 inches; light olive brown (2.5Y 5/4) loam, olive brown (2.5Y 4/4) moist; massive; slightly hard, friable; calcareous; mildly alkaline; clear smooth boundary.

C1—14 to 37 inches; light yellowish brown (2.5Y

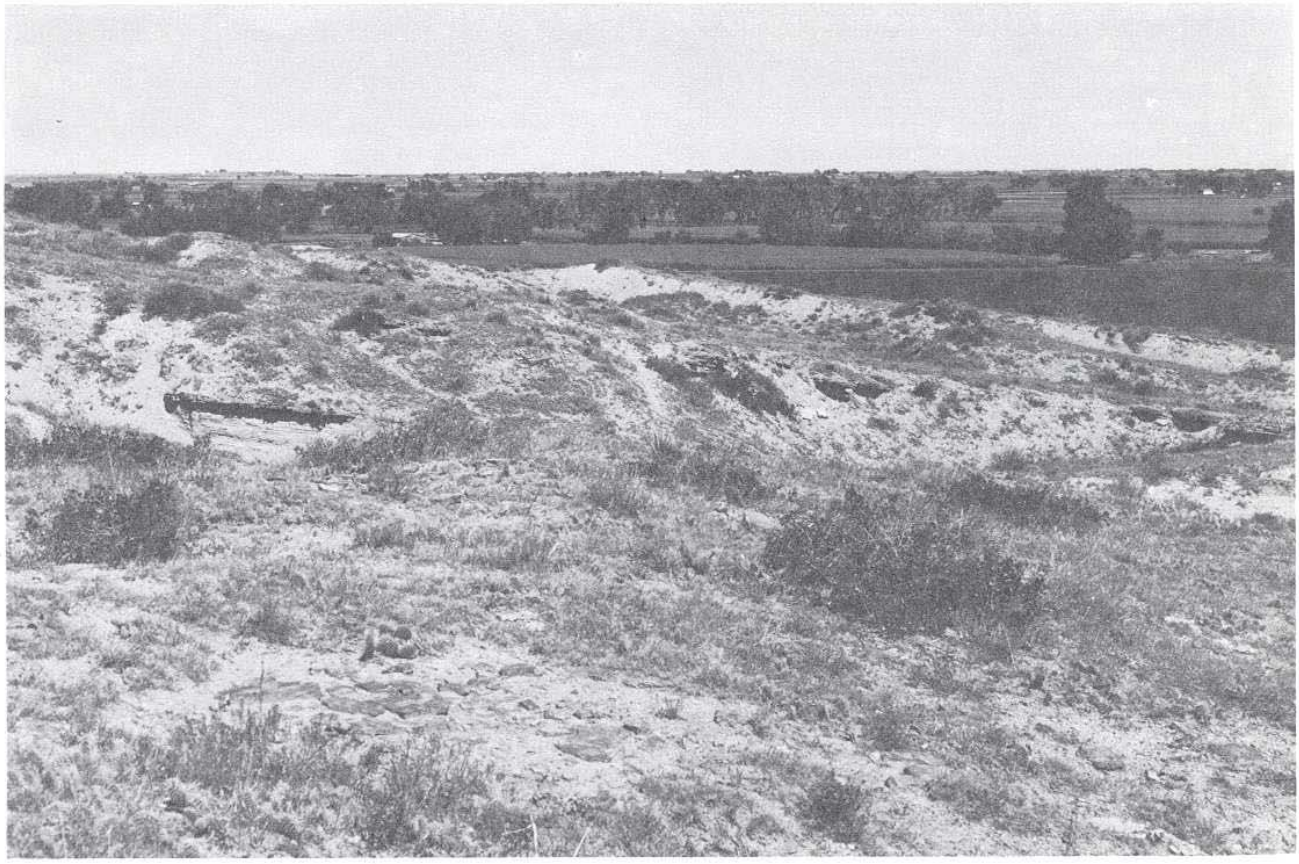

Figure 11.—Area of Tassel sandy loam, 3 to 25 percent slopes, in foreground; Cache La Poudre river valley in background.

6/4) loam, light olive brown (2.5Y 5/4) moist; massive; hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

C2r—37 to 60 inches; light gray (2.5Y 7/2) dry and moist interbedded shale and sandstone.

The A1 horizon is loam or light clay loam 4 to 11 inches thick. The C horizon is loam or light clay loam. Depth to calcareous material ranges from 0 to 6 inches. Reaction ranges from neutral to moderately alkaline. Content of rock fragments ranges from 0 to 15 percent throughout, but particularly in the surface layer.

107—Thedalund loam, 0 to 3 percent slopes. This nearly level soil is on uplands. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 8 inches thick.

Included with this soil in mapping are some small areas of soils that are more sloping and a few small areas of Kim soils.

Runoff is slight, and the hazard of erosion is slight to moderate.

If irrigated, this soil is suited to barley, wheat, and corn and, to a lesser extent, alfalfa and sugar beets. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIIe–3, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

108—Thedalund loam, 3 to 9 percent slopes. This gently sloping to moderately sloping soil is on uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping. Also included are a few small areas of soils that have a surface layer of clay loam and small areas of Kim, Cushman, and Midway soils.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to barley, wheat, alfalfa, and pasture. Under dryland management it is suited to pasture or native grasses. Capability units IVe–1, irrigated, and VIe–1, dryland; Loamy Plains range site; windbreak suitability group 1.

Thiel Series

The Thiel series consists of deep, well drained soils that formed in alluvium or glacial outwash. These soils are on terraces and high benches and are underlain by sand and gravel at a depth of 20 to 40 inches. Elevation

ranges from 7,500 to 8,500 feet. Slopes are 5 to 25 percent. The native vegetation is mainly Idaho fescue, needleandthread, and sage. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is brown gravelly sandy loam about 4 inches thick. The subsoil is brown very gravelly sandy loam about 8 inches thick and light yellowish brown very gravelly light sandy clay loam about 2 inches thick. The underlying material is very gravelly sandy loam about 16 inches thick over very pale brown extremely gravelly sand.

Permeability is moderately rapid above a depth of about 30 inches and very rapid below that depth. The available water capacity is low to medium. Reaction is neutral above a depth of 8 inches, slightly acid between depths of 8 and 12 inches, and moderately alkaline below a depth of 12 inches.

These soils are used mainly for native grasses.

Representative profile of Thiel gravelly sandy loam, 5 to 25 percent slopes, in native grass, about 2,350 feet east and 100 feet north of the southwest corner of sec. 4, T. 12 N., R. 77 W.:

A1—0 to 4 inches; brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) moist; strong fine granular structure; soft, very friable; 40 percent fine and very fine angular granite gravel; neutral; clear smooth boundary.

B21t—4 to 8 inches; brown (7.5YR 5/3) very gravelly sandy loam, dark brown (7.5YR 3/3) moist; moderate medium subangular blocky structure parting to strong medium granular; slightly hard, very friable; thin clay films on ped faces and on gravel fragments and as bridges between sand grains; 50 percent fine angular granite gravel; neutral; clear smooth boundary.

B22t—8 to 12 inches; brown (7.5YR 5/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure parting to strong medium granular; extremely hard, very friable; common thin clay films on ped faces and on gravel fragments and as bridges between sand grains; 50 percent fine granite gravel; slightly acid; clear wavy boundary.

B3ca—12 to 14 inches; light yellowish brown (10YR 6/4) very gravelly light sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; extremely hard, very friable; few clay films on gravel fragments; few clay bridges between sand grains; 50 percent fine granite gravel; moderate continuous accumulation of secondary calcium carbonate as soft concretions; calcareous; moderately alkaline; diffuse wavy boundary.

C1ca—14 to 30 inches; very pale brown (10YR 8/3) very gravelly sandy loam, pale brown (10YR 6/3) moist; single grained; extremely hard, very friable; 60 percent fine and very fine granite gravel; strong continuous horizon of secondary carbonate accumulation and carbonate in finely divided marl-like forms; calcareous; moderately alkaline; diffuse wavy boundary.

IIC2ca—30 to 60 inches; very pale brown (10YR 7/3) extremely gravelly sand, brown (10YR 5/3) moist; single grained; very hard, loose; 70 percent fine angular granite gravel; moderate continuous horizon of secondary carbonate accumulation and calcium carbonate mostly in seams and streaks or as coatings on coarse fragments; content of carbonate decreases with depth; calcareous; moderately alkaline.

The A horizon is sandy loam to very gravelly sandy loam 3 to 8 inches thick. The combined thickness of the A and B horizons ranges from 8 to 15 inches. The B horizon is very gravelly sandy loam or very gravelly sandy clay loam. Depth to calcareous material ranges from 6 to 15 inches. Content of rock fragments, mainly fine granitic gravel, ranges from 35 to 80 percent.

109—Thiel gravelly sandy loam, 5 to 25 percent slopes. This strongly sloping or moderately steep soil is on high benches, terraces, and alluvial fans.

Included with this soil in mapping are small areas of soils that lack lime accumulations and a few small areas of soils that are underlain by sand and gravel at a shallow depth.

Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This soil is suited to pasture and native grasses. Capability unit VIe–7, dryland; Dry Mountain Loam range site; not assigned to a windbreak suitability group.

Tine Series

The Tine series consists of deep, well drained or somewhat excessively drained soils that formed in material weathered from alluvium or glacial outwash. These soils are on terraces and benches and are underlain by sand and gravel at a depth of 10 to 20 inches. Elevation ranges from 7,500 to 9,000 feet. Slopes are 0 to 40 percent. The native vegetation is mainly wheatgrass, junegrass, sedges, and sagebrush. Mean annual precipitation ranges from 13 to 17 inches, mean annual air temperature ranges from 42° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile the surface layer is brown gravelly sandy loam about 15 inches thick. The underlying material is yellowish brown very gravelly loamy sand about 3 inches thick over sand, gravel, and cobbles.

Permeability is moderately rapid above a depth of about 15 inches and rapid below that depth. The available water capacity is low. Reaction is slightly acid.

These soils are used mainly for native grasses.

Representative profile of Tine gravelly sandy loam, 0 to 3 percent slopes, in native grass, about 2,000 feet south and 1,700 feet west of the northeast corner of sec. 35, T. 12 N., R. 77 W.:

A11—0 to 8 inches; brown (10YR 4/3) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; 25 percent gravel; slightly acid; clear smooth boundary.

A12—8 to 15 inches; brown (10YR 4/3) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky and weak fine granular structure; slightly hard, very friable; 25 percent gravel; slightly acid; clear smooth boundary.

C1—15 to 18 inches; yellowish brown (10YR 5/4) very gravelly loamy sand, brown (10YR 4/3) moist; massive; slightly hard, very friable; 40 percent gravel; slightly acid; gradual smooth boundary.

IIC2—18 to 60 inches; sand, gravel, and cobbles.

The A horizon is sandy loam to very gravelly or cobbly sandy loam 6 to 15 inches thick. The A and C horizons range from slightly acid to mildly alkaline. Depth to uniformly calcareous material is more than 40 inches. Inconsistent zones of calcareous material occur above a depth of 40 inches in places. Content of rock fragments in the IIC horizon is 35 to 80 percent.

110—Tine gravelly sandy loam, 0 to 3 percent slopes. This nearly level soil is on terraces, benches, and outwash plains. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have more lime in the profile. Also included are small areas of Tine cobbly sandy loam and a few areas of soils that are more sloping.

Runoff is slow, and the hazard of erosion is slight.

This soil is suited to pasture or native grasses. Capability unit VIe–7, dryland; Dry Mountain Loam range site; not assigned to a windbreak suitability group.

111—Tine cobbly sandy loam, 15 to 40 percent slopes. This moderately steep or steep soil is on the edges of terraces and benches. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 6 to 8 inches thick and it contains more cobbles.

Included with this soil in mapping are small areas of Tine gravelly sandy loam and some small areas of soils in which sandstone or shale is at a depth of 40 to 60 inches.

Runoff is medium to rapid, and the hazard of water erosion is moderate to severe.

This soil is suited to pasture or native grasses. Capability unit VIIe–1, dryland; Dry Mountain Loam range site; not assigned to a windbreak suitability group.

Trag Series

The Trag series consists of deep, well drained soils that formed in material weathered from granite and schist. These soils are on uplands and side slopes. Elevation ranges from 6,800 to 7,800 feet. Slopes are 5 to 30 percent. The native vegetation is mainly blue grama, big and little bluestem, junegrass, and some forbs, shrubs, and scattered ponderosa pine. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile (fig. 12) the surface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is brown clay loam about 26 inches thick. The underlying material is brown sandy clay loam.

Permeability is moderate, and the available water capacity is high. Reaction is slightly acid above a depth of about 9 inches and neutral below that depth.

These soils are used mainly for native grasses and recreation.

Representative profile of Trag sandy loam in an area of Trag-Moen complex, 5 to 30 percent slopes, in native grass, about 2,350 feet east and 600 feet south of the northwest corner of sec. 10, T. 7 N., R. 71 W.:

A1—0 to 9 inches, dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate fine granular; soft, very friable; slightly acid; clear wavy boundary.

B1—9 to 16 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 3/3) moist;

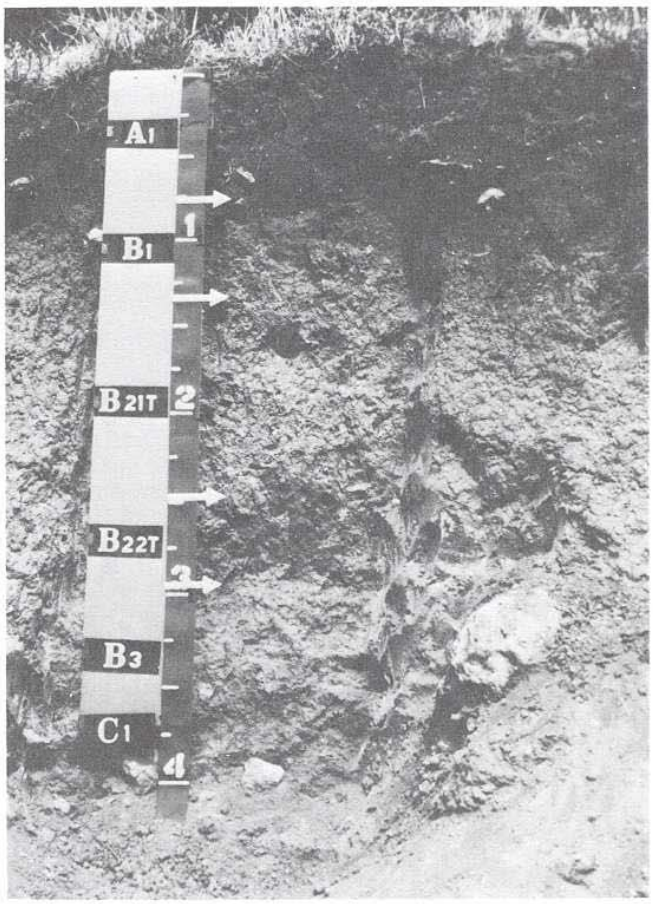

Figure 12.—**Profile of Trag sandy loam.**

weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; thin patchy clay films; neutral; clear wavy boundary.

B2t—16 to 35 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; thin nearly continuous clay films; neutral; clear smooth boundary.

C—35 to 60 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; very hard, friable; neutral.

The A horizon is loam or sandy loam 5 to 12 inches thick. The combined thickness of the A and B horizons ranges from 24 to 44 inches. The B horizon is light clay loam or heavy loam. Thickness of the mollic epipedon is 7 to 20 inches. Bedrock is at a depth of 50 to 60 inches in some profiles. Coarse fragments, mainly cobbles and stones, make up 0 to 15 percent of the solum.

112—Trag-Moen complex, 5 to 30 percent slopes. This complex consists of strongly sloping to steep soils on mountainsides and ridges. It is about 45 percent Trag sandy loam and about 40 percent Moen loam. Trag sandy loam is more nearly level and at the base of slopes, and Moen loam is on ridgetops and higher side slopes.

Included with this soil in mapping are about 15 percent areas of Breece soils and Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

These soils are suited to pasture and native grasses. Capability unit VIe–5, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

Ulm Series

The Ulm series consists of deep, well drained soils that formed in mixed alluvium from shale. These soils are on fans and side slopes. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 5 percent. The native vegetation is mainly blue grama, buffalograss, western wheatgrass, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown clay loam about 4 inches thick. The subsoil is light brownish gray and light olive brown clay loam about 18 inches thick. The underlying material is light yellowish brown clay loam and silty clay loam.

Permeability is moderately slow, and the available water capacity is high. Reaction is mildly alkaline above a depth of about 14 inches and moderately alkaline below that depth.

These soils are used for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Ulm clay loam, 0 to 3 percent slopes, in dryfarmed cropland, about 700 feet north and 100 feet east of the southwest corner of sec. 33, T. 6 N., R. 68 W.:

Ap—0 to 4 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, friable; mildly alkaline; clear smooth boundary.

B2t—4 to 14 inches; light brownish gray (2.5Y 6/2) heavy clay loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; thin nearly continuous clay films; mildly alkaline; gradual smooth boundary.

B3ca—14 to 22 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; thin patchy clay films; calcareous; secondary calcium carbonate as spots and seams; moderately alkaline; gradual smooth boundary.

C1ca—22 to 34 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm; calcareous; visible secondary calcium carbonate as seams and spots; moderately alkaline; gradual smooth boundary.

C2ca—34 to 60 inches; light yellowish brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, friable; calcareous; visible secondary calcium carbonate as seams and spots; moderately alkaline.

The A horizon is clay loam or silty clay loam 4 to 12 inches thick. The B2t horizon is heavy clay loam or light clay. The combined thickness of the A and B horizons ranges from 20 to 40 inches. Depth to calcareous material typically is about 10 to 14 inches, but some profiles are slightly calcareous in the surface layer. Shale is at a depth of 40 to 60 inches in some profiles. Reaction ranges from neutral to moderately alkaline.

113—Ulm clay loam, 0 to 3 percent slopes. This nearly level soil is on valleysides, fans, and uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that are more sloping. Also included are some small areas of Heldt and Renohill soils.

Runoff is slow to medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to corn, sugar beets, wheat, barley, beans, and alfalfa. Under dryland management it is suited to pasture and native grasses. Capability unit IIe–1, irrigated, and IVe–3, dryland; Clayey Plains range site; windbreak suitability group 1.

114—Ulm clay loam, 3 to 5 percent slopes. This gently sloping soil is on valleysides, fans, and uplands. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 18 to 20 inches.

Included with this soil in mapping are a few small areas of soils that are more sloping or less sloping and a few areas of soils that have a surface layer of clay.

Also included are small areas of Heldt and Renohill soils.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to wheat, barley, and alfalfa and, to a lesser extent, corn, sugar beets, and beans. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIIe–1, irrigated, and IVe–3, dryland; Clayey Plains range site; windbreak suitability group 1.

Weld Series

The Weld series consists of deep, well drained soils that formed in uniform textured, silty, wind-deposited material. These soils are on uplands. Elevation ranges from 4,800 to 5,600 feet. Slopes are 0 to 3 percent. The native vegetation is mainly blue grama, western wheatgrass, sage, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is grayish brown silt loam about 7 inches thick. The upper part of the subsoil is dark brown light silty clay about 8 inches thick, and the lower part is brown and pale brown silty clay loam about 15 inches thick. The underlying material is pale brown silt loam.

Permeability is moderate above a depth of about 7 inches, moderately slow between depths of 7 and 20 inches, and moderate below a depth of 20 inches. The available water capacity is high. Reaction is neutral above a depth of about 15 inches, mildly alkaline between depths of 15 and 20 inches, and moderately alkaline below a depth of 20 inches.

These soils are used mainly for irrigated and dryfarmed crops.

Representative profile of Weld silt loam, 0 to 3 percent slopes, in a cultivated area, about 50 feet west of the east quarter corner of sec. 36, T. 6 N., R. 68 W.:

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky and weak medium and fine granular structure; soft, very friable; neutral; clear smooth boundary.

B21t—7 to 15 inches; dark brown (10YR 4/3) light silty clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate to strong medium and fine angular and subangular blocky; hard, very firm; thin nearly continuous clay films on peds; neutral; clear smooth boundary.

B22tca—15 to 20 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; slightly hard, firm; thin nearly continuous clay films on peds; calcareous; visible secondary calcium carbonate as streaks and seams; mildly alkaline; clear smooth boundary.

B3ca—20 to 30 inches; pale brown (10YR 6/3) light silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; thin patchy clay films on peds; calcareous; visible secondary calcium carbonate as spots and finely divided forms; moderately alkaline; clear smooth boundary.

Cca—30 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; calcareous; visible secondary calcium carbonate as spots and finely divided forms; moderately alkaline.

The A horizon is loam or silt loam 5 to 12 inches thick. The B2t horizon is heavy silty clay loam or silty clay. The combined thickness of the A and B horizons ranges from 15 to 35 inches. Reaction ranges from neutral to moderately alkaline.

115—Weld silt loam, 0 to 3 percent slopes. This nearly level soil is on uplands.

Included with this soil in mapping are a few small areas of soils that are slightly more sloping and a few small areas of soils that have a surface layer of silty clay loam. Also included are small areas of Wiley soils.

Runoff is slow. The hazard of erosion is slight, but erosion losses are high sometimes following heavy rain.

If irrigated, this soil is well suited to corn, sugar beets, beans, wheat, barley, and alfalfa. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIe–1, irrigated, and IIIe–6, dryland; Loamy Plains range site; windbreak suitability group 1.

Wetmore Series

The Wetmore series consists of shallow, well drained soils that formed in material weathered from granite. These soils are on mountainsides and ridges and are underlain by granite bedrock at a depth of less than 20 inches. Elevation ranges from 6,500 to 8,000 feet. Slopes are 5 to 40 percent. The native vegetation is mainly ponderosa pine and Douglas fir and an understory of grasses and shrubs. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 42° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile a 2-inch-thick layer of organic material is on the surface. The surface layer is dark gray gravelly sandy loam about 2 inches thick. The subsurface layer is pinkish gray gravelly loamy sand about 3 inches thick. The subsoil is pinkish gray very gravelly loamy sand about 11 inches thick. Below this is granite bedrock.

Permeability is rapid, and the available water capacity is low. Reaction is slightly acid.

These soils are used mainly for forest and recreation. Some areas are used for grazing.

Representative profile of Wetmore gravelly sandy loam in an area of Wetmore-Boyle-Rock outcrop complex, 5 to 60 percent slopes, in forest, about 600 feet east of the southwest corner of sec. 13, T. 9 N., R. 73 W.:

O1—2 inches to 0; partly decomposed needles, leaves, and twigs.

A1—0 to 2 inches; dark gray (10YR 4/1) gravelly sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; 15 percent fine granitic gravel; slightly acid; abrupt smooth boundary.

A2—2 to 5 inches; pinkish gray (7.5YR 6/2) gravelly loamy sand, dark brown (7.5YR 4/2) moist; weak thin platy structure; soft, very friable; about 15 percent fine granitic gravel; slightly acid; gradual wavy boundary.

B2t—5 to 16 inches; pinkish gray (7.5YR 6/2) gravelly loamy sand, dark brown (7.5YR 4/2) moist; massive; slightly hard, very friable; seams and nodules of brown (7.5YR 4/3) light sandy clay loam embedded in material similar to that of the A2 horizon; some clay films bridging sand grains and on peds of sandy clay loam material; 40 percent gravel and stones; slightly acid; clear wavy boundary.

R—16 inches; granite bedrock.

The A horizon is sandy loam or loamy sand 0 to 3 inches thick. The B2t horizon is heavy sandy loam or sandy clay loam. It consists of lamellae about ¼ to ¾ inch thick imbedded in a matrix of loamy sand or light sandy loam. Content of rock fragments ranges from 35 to 60 percent in the B2t horizon. Depth to bedrock ranges from 8 to 20 inches. Reaction ranges from slightly acid to neutral.

116—Wetmore-Boyle-Moen complex, 5 to 40 percent slopes. This complex consists of strongly sloping to steep soils on mountainsides and ridges. It is about 35 percent Wetmore gravelly sandy loam, about 25 percent Boyle gravelly sandy loam, and about 25 percent Moen loam. The Wetmore soil is in forest. The Boyle soil is more sloping in grassed areas. The Moen soil is flatter in grassed areas.

Included with these soils in mapping is about 15 percent areas of Ratake and Trag soils and Rock outcrop.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to native grasses and woodland. They are also used for recreation. Capability unit VIIs–1, dryland; Wetmore soil not assigned to a range site, Boyle soil in Rocky Loam range site, and Moen soil in Loamy Park range site; woodland suitability group 6d1; not assigned to a windbreak suitability group.

117—Wetmore-Boyle-Rock outcrop complex, 5 to 60 percent slopes. This complex consists of strongly sloping to very steep soils on mountainsides and ridges (fig. 13). It is about 35 percent Wetmore gravelly sandy loam, about 30 percent Boyle gravelly sandy loam, and about 25 percent Rock outcrop. Wetmore gravelly sandy loam is in forest, Boyle gravelly sandy loam is in open grassed areas, and Rock outcrop occurs throughout but is commonly near ridgetops and is steeper. The Wetmore soil has the profile described as representative of the Wetmore series. The Boyle soil has a profile similar to the one described as representative of the Boyle series.

Included with these soils in mapping are minor areas of Redfeather and Schofield soils.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to woodland or native grasses. They are also used for recreation, as sites for summer homes, and for wildlife habitat. Capability unit VIIs–1, dryland; Wetmore soil and Rock outcrop not assigned to a range site, and Boyle soil in Rocky Loam range site; woodland suitability group 6x1; not assigned to a windbreak suitability group.

Wiley Series

The Wiley series consists of deep, well drained soils that formed in uniform, silty, wind-deposited material. These soils are on uplands. Elevation ranges from 4,800 to 5,600 feet. Slopes are 1 to 9 percent. The native vegetation is mainly blue grama, western wheatgrass, and cactus. Mean annual precipitation ranges from 13 to 15 inches, mean annual air temperature ranges from 48° to 50° F, and the frost-free season ranges from 135 to 150 days.

In a representative profile the surface layer is brown silt loam about 6 inches thick. The upper part of the subsoil is brown and pale brown silty clay loam about 9 inches thick, and the lower part is pale brown silt loam about 8 inches thick. The underlying material is pale brown silt loam.

Permeability is moderate, and the available water capacity is high. Reaction is mildly alkaline above a depth of 10 inches and moderately alkaline below that depth.

These soils are used for irrigated and dryfarmed crops and for pasture and native grasses.

Representative profile of Wiley silt loam, 3 to 5 percent slopes, in cropland, about 50 feet north and 670 feet east of the southwest corner of sec. 23, T. 6 N., R. 68 W.:

Ap—0 to 6 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak very fine granular structure; slightly hard, friable; calcareous; mildly alkaline; abrupt smooth boundary.

B21t—6 to 10 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak to moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable; thin continuous clay films on soil aggregates; calcareous; mildly alkaline; clear smooth boundary.

B22tca—10 to 15 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; weak to moderate medium subangular blocky structure; hard, friable; very thin patchy clay films on vertical and horizontal faces of soil aggregates; visible secondary calcium carbonate as soft spots; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—15 to 23 inches; pale brown (10YR 6/3) heavy silt loam, brown (10YR 4/3)

Figure 13.—**Area of Wetmore-Boyle-Rock outcrop complex, 5 to 60 percent slopes.**

moist; weak medium subangular blocky structure; hard, friable; visible calcium carbonate as soft spots; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—23 to 32 inches; pale brown (10YR 6/3) heavy silt loam, brown (10YR 5/3) moist; very weak to weak medium subangular blocky structure; hard, very friable; visible calcium carbonate as small spots; calcareous; moderately alkaline; clear smooth boundary.

C2—32 to 60 inches; pale brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The A horizon is loam, silt loam, or light silty clay loam 6 to 12 inches thick. The B horizon is silty clay loam or heavy silt loam, and visible accumulations of secondary calcium carbonate are in the lower part. The combined thickness of the A and B horizons ranges from 15 to 35 inches. Depth to calcareous material ranges from 0 to 6 inches. Reaction ranges from mildly alkaline to strongly alkaline.

118—Wiley silt loam, 1 to 3 percent slopes. This nearly level soil is on uplands. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 28 inches.

Included with this soil in mapping are a few small areas of soils that have a subsurface layer of silt loam. Also included are some small areas of soils that are more sloping or less sloping and some areas of soils that have a surface layer of silty clay loam.

Runoff is slow to medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to corn, sugar beets, beans, alfalfa, wheat, and barley. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIe–1, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

119—Wiley silt loam, 3 to 5 percent slopes. This gently sloping soil is on uplands. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small areas of soils that have a subsurface layer of silt loam or loam. Also included are a few small areas of soils

that are more sloping or less sloping and a few small areas of soils that have a surface layer of silty clay loam.

Runoff is medium, and the hazard of erosion is moderate.

If irrigated, this soil is suited to barley, wheat, and alfalfa and, to a lesser extent, corn, sugar beets, and beans. Under dryland management it is suited to wheat and barley. It is also well suited to pasture and native grasses. Capability units IIIe–2, irrigated, and IVe–3, dryland; Loamy Plains range site; windbreak suitability group 1.

Use and Management of the Soils

This section first discusses cropping system and general management suitable for use of irrigated and dryfarmed soils. It then describes the system of capability classification used by the Soil Conservation Service and it discusses management of the soils by capability units. A table showing the estimated yields of the principal irrigated and dryfarmed crops grown in the survey area is also given. It also describes use and management of the soils for range, woodland, windbreaks, wildlife habitat, and recreation. Finally, this section discusses soil properties, soil and water features, and engineering uses of the soils.

Management of Irrigated Soils [2]

The main irrigated crops in Larimer County Area are corn, sugar beets, alfalfa, barley, dry beans, oats, and wheat. Generally, in most of the irrigated areas, the length of the growing season permits three cuttings of alfalfa and allows for maturation of selected varieties of corn. In the foothills the growing season is generally too short for maturing corn. Vegetables, such as sweet corn, tomatoes, pumpkins, cucumbers, cabbage, onions, peppers, peas, and red beets, are suited to much of the Area but are grown only on a limited acreage. Most of the barley grown is malting barley.

In 1969 about 96,000 acres in the survey area was irrigated. The irrigated areas are mainly in the southeastern part of the survey area, but areas of irrigated meadows are in the foothills and mountains, including those along the Laramie River in the northwestern part.

Most of the water for irrigation and domestic uses is supplied by the river systems in the survey area. The main streams are the Cache La Poudre and Big Thompson Rivers and their tributaries. In addition, much of the Area is served by the Colorado Big Thompson Transmountain Diversion Project. This project supplies supplemental water, and in most years it insures a supply of late-season irrigation water.

Most of the water from the river systems is stored in the many lakes and reservoirs during spring runoff and is released as needed. A few farms have irrigation wells that are used mainly for supplemental irrigation water.

One or more methods of irrigation can be used on the soils of the survey area. Methods used are border irrigation, furrow irrigation, controlled flooding, sprinkler irrigation, and corrugation irrigation. The method to be used must be designed to fit the soil and the slope.

Border irrigation is used on nearly level fields that are planted with close-growing crops, such as alfalfa or small grain. In this method water flows down a narrow strip between ridges and soaks into the soil. Uniform grades are necessary to insure an even distribution of water and to prevent ponding.

Furrow irrigation is most commonly used on row crops, such as corn, beets, and beans. Water is taken from ditches by siphon tubes, gated pipe, or cuts in the ditchbank and is applied in the furrows between the rows of plants. On sloping soils contour furrows provide more uniform irrigation and help to control erosion.

Controlled flooding is used on close-growing crops. In this method water is flooded down the slope between closely spaced field ditches.

Sprinkler irrigation is used where the slopes are uneven or steep and in most of the areas that have irrigation wells. An advantage of sprinklers is that less land leveling is required. Sprinklers are also advantageous in years when preemergence irrigations are necessary. Evaporation losses are higher in places than with other forms of irrigation, and wind drift causes uneven application of water in places.

Corrugation irrigation is used mainly on small grain crops and on fields that do not have uniform grades.

The more efficiently water is applied, the smaller the amount of water that is needed. If irrigation runs are too long or the water is allowed to run for too long a time, water penetrates below the root zone and is lost. Water is also lost in runoff at the lower end of the field. If the runs are too long, the soils at the upper end of the field become wet below the root zone before the soils at the lower end have received enough water.

The amount of moisture that can be retained by the soil depends largely on the texture and thickness of the soil. In general, loamy sands and fine sands hold about 0.05 to 0.08 inch of water per inch of soil depth; sandy loams, about 0.11 to 0.13 inch per inch; clay loams, about 0.19 to 0.21 inch per inch; and clays, about 0.14 to 0.7 inch per inch.

Irrigating to obtain high production without waste of either soil or water requires the use of certain management practices. These practices can save water, control erosion, increase crop yields, and lower labor costs. In Larimer County Area the following practices are used.

Land leveling.—Land with a uniform grade is necessary for the uniform application of irrigation water. The amount of leveling involved depends on the relief and the kinds of soil. Most land leveling in the past has been done in areas that are already nearly level. With large machinery more complex land leveling is possible.

Drainage.—Since many areas have been irrigated for more than one hundred years, sometimes with inefficient methods, many soils have become seeped. Some soils are naturally wet. In order to grow crops on these soils, they must be drained. Tile drains and open drains are both used. Once drained many of the soils need to be leached of excess accumulations of salts. This can be done by applying additional amounts

[2] ALBERT YOXALL, soil conservationist, Soil Conservation Service, helped prepare this section.

of irrigation water. On some soils chemical amendments are helpful. Salt-tolerant crops, such as barley or sugar beets, can be grown until leaching is accomplished.

Erosion control.—To help to control erosion, close-growing crops should be grown on steeper slopes. Irrigating on the contour, or across the slope, and careful application of irrigation water help to prevent excessive erosion. Installation of concrete lined ditches or pipelines helps to prevent erosion and also conserve water.

Cropping systems.—Use of cropping systems that include crops grown in rotation helps to maintain soil tilth and fertility and aids in the control of insects, diseases, and weeds. The use of alfalfa or another soil building crop aids in maintaining soil tilth and good permeability. Applying fertilizer according to soil tests is necessary for continued high production. Applications of barnyard manure are also helpful in maintaining organic-matter content and are particularly helpful in restoring tilth on land-leveling cut areas.

Management of Dryfarmed Soils [3]

About 35,000 acres in Larimer County Area is used for dryfarmed crops. Although there are dryfarmed areas scattered throughout the survey area, most of the dryfarmed soils are along the edge of the foothills.

The average annual precipitation of most of the dryfarmed areas ranges from 13 to 15 inches, but areas near or in the foothills receive as much as 17 inches per year. Most of this precipitation comes in spring and early in summer.

Because annual rainfall is so low, the conservation of moisture is important. Summer fallow helps to store soil moisture in sufficient quantities for crop production. Soils generally are summer fallowed one year and planted the next year.

As a result of summer fallowing, there is a hazard of wind and water erosion. Water erosion can be controlled to some degree by the use of terraces, either conventional channel types or flat channel terraces. These terrace systems, if supported by contour planting, generally reduce water erosion to a tolerable level. Grassed waterways can be used to carry off excess water.

Wind erosion is a hazard, particularly in winter and spring. Stubble mulch or crop residue on the soil surface helps to control wind and water erosion. It also aids moisture penetration and helps to maintain good tilth. Subsurface tillage with such implements as blades and sweeps helps to keep residue on the surface and controls weeds. Minimum tillage also helps to keep residue on the surface.

Stripcropping to control wind erosion is common in the Area. Alternate strips of crops and fallow are farmed at right angles in the direction of the prevailing winds. Contour stripcropping helps to control water erosion and aids in the storage of moisture in winter.

If there is not enough stubble to protect the soil from blowing, emergency tillage is necessary at times. Implements are used that bring clods to the surface, which helps to reduce soil losses.

[3] ALBERT YOXALL, soil conservationist, Soil Conservation Service, helped prepare this section.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment (*4*). The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops 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, forest trees, or engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the 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, defined as follows:

Class I soils have few limitations that restrict their use.

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

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 habitat.

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

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

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

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of

erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–4 or IIIe–6. 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 paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

Irrigated capability units

In this section each irrigated capability unit in Larimer County Area is described and use and management are discussed.

CAPABILITY UNIT I, IRRIGATED

This unit consists of deep, well drained soils that have a surface layer of loam and a subsoil and underlying material of loam to clay loam. Slopes are 0 to 1 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate, and the available water capacity is high. The hazards of wind and water erosion are slight. Runoff is slow.

These soils are well suited to all of the crops commonly grown in the Area. The main crops are corn for silage or grain, sugar beets, barley, alfalfa, dry beans, and wheat.

Row crops can be grown nearly continuously if crop residue and manure are used to help maintain good soil tilth. Nitrogen and phosphorus fertilizers applied according to the soil tests help to maintain high production.

Nearly all irrigation methods are suited to these soils. The length of runs can be relatively long but varies with the soil.

CAPABILITY UNIT IIe–1, IRRIGATED

This unit consists of deep, well drained soils that generally have a surface layer of loam to clay loam and a subsoil and underlying material of loam to silty clay loam or clay. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is generally moderate to moderately slow, but it is slow on some soils. The available water capacity is high. The hazard of erosion is slight to moderate. Runoff is slow to medium.

These soils are well suited to all of the crops commonly grown in the Area. The main crops are corn for silage and grain, sugar beets, barley, alfalfa, dry beans, and wheat. The soils are also suited to pasture.

Use of crop residue and addition of manure help to maintain tilth and improve water infiltration, especially on the slowly permeable soils. Fall plowing of the clay loam soils helps in seedbed preparation. Nitrogen and phosphorus fertilizers applied according to soil tests help to obtain high production.

Furrow and contour furrow irrigation are suited to row crops on these soils. Flooding between contour ditches, corrugations, and border dikes can be used for alfalfa and small grain. Sprinkler systems can also be used for most crops.

CAPABILITY UNIT IIe–2, IRRIGATED

This unit consists of deep, well drained soils that have a surface layer of sandy loam or fine sandy loam. Some of the soils in this unit have a surface layer of loam. The subsoil or subsurface layer is sandy clay loam, clay loam, or loam and the underlying material is sandy loam or loam. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mainly 135 to 150 days, but it is as short as 115 days in some places. Permeability is moderate, and the available water capacity is medium to high. The hazard of water erosion is slight to moderate, and the hazard of wind erosion is moderate. Runoff is slow.

These soils are well suited to most of the crops commonly grown in the Area. The main crops are corn, barley, alfalfa, and wheat. Sugar beets and dry beans are grown in some places. The soils are also well suited to pasture.

Leaving stubble and crop residue on the surface or leaving the surface ridged helps to prevent erosion on areas that are exposed to high winds. Nitrogen and phosphorus fertilizers applied according to soil tests are generally beneficial to these soils.

Border dikes, contour ditches, corrugation, furrows, contour furrows, and sprinklers are suitable irrigation methods. Irrigation heads and the length of runs need to be shorter than on less sloping soils to prevent erosion and uneven penetration. Land leveling or smoothing helps in irrigation.

CAPABILITY UNIT IIw–1, IRRIGATED

This unit consists of deep, well drained soils that have a surface layer of loam or fine sandy loam, a subsoil or subsurface layer of loam to clay loam, and underlying material of loam to sandy loam. Slopes are 0 to 1 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mainly 120 to 150 days, but it is as short as 115 days in places. Permeability is moderate, and the available water capacity is high. The hazard of erosion is slight to moderate. Some cutting occurs in areas adjacent to stream channels, and the lower lying areas of these soils are subject to overflow. Runoff is slow.

These soils are suited to most of the crops commonly

grown in the Area. The main crops are corn for silage, barley, alfalfa, dry beans, and wheat. Corn for grain and sugar beets are grown where the growing season is longer. The soils are also well suited to pasture.

Nearly all irrigation methods are suitable for these soils. Borders are well suited to small grain, alfalfa, and pasture and furrow irrigation is suited to row crops.

These soils should be protected from damaging overflow, particularly during spring and early summer. Use of crop rotation systems that include alfalfa, pasture, or other close-growing crops is helpful. In some places diversions help to control overflow.

CAPABILITY UNIT IIs–1, IRRIGATED

Nunn clay loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep and well drained soil that has a surface layer of clay loam and a subsoil of clay loam or clay. The underlying material is clay loam. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderately slow, and the available water capacity is high. The hazard of erosion is slight. Runoff is slow.

This soil is well suited to all of the crops commonly grown in the Area. The main crops are sugar beets, corn for silage and grain, barley, dry beans, alfalfa, and wheat.

Deep-rooted crops, manure, and high-residue crops help to maintain good soil tilth and improve permeability. Fall plowing is helpful in preparing a seedbed. Nitrogen and phosphorus fertilizers help to increase production.

Any method of irrigation is suited to this soil. The length of runs can be fairly long and should have small streams of water to thoroughly wet the root zone.

CAPABILITY UNIT IIs–2, IRRIGATED

Paoli fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, well drained soil that has a surface layer and underlying material of fine sandy loam. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderately rapid, and the available water capacity is high. The hazard of water erosion is slight, and the hazard of wind erosion is moderate. Runoff is slow.

This soil is well suited to most of the crops grown in the Area. The main crops are corn for silage and grain, barley, sugar beets, dry beans, alfalfa, and wheat.

Use of crop residue helps to control erosion. Nitrogen and phosphorus fertilizers applied according to soil tests help to obtain good production.

Shortening the length of irrigation runs helps in uniform application of water and helps to control erosion. Borders, flooding from contour ditches, furrows, and sprinklers are suitable irrigation methods. Frequent, light irrigation helps to maintain adequate soil moisture.

CAPABILITY UNIT IIIe–1, IRRIGATED

This unit consists of deep and moderately deep, well drained soils that have a surface layer of clay loam and a subsoil of clay. The underlying material is clay or shale. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 155 days. Permeability is slow, and the available water capacity is medium to high. The hazard of erosion is slight to moderate. Runoff is medium.

These soils are suited to most of the crops grown in the Area. The main crops are corn, barley, alfalfa, and wheat. Sugar beets are grown in places, as is pasture.

A rotation system that includes alfalfa or other deep-rooted crops improves permeability. Use of crop residue and additions of manure or green manure crops also help to maintain tilth and improve permeability. Fall plowing is important in seedbed preparation. Minimum tillage helps to maintain organic-matter content and soil cover.

Contour ditches and corrugations are suitable irrigation methods for close-grown crops and pasture. Furrows and contour furrows can be used for row crops, and sprinklers can be used for most other crops. Careful irrigation is necessary to avoid waterlogging the soils.

CAPABILITY UNIT IIIe–2, IRRIGATED

This unit consists of deep, well drained soils that have a surface layer of loam, silt loam, or clay loam; a subsoil of loam to clay; and underlying material of loam to clay loam. Slopes are 3 to 5 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate to slow, and the available water capacity is high. The hazard of erosion is moderate. Runoff is medium.

These soils are suited to most of the crops commonly grown in the Area. The main crops are barley, alfalfa, corn, dry beans, and wheat. Sugar beets are grown in places. Pasture grows well.

Row crops should not be grown for more than two years in a row. Planting and irrigating across the slope help to control erosion and allows more uniform application of irrigation water. Close-growing crops, such as alfalfa and small grain, help to protect against erosion. Fall plowing the clay loam soils helps in seedbed preparation.

Controlled flooding from closely spaced contour ditches can be used to irrigate drilled crops. Short furrows or contour furrows can be used for row crops, and sprinkler systems can be used for most other crops and for pasture.

CAPABILITY UNIT IIIe–3, IRRIGATED

This unit consists of deep and moderately deep, well drained soils that have a surface layer of loam, a subsoil or subsurface layer of clay loam or loam, and underlying material of loam, sand and gravel, or sandstone or shale. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mainly 135 to 150 days, but it is as short as 120 days in places. Permeability is moderate in the upper part of the soils and mostly ranges from rapid to moderate in the lower part. The available water capacity is medium to high. The hazard of erosion is slight to moderate. Runoff is slow to medium.

These soils are suited to corn, barley, dry beans, alfalfa, wheat, and pasture. Sugar beets are grown in some places.

Row crops should be rotated every two or three years, unless they are planted across the slope to help

control erosion. Alfalfa is limited on some of the soils because of depth. Close-growing crops help to control erosion.

Borders and controlled flooding from contour ditches can be used for alfalfa and small grain. Contour furrows are suited to row crops, and sprinklers can be used for most other crops. Good water management is necessary to avoid overirrigation and to conserve water. Land leveling is limited by soil depth.

CAPABILITY UNIT IIIe–4, IRRIGATED

This unit consists of deep, well drained soils that have a surface layer of sandy loam, a subsoil or subsurface layer of sandy loam or sandy clay loam, and underlying material of sandy loam. Slopes are 3 to 5 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate to moderately rapid or rapid. The hazard of erosion is moderate. Runoff is medium.

These soils are suited to most of the crops grown in the Area. The main crops are alfalfa, barley, corn, dry beans, wheat, and pasture.

Because of the hazard of erosion, row crops should be rotated every one or two years. Small grain and alfalfa or pasture minimize erosion. Leaving crop residue on the surface and minimum tillage help to control erosion, particularly during high winds.

Sprinklers and controlled flooding from contour ditches are suited to drilled crops and pasture. Furrows or sprinklers are suited to row crops. Short irrigation runs are necessary so that small, nonerosive streams can be used to control erosion and avoid overirrigation.

CAPABILITY UNIT IIIe–5, IRRIGATED

This unit consists of deep, well drained soils that have a surface layer of fine sandy loam or sandy loam, a subsoil or subsurface layer of loam or sandy loam, and underlying material of sandy loam to sand and gravel. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mostly 135 to 150 days, but it is as short as 120 days in some places. Permeability is moderate to moderately rapid or rapid, and the available water capacity is medium. The hazard of water erosion is slight, and the hazard of wind erosion is moderate. Runoff is slow.

These soils are suited to most of the crops commonly grown in the Area. The main crops are corn, barley, alfalfa, dry beans, wheat, and pasture. Sugar beets are grown in some areas.

Minimum tillage and use of crop residue keep residue on the surface and help to control erosion. Fertility maintenance is important on these soils.

Most methods of irrigation are suited to these soils, but the soils require frequent, light irrigation. The length of runs needs to be fairly short to obtain even penetration, to conserve water, and to avoid loss of nutrients.

CAPABILITY UNIT IIIw–1, IRRIGATED

This unit consists of deep, somewhat poorly drained soils that have a surface layer of clay loam, a subsoil or subsurface layer of clay loam to clay, and underlying material of clay loam to sand and gravel. Slopes are 0 to 1 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate to moderately slow in the upper part of these soils and moderately slow to rapid in the lower part. The available water capacity is medium to high. The hazard of erosion is slight. Runoff is slow. Areas of these soils near channels are subject to overflow and cutting. The soils have a seasonal high water table.

These soils are mainly suited to water- and salt-tolerant crops. Barley and irrigated pasture are fairly well suited. If the soils are drained, sugar beets and corn can be grown.

Fertilizer is not helpful everywhere unless the soils are drained. Most methods of irrigation are suited to these soils, but length of runs should be short to avoid overirrigation. Frequent, light irrigation helps to keep salt accumulations down and conserves water.

CAPABILITY UNIT IVe–1, IRRIGATED

This unit consists of moderately deep and deep, well drained soils that have a surface layer of fine sandy loam to clay loam, a subsoil or subsurface layer of loam to clay, and underlying material of clay to sand and gravel. Some of the soils are underlain by shale, sandstone, or limestone. Slopes are 3 to 10 percent. The annual precipitation is 13 to 17 inches. The frost-free season is mainly 135 to 150 days, but it is as short as 115 days in some places. Permeability is moderate to slow, and the available water capacity is medium to high. Some of the soils are rapidly permeable in the underlying material and some are underlain by impermeable material. The hazard of erosion, mainly water erosion, is moderate to severe. Runoff is medium to rapid.

These soils are suited to crops, mainly such close-growing crops as barley, alfalfa, and wheat. The soils are also suited to pasture. Row crops can be grown on some of the more nearly level areas if the rows are planted across the slope.

Leveling or smoothing the soil helps to obtain uniform application of water, but is limited by depth on some of the soils. Irrigating small grain or pasture from closely spaced contour ditches and using contour furrows for row crops are suitable irrigation methods. Sprinkler systems are also suited to most crops. Planting pasture or permanent hay and permanent contour ditches help in erosion control and simplify the irrigation system. Applying necessary fertilizers at the time of seeding helps to obtain good stands and high production.

CAPABILITY UNIT IVe–2, IRRIGATED

This unit consists of deep and moderately deep, well drained soils that have a surface layer of fine sandy loam or sandy loam and a subsoil or subsurface layer of sandy loam to clay loam. The underlying material is generally sandy loam to loam, but the moderately deep soils are underlain by sandstone. Slopes are 3 to 9 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mainly 135 to 150 days, but it is about 120 days in some places. Permeability is moderate to moderately rapid, and the available water capacity is low to high. The hazard of erosion is moderate to severe.

These soils are well suited to close-growing crops, such as barley, wheat, alfalfa, and pasture. Row crops,

such as corn and beans, can be grown occasionally, but care is needed to prevent erosion. Alfalfa is limited by depth on some of the soils.

Limiting row crops and keeping the soil in pasture, alfalfa, or small grain help to control erosion. Use of crop residue helps to maintain organic-matter content and control erosion. If row crops are grown, they should be limited to one year and planted across the slope.

Sprinkler systems, controlled flooding from contour ditches, contour furrows, and cross-slope furrows are suitable irrigation methods. Short irrigation runs help to control erosion, aid in uniform irrigation, and avoid waterlogging soils that are underlain by sandstone.

CAPABILITY UNIT IVw–1, IRRIGATED

This unit consists of shallow to deep, poorly drained soils that have a surface layer of sandy loam to loam and underlying material of sandy loam to sand or gravel. Slopes are 0 to 1 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderately rapid or rapid, and the available water capacity is low to high. The hazard of erosion is mainly slight, but areas near stream channels are subject to cutting. A water table is within the root zone during much of the growing season, and the soils are flooded in spring and early summer in places.

These soils are well suited to pasture. Drained areas are suitable for barley and corn.

Furrows or flooding are suitable irrigation methods. Good water management practices are necessary. Many areas need only light irrigation to moisten the surface. Leaving areas near channels in permanent vegetation decreases the hazard of erosion.

CAPABILITY UNIT VIw–1, IRRIGATED

This unit consists of deep, poorly drained and somewhat poorly drained soils that have a surface layer and a subsoil or subsurface layer of sandy loam to clay loam. The underlying material ranges from clay to sand and gravel. Slopes are 0 to 5 percent. The annual precipitation is about 12 to 18 inches, and the frost-free season is 60 to 85 days. Permeability is slow to rapid, and the available water capacity is low to high. The hazard of erosion is slight. Runoff is slow to medium. These soils are occasionally flooded, generally in spring or early summer.

These soils are suited to hay and pasture.

Good water management practices are important to avoid further waterlogging of the soils. Maintaining good vegetative cover reduces the hazard of erosion. Fertilizers help to increase the amount and quality of hay or forage.

CAPABILITY UNIT VIc–1, IRRIGATED

This unit consists of deep and moderately deep soils that have a surface layer of clay loam to sandy loam and a subsoil or subsurface layer of clay to sandy loam. The underlying material ranges from sandy loam to sand and gravel in the deep soils and is shale in the moderately deep soils. Slopes are 0 to 3 percent. The annual precipitation is 13 to 18 inches, and the frost-free season is 60 to 85 days. Permeability is slow to rapid, and the available water capacity is low to high. The hazard of erosion is slight. Runoff is slow.

These soils are suited to hay and pasture.

Good water management practices help to avoid waterlogging the soils and control erosion. The length of runs should be fairly short to conserve water on the rapidly permeable soils. Nitrogen fertilizer improves production and quality of hay.

Dryland capability units

In this section each dryland capability unit in the survey area is described, and use and management of the soils are discussed.

CAPABILITY UNIT IIIe–6, DRYLAND

This unit consists of deep, well drained soils that generally have a surface layer of loam, silt loam, or clay loam; a subsoil of clay loam or clay; and underlying material commonly of loam to clay loam. One of the soils is underlain by sand and gravel. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mainly 135 to 150 days, but it is as short as 120 days in places. Permeability is moderate to slow, but it is rapid in the underlying material of some of the soils. The available water capacity is high. The hazard of erosion is slight to moderate. Runoff is slow to medium.

These soils are suited to all of the commonly grown crops, but wheat or barley are the main crops. The soils are also suited to pasture or native grasses.

A small, grain-summer fallow cropping system is a common practice to store adequate moisture for crop production. Using crop residue or stubble mulching helps to control erosion and improves water infiltration. Chiseling or subsoiling also helps to improve infiltration. Terracing reduces runoff and allows more moisture to be stored.

CAPABILITY UNIT IIIe–7, DRYLAND

This unit consists of deep, well drained soils that generally have a surface layer of loam or clay loam, a subsoil of clay loam, and underlying material of loam to clay loam. Slopes are 3 to 5 percent. The annual precipitation is 13 to 15 inches. The frost-free season is mainly 135 to 150 days but it is as short as 120 days in places. Permeability is moderate to moderately slow, and the available water capacity is high. The hazard of erosion is moderate; the hazard is mainly from water. Runoff is medium.

These soils are suited to all commonly grown crops. The main crops are wheat and barley. The soils are also suited to pasture or native grasses.

A small grain-fallow system is used on these soils for moisture conservation. Stubble mulching or use of crop residue and contour or cross-slope stripcropping help to control erosion.

CAPABILITY UNIT IIIe–8, DRYLAND

This unit consists of deep, well drained soils that generally have a surface layer of fine sandy loam or sandy loam, a subsoil or subsurface layer of fine sandy loam to clay loam, and underlying material of sandy loam to loam. Slopes are 0 to 5 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 120 to 150 days. Permeability is moderate to

moderately rapid, and the available water capacity is high. The hazard of erosion is slight to moderate. Runoff is slow to medium.

These soils are suited to most of the commonly grown crops. Wheat and barley are the main crops. The soils are also suited to pasture and native grasses.

A small grain-fallow system is a common practice for moisture conservation, but wind erosion is a hazard when the soils are fallow. Stubble mulching or use of crop residue and stripcropping help to control erosion. The soils respond well to nitrogen in years of sufficient rainfall.

CAPABILITY UNIT IIIc–1, DRYLAND

This unit consists of deep, well drained soils that generally have a surface layer of loam or clay loam and a subsoil and underlying material of loam to clay loam. Slopes are 0 to 1 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is about 135 to 150 days. Permeability is moderate to moderately slow, and the available water capacity is high. The hazard of erosion is slight. Runoff is slow.

These soils are suited to all of the commonly grown crops. Wheat and barley are the main crops. The soils are also suited to pasture or native grasses.

Alternate strips of small grain and summer fallow help to store moisture and control erosion. Use of crop residue or stubble mulching helps in erosion control, water infiltration, and maintenance of good soil tilth. Terracing reduces runoff and keeps more water in the soil for plant growth.

CAPABILITY UNIT IVe–3, DRYLAND

This unit consists of deep and moderately deep, well drained soils that generally have a surface layer of loam, silt loam, or clay loam and a subsoil or subsurface layer of loam to clay. One soil has a surface layer of fine sandy loam. The underlying material is loam, silt loam, clay loam, or clay in the deep soils and ranges from sand and gravel to shale or sandstone in the other soils. Slopes are 0 to 9 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 115 to 150 days. Permeability is moderate to slow, and the available water capacity is medium to high. The hazard of erosion is slight to severe; the hazard is mainly from water erosion, but some soils are subject to wind erosion. Runoff is slight to rapid.

These soils are suited to most of the commonly grown crops, but controlling erosion is important if they are grown. Wheat-summer fallow is the main cropping system, although barley is sometimes grown. Pasture or native grasses are well suited.

Stubble mulching or using crop residue helps to control erosion and store moisture by increasing water infiltration. Stripcropping at right angles to the prevailing winds also helps to control erosion. If grass is planted, proper grazing practices help to establish and maintain pasture; but if the soils are in native grasses, they should remain so because establishing pasture is difficult in some places.

CAPABILITY UNIT IVe–4, DRYLAND

Satanta loam, gullied, 3 to 9 percent slopes, is the only soil in this unit. It has a surface layer of loam, a subsoil of clay loam, and underlying material of loam. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate, and the available water capacity is high. The hazard of erosion, mainly water erosion, is severe. Runoff is medium to rapid. This soil receives runoff from adjacent areas.

This soil is suited to small grain, pasture, or native grasses. Wheat-summer fallow is a common cropping system.

This soil should be protected from runoff from adjacent areas by diversions or terraces. Grassed waterways help to carry off excess water and help to control erosion. Stubble mulching or use of crop residue helps to protect against erosion and maintain good tilth and reduces runoff.

CAPABILITY UNIT IVe–5, DRYLAND

This unit consists of deep and moderately deep, well drained soils that have a surface layer of fine sandy loam or sandy loam and a subsoil or subsurface layer of loam to clay loam. The underlying material is loam or sandy loam in the deep soils and ranges from sand and gravel to sandstone in the other soils. Slopes are 0 to 3 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 115 to 150 days. Permeability is moderate to rapid, and the available water capacity is medium to high. The hazard of erosion, mainly wind erosion, is slight to moderate. Runoff is slow.

These soils are mainly suited to small grain, pasture, and native grasses. Wheat-summer fallow is a common cropping system.

Practices such as stubble mulching, using crop residue, and stripcropping to protect the soil against wind erosion are especially important if crops are grown. Minimum tillage helps to maintain crop residue on the surface. Planting in stubble controls erosion and helps to establish pasture grasses if desired. Good pasture management helps to maintain plant vigor.

CAPABILITY UNIT IVe–6, DRYLAND

This unit consists of deep, well drained soils that generally have a surface layer of loam to coarse sandy loam, a subsoil or subsurface layer of clay loam to sandy loam, and underlying material of loam to sandy loam. Slopes are 2 to 10 percent. The annual precipitation is 15 to 18 inches, and the frost-free season is 75 to 100 days. Permeability is moderate to rapid, and the available water capacity is medium to high. The hazard of erosion is moderate to severe. Runoff is medium.

These soils are used for native grasses. Barley, wheat, and other short season crops can be grown if erosion control practices are used. If the land is in native grass, however, it should remain so.

Range management practices, such as deferred grazing and proper grazing use, permits maximum use of range and protects the soil against erosion.

CAPABILITY UNIT IVe–1, DRYLAND

Breece coarse sandy loam, 0 to 3 percent slopes, is the only soil in this unit. It is a deep, well drained soil that has surface and subsurface layers, and underlying material of coarse sandy loam. The annual precipitation is 15 to 18 inches, and the frost-free season is 75

to 100 days. Permeability is rapid, and the available water capacity is medium. The hazard of erosion is slight to moderate. Runoff is slow.

This soil is used for pasture and native grasses. Barley, wheat, or other short season crops can be grown, but if the soil is in native grasses it should remain so.

Good range management practices help to obtain maximum use of range. Water spreading helps to increase the amount of forage in places. If the soil is farmed, use of crop residue helps to control erosion and conserves moisture. Minimum tillage helps to keep residue on the surface.

CAPABILITY UNIT Vw–1, DRYLAND

This unit consists of deep to shallow, somewhat poorly drained and poorly drained soils that generally have a surface layer of clay loam to sandy loam and a subsurface layer and underlying material of clay loam to sand. Slopes are mainly 0 to 1 percent, but are as much as 4 or 5 percent in places. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate to rapid, and the available water capacity is medium to high. The hazard of erosion is slight. Runoff is slow. Most of these soils are subject to flooding, generally in spring or early summer.

These soils are suited to pasture or native grasses. Grasses that are somewhat drought resistant but will grow in wet soil are well suited. Additions of nitrogen fertilizer on drier areas help to increase forage production. Areas near stream channels should be protected to help control cutting.

CAPABILITY UNIT VIe–1, DRYLAND

This unit consists of deep and moderately deep, well drained soils that have a surface layer of loam, silt loam, or clay loam and a subsoil or subsurface layer of loam to clay. The underlying material ranges from loam to clay and shale or sandstone. Some of the soils in complexes are shallow to shale or sandstone. Slopes are 3 to 20 percent. The annual precipitation is 13 to 17 inches, and the frost-free season is 115 to 150 days. Permeability is moderate to slow. The available water capacity is medium to high, but it is low in shallow soils in some complexes. Runoff is medium to rapid. The hazards of water and wind erosion are moderate to severe.

These soils are suited to pasture or native grasses.

Management practices that permit maximum use and protect against erosion are necessary. Deferring and rotating grazing improve plant cover. Reseeding can be done on many of the soils.

CAPABILITY UNIT VIe–2, DRYLAND

This unit consists of deep and moderately deep, well drained soils that have a surface layer of fine sandy loam or sandy loam and a subsoil or subsurface layer of loam to sandy loam. The underlying material is sandy loam to sand and gravel in the deep soils and sandstone in the moderately deep soils. Slopes are 3 to 25 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is moderate or moderately rapid, and the available water capacity is low to medium. The hazard of erosion is moderate to severe. Runoff is medium.

These soils are suited to pasture and native grasses.

Maintaining good vegetative cover is important for erosion control. Planned grazing systems help to control erosion and permit maximum use. Reseeding helps to obtain desired grass species. Planting in stubble helps to control erosion and protects seedlings.

CAPABILITY UNIT VIe–3, DRYLAND

This unit consists of shallow, well drained soils that generally have a surface layer of clay loam to sandy loam and underlying material of shale or sandstone. Slopes are 1 to 25 percent. The annual precipitation is 13 to 15 inches, and the frost-free season is 115 to 150 days. Permeability is moderately rapid to slow, and the available water capacity is low. The hazard of erosion is severe. The sandy loam soils are more subject to wind erosion than the clay loam soils. Runoff is medium to rapid.

These soils are suited to pasture or native grasses.

Deferred grazing and proper use help to maintain good vegetative cover that minimizes erosion. Reseeding is necessary in some areas.

CAPABILITY UNIT VIe–4, DRYLAND

This unit consists of deep, well drained or somewhat excessively drained soils that have a surface layer of gravelly sandy loam, a subsoil or subsurface layer of gravelly sandy loam or very gravelly sandy clay loam, and underlying material of gravelly or very gravelly loamy sand. Slopes are 0 to 40 percent. The annual precipitation is 13 to 17 inches. The frost-free season is mainly 60 to 85 days, but it is as long as 150 days on one of the soils. Permeability is moderate to rapid, and the available water capacity is low to medium. The hazard of erosion is slight to severe. Runoff is slow to rapid.

These soils are suited to native grasses.

Planned grazing systems are essential in maintaining sufficient plant cover to help control erosion. Proper use helps desirable grasses to retain their vigor. Reseeding is difficult because of gravel and cobbles and the steep slopes. Control of sagebrush is helpful on some of the soils.

CAPABILITY UNIT VIe–5, DRYLAND

This unit consists of deep and moderately deep, well drained soils that generally have a surface layer of sandy loam to clay loam and a subsoil of clay loam or clay. The underlying material ranges from loam to sand and gravel and it is granite or shale in the moderately deep soils. One of the soils is shallow and granite is at a depth of 10 to 20 inches. Slopes are 0 to 35 percent. The annual precipitation is 13 to 20 inches, and the frost-free season is 60 to 100 days. Permeability is mainly moderate, but it is slow in one of the soils. The available water capacity ranges from low to high. The hazard of erosion is moderate to severe on most of the soils. Runoff is mainly medium to rapid.

These soils are suited to native grasses.

Planned grazing systems help to obtain maximum use without depleting the vegetative cover. Reseeding can be done on some of the soils, but they should be protected from erosion.

CAPABILITY UNIT VIe–6, DRYLAND

This unit consists of deep and moderately deep, well drained soils that have a surface layer of loamy fine sand to fine sandy loam and a subsoil or subsurface layer of loamy fine sand to clay. The underlying material is gravelly loamy sand to sandy loam in the deep soils and sandstone or granite in the moderately deep soils. One of the soils is shallow and is underlain by granite. Slopes are 1 to 25 percent. The annual precipitation is 13 to 20 inches, and the frost-free season is 60 to 100 days. Permeability is mainly moderate to rapid, and the available water capacity is mainly low to medium. One of the soils is slowly permeable in the subsoil, and one has a high available water capacity. The hazard of erosion is moderate to severe. Runoff is mainly medium to rapid. One of the soils has slow runoff and a slight hazard of erosion.

These soils are suited to native grasses or woodland.

Planned grazing systems help to maintain desirable grass species and, as a result, help to control erosion and increase the forage value. Reseeding can be helpful on some soils.

CAPABILITY UNIT VIw–2, DRYLAND

Longmont clay, 0 to 3 percent slopes, is the only soil in this unit. It is a deep, poorly drained soil that has a surface layer, subsurface layer, and underlying material of clay. The annual precipitation is 13 to 15 inches, and the frost-free season is 135 to 150 days. Permeability is slow, and the available water capacity is high. The hazard of erosion is slight. Runoff is slow. The soil is moderately alkaline to strongly alkaline. A water table is at or near the surface most of the year.

This soil is suited to native grasses.

If the soil is extremely wet, grazing should be limited to avoid compacting and trampling the grass. Reseeding is difficult because the soils are hard to work and are wet much of the time. Suitable grasses can be planted in the drier areas.

CAPABILITY UNIT VIIe–1, DRYLAND

This unit consists of shallow to deep, well drained or excessively well drained soils that generally have a surface layer of gravelly sandy loam to clay loam and a subsurface layer or subsoil of clay to gravelly loamy sand. The underlying material ranges from clean sand and gravel to bedrock. Slopes are 5 to 60 percent. The annual precipitation is 13 to 18 inches. The frost-free season is mainly 60 to 100 days, but it is as much as 150 days in places. Permeability is mainly moderate or rapid, and the available water capacity is low. One of the soils is slowly permeable and has a low to medium available water capacity. The hazard of erosion is moderate to severe. Runoff is medium to rapid.

These soils are suited to native grasses.

Maintaining plant cover is important to control erosion. Planned grazing systems maintain plant cover. Reseeding is extremely difficult because of the slope and the content of coarse fragments in the soil.

CAPABILITY UNIT VIIs–1, DRYLAND

This unit consists of shallow to deep, well drained or excessively drained soils that have a surface layer and subsoil of sandy loam to loam and a subsurface layer of clay to loamy sand. The underlying material is clay loam to loam in the deep soils and sandstone, granite, or schist in the moderately deep and shallow soils. Some of the soils are gravelly, channery, or stony. Slopes are 1 to 60 percent. The annual precipitation is 12 to 20 inches, and the frost-free season is 60 to 150 days. Permeability is mainly moderate or rapid, and the available water capacity is mainly low. Some of the soils are slowly permeable and have a medium available water capacity. The hazard of erosion is moderate to severe on most of the soils. Runoff is medium to rapid. Some of the soils, however, have slow runoff and a slight hazard of erosion.

These soils are suited to native grasses or woodland.

Reseeding is very difficult or impossible because of the slope and the content of coarse fragments. As a result, planned grazing systems are necessary to obtain maximum use without depleting the plant cover. If trees are cut, logging roads should be designed and constructed with a minimum amount of disturbance of the vegetation. Use of equipment should be limited on the steep slopes to avoid gullying.

CAPABILITY UNIT VIIIs–1, DRYLAND

Only Rock outcrop is in this unit. There is little or no plant cover. Rock outcrop has little value for farming or grazing. This land type is used mainly for wildlife habitat, watershed, and recreation.

CAPABILITY UNIT VIIIw–1, DRYLAND

Riverwash and Aquepts, ponded, are in this unit. They have a small amount of vegetation, mainly grasses, sedges, and rushes. They have little or no value for farming or grazing. They are used for wildlife habitat and recreation and should be protected from burning and trampling by livestock.

Estimated Yields

The average yields per acre that can be expected of the principal crops grown in the survey area under a high level of management are shown in table 2. In any given year, yields can be higher or lower than those indicated because of seasonal variations in rainfall and other climatic factors. Absence of a yield estimate indicates that the crop is not suited to or not commonly grown on the soil or that irrigation of a given crop is not commonly practiced on the soil.

The predicted yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The latest soil and crop management practices used by many farmers in the county are assumed in predicting the yields. Hay and pasture yields are predicted for varieties of grasses and legumes suited to the soil. A few farmers may be using more advanced practices and obtaining average yields higher than those shown in the table.

The management needed to achieve the indicated yields of the various crops depends upon the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; proper planting and seeding rates; suitable high-yield crop

TABLE 2.—*Yields per acre*

[All yields were estimated for a high level of management in 1975. Absence of a yield indicates the crop is seldom grown or is not suited. Absence of a soil unit indicates the soil is seldom cropped. Asterisk indicates mapping unit consists of two or more dominant kinds of soil. See mapping unit description for composition and behavior of the whole mapping unit]

Soil name and map symbol	Irrigated crops						Dryfarmed crops	
	Alfalfa for hay	Corn		Sugar beets	Barley	Wheat	Barley	Wheat
		Grain	Silage					
	Tons	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*	*Bu*	*Bu*
Altvan:								
1	4.5	110	18	18	80	55	24	20
2	3.5				50	40	20	18
*3:								
Altvan part	4.5	110	18	18	80	55	24	20
Satanta part	5.5	140	25	25	80	60	30	23
*4:								
Altvan part	3.5				50	40	20	18
Satanta part	4.5				60	45	25	20
Aquepts, loamy:								
5	3.0	80	15	16		30		
Ascalon:								
7	5.5	140	25	24	90	60	30	25
8	4.5	110	20		75	50	25	20
Bainville:								
*10:								
Bainville part							20	18
Keith part							22	20
Carnero:								
21	4.0						20	19
Caruso:								
22	5.0	110	18	21	80	50		
Connerton:								
*24:								
Connerton part	5.0	120	20	20	80	60	25	25
Barnum part	5.0	110	18	20	90	60	25	27
*25:								
Connerton part	4.0	90	15		65	45		
Barnum part	4.0	90	15		70	50		
Cushman:								
26	4.0	100	17	17	65	55	25	18
27	3.0				40	35		
Fort Collins:								
34	6.0	140	25	26	90	65	25	22
35	5.5	135	22	25	85	60	22	20
36	5.0	100	17		70	45	19	18
37	4.0				55	35		
Garrett:								
40	5.5	140	25	25	90	60	30	25

TABLE 2.—*Yields per acre*—Continued

Soil name and map symbol	Irrigated crops						Dryfarmed crops	
	Alfalfa for hay	Corn		Sugar beets	Barley	Wheat	Barley	Wheat
		Grain	Silage					
	Tons	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*	*Bu*	*Bu*
Garrett—Continued:								
41	5.0	130	23	22	80	50	25	22
Harlan:								
46	5.5	----	19	----	90	60	30	25
47	4.0	----	----	----	70	40	25	20
Heldt:								
48	4.5	90	16	18	80	50	22	18
49	3.5	----	----	----	60	35	----	----
Keith:								
50	5.5	----	----	----	90	55	30	25
Kim:								
53	5.5	135	22	25	85	55	22	19
54	5.0	100	17	----	60	45	18	17
55	4.0	----	----	----	40	30	----	----
Kirtley:								
57	3.0	----	----	----	45	35	----	----
Larimer:								
61	4.5	110	18	18	75	50	22	19
62	3.5	----	----	----	50	40	----	----
Loveland:								
64	4.0	110	18	17	60	45	----	----
Minnequa:								
66	3.0	----	----	----	40	35	----	----
Nelson:								
71	3.0	----	----	----	40	35	----	----
Nunn:								
73	6.0	145	25	27	90	60	30	25
74	5.5	135	20	25	85	55	25	22
75	4.0	100	17	----	70	45	20	18
76	5.0	130	19	22	80	50	22	20
Otero:								
77	5.0	115	18	20	75	45	25	20
78	4.0	90	17	----	45	30	----	----
79	2.5	----	----	----	----	----	----	----
Paoli:								
81	5.5	140	25	24	80	60	25	20
Poudre:								
84	2.5	----	----	----	----	----	----	----
Renohill:								
89	3.5	100	18	17	60	50	20	18
90	2.5	----	----	----	40	35	----	----

TABLE 2.—*Yields per acre*—Continued

Soil name and map symbol	Irrigated crops						Dryfarmed crops	
	Alfalfa for hay	Corn		Sugar beets	Barley	Wheat	Barley	Wheat
		Grain	Silage					
	Tons	*Bu*	*Tons*	*Tons*	*Bu*	*Bu*	*Bu*	*Bu*
Satanta:								
94	6.0	145	26	26	90	65	35	25
95	5.5	140	25	25	80	60	30	23
96	5.0	110	20	----	70	45	25	20
97	----	----	----	----	----	----	20	18
Satanta Variant:								
98	5.0	120	21	20	75	45	18	16
Stoneham:								
100	5.5	130	23	24	90	65	23	20
101	5.0	125	22	22	80	55	22	19
102	4.0	90	17	----	70	45	20	17
103	3.5	----	----	----	50	35	----	----
Table Mountain:								
105	6.0	145	25	26	90	65	30	25
Thedalund:								
107	4.0	100	18	18	70	50	25	20
108	3.0	----	----	----	40	35	----	----
Ulm:								
113	4.5	110	20	24	85	55	23	19
114	3.5	80	16	----	70	40	20	17
Weld:								
115	5.5	140	24	25	90	65	30	25
Wiley:								
118	5.5	140	24	25	90	65	28	23
119	4.5	110	20	----	85	50	25	20

varieties; appropriate tillage practices, including time of tillage, seedbed preparation, and tilling when soil moisture is favorable; controlling weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops it is assumed that the irrigation system is suited to the soil and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The predicted yields reflect the relative productive capacity of the soil for each of the principal crops. Yields are likely to increase in the future as new production technology is developed. The relative productivity of a given soil compared to other soils, however, is not likely to change.

Crops other than those shown in table 2 are grown in the survey area, but because their acreage is small, predicted yields for these crops are not included. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the productivity and management concerns of the soils for those crops.

Range[4]

Rangeland grazing and related livestock enterprises are major sources of income in the survey area. The cow-calf operation is the major type of livestock operation. Range and grazable woodland account for about

[4] HARVEY A. SPROCK, range conservationist, Soil Conservation Service, helped to prepare this section.

59 percent, or 513,000 acres, of the privately owned land in the Area.

Larimer County Area is in three major land resource areas. The eastern part is in the Central High Plains area, the western part is in the Southern Rocky Mountains area, and the transition zone between the plains and mountains is in the Southern Rocky Mountain Foothills area. The average annual precipitation in the Central High Plains area is 11 to 16 inches, and 65 to 75 percent of this falls during the growing season. The frost-free period ranges from 130 to 160 days, and temperature ranges from the 90's in summer to the −20's in winter. In the Southern Rocky Mountain Foothills area the average annual precipitation is 11 to 16 inches, and 60 to 70 percent of this falls during the growing season. The frost-free period ranges from 120 to 150 days, and temperature ranges from the 90's in summer to the −20's in winter. The Southern Rocky Mountains area has an average annual precipitation of 12 to 20 inches or more, and more than 50 percent of this falls in winter in the form of snow. The frost-free period ranges from 30 to 100 days, and temperature ranges from the 70's in summer to the −40's in winter.

Range sites and condition classes

Soils that have the capacity to produce the same kinds, amounts, and proportions of range plants are grouped into range sites. A range site is the product of all the environmental factors responsible for its development.

A plant community existing within a range site that has not undergone abnormal disturbances is the potential, or climax, plant community for that site. Climax plant communities are not precise or fixed in their composition but vary, within reasonable limits, from year to year and from place to place. Abnormal disturbances, such as overuse by livestock, excessive burning, erosion, or plowing, result in changes in the climax plant community or even in complete destruction if the disturbance is drastic enough. If the range site has not deteriorated significantly under such disturbances, secondary plant succession progresses in the direction of a natural potential, or climax, plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential vegetation brought about by grazing or by other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is the same as that in the climax stand. It is in *good* condition if the percentage is 51 to 75, in *fair* condition if it is 26 to 50 percent, and in *poor* condition if it is less than 25 percent.

When changes occur in the climax plant community due to use by livestock or disturbance, some plant species increase and others decrease. This depends on the grazing animal, season of use, and the degree of use. By comparing the composition of the present plant community to the potential plant community, it is possible to see how individual species have increased while others decreased. Plants that are not present in the climax community but that show up in the present plant community are invaders of the site.

The composition of climax and present plant communities, together with other range site information, provides the basis for selecting range management systems. Management programs for range generally try to increase desirable plants and restore the range to as near climax condition as possible. Some programs are designed to create or maintain plant communities somewhat removed from the climax community to fit specific needs in the grazing program, to provide for wildlife habitat, or for other benefits. Any management objective should be compatible with conservation objectives.

Descriptions of the range sites

In the following pages the 24 range sites in Larimer County Area are briefly described and the climax plants and principal invaders on each site are named. Also given are estimates of the potential annual production expressed in terms of excellent condition, unless otherwise identified, for favorable and unfavorable years. These yields are given as the normal high and low rather than the extremes. Production is the total annual production in pounds of air-dry herbage per acre, which includes the current year's growth of leaves, stems, twigs, and fruit of all the plants on the site. Not all of this herbage is usable by livestock. The soils in each site can be determined by referring to the appropriate map unit description.

LOAMY PLAINS RANGE SITE

This site consists mainly of nearly level to strongly sloping soils. Elevation ranges from 4,500 to 5,700 feet. The soils are well drained and moderately deep or deep. The surface layer is medium textured. Permeability is moderate, and the available water capacity is medium to high.

Short grasses are suited to these soils because of their fibrous and relatively shallow root systems and their ability to go dormant during dry periods. The potential plant community is mostly blue grama and scattered western wheatgrass and needleandthread. Side-oats grama is in the steeper areas and just below the crest of ridges. Buffalograss is of minor importance, but is one of the first grasses to show up after extended dry periods and continued overgrazing. The approximate composition of the potential plant community, by percentage of total weight, is 55 percent blue grama, 10 percent western wheatgrass, 10 percent needleandthread, 10 percent buffalograss, 10 percent sedges, and 5 percent squirreltail. Other species include sand dropseed, three-awn, side-oats grama, and several species of forbs and shrubs.

The total annual production of air-dry vegetation ranges from 1,600 pounds per acre in favorable years to 750 pounds per acre in unfavorable years. As much as 85 percent of this production provides forage for cattle.

If this site is overgrazed, blue grama and buffalograss form a sod and production is lowered. Three-awn, snakeweed, pricklypear, and fringed sage increase as the range condition deteriorates. As the condition declines further rabbitbrush, yucca, and annuals invade.

SANDY PLAINS RANGE SITE

This site consists mainly of nearly level to strongly sloping soils. Elevation ranges from 3,800 to 5,000 feet. The soils are deep or moderately deep and well drained. The surface layer is moderately coarse textured. Permeability is moderate to rapid, and the available water capacity is low to high.

The potential plant community is mostly needleandthread, little bluestem, side-oats grama, and junegrass. Tall and short grasses are present but less important. Prairie sandreed and sand bluestem are the most important tall grasses. Blue grama provides much of the total production but is second to the midgrasses in general appearance. Sand sage and eriogonum are characteristic of the site but are widely scattered. The approximate composition of the potential plant community, by percentage of total weight, is 25 percent blue grama, 10 percent needleandthread, 10 percent sand bluestem, 10 percent prairie sandreed, 10 percent western wheatgrass, 10 percent side-oats grama, 10 percent little bluestem, and 10 percent switchgrass. The remaining 5 percent is junegrass, sedge, three-awn, sand dropseed, buffalograss, indiangrass, prairie-clover, yucca, wormwood, and fringed sage.

The total annual production of air-dry vegetation ranges from 2,000 pounds per acre in favorable years to 1,200 pounds per acre in unfavorable years. As much as 85 percent of this production provides forage for cattle.

Blue grama, three-awn, and sand dropseed are the main increasing grasses and sand sage, wormwood, fringed sage, and yucca are the main increasing shrubs as the range starts to deplete. As the condition declines further snakeweed, rabbitbrush, and annuals invade.

SALT MEADOW RANGE SITE

This site consists of nearly level soils. Elevation ranges from 4,500 to 6,000 feet. The soils are deep and poorly drained. The surface layer is fine textured. Permeability is slow, and the available water capacity is high. A water table is at or near the surface during most of the year. Salt content is high.

The approximate composition of the potential plant community, by percentage of total weight, is 30 percent alkali sacaton, 15 percent switchgrass, 15 percent western wheatgrass, 10 percent saltgrass, 10 percent alkali bluegrass, 10 percent sedges, and 10 percent Baltic rush. Other species include Nuttall alkaligrass, slender wheatgrass, prairie cordgrass, Canada wildrye, wild licorice, and four-wing saltbrush.

The total annual production of air-dry vegetation ranges from 3,000 pounds per acre in favorable years to 2,000 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle.

Saltgrass, sedges, Baltic rush, foxtail, and wild licorice are the main increasing species as the range starts to deplete. When the range is in poor condition foxtail, greasewood, and rabbitbrush dominate.

OVERFLOW RANGE SITE

This site consists of nearly level soils in draws, in valleys, on fans, and in other lowlands. This site is flooded periodically. Elevation generally is below 6,000 feet. The soils are deep and well drained. The surface layer is medium textured or moderately fine textured. Permeability is moderate or moderately slow, and the available water capacity is high.

The potential plant community is mostly tall grasses. Mid and short grasses are present but less important. Switchgrass, big bluestem, western wheatgrass, indiangrass, and blue grama are the most abundant species. The approximate composition of the potential plant community, by percentage of total weight, is 15 percent switchgrass, 15 percent western wheatgrass, 15 percent blue grama, 10 percent big bluestem, 10 percent indiangrass, 10 percent prairie sandreed, 10 percent side-oats grama, and 10 percent slender wheatgrass. The remaining 5 percent is green needlegrass, buffalograss, Canada wildrye, sedge, four-wing saltbush, and winterfat.

The total annual production of air-dry vegetation ranges from 3,000 pounds per acre in favorable years to 1,500 pounds per acre in unfavorable years. As much as 95 percent of this production provides forage for cattle.

Western wheatgrass, blue grama, buffalograss, three-awn, sand dropseed, and rabbitbrush are the main species to increase as the range starts to deplete. As the condition declines further snakeweed, wormwood, and annuals invade.

WET MEADOW RANGE SITE

This site consists of nearly level soils on meadows along streams, below permanent springs, and in valleys that have a high water table. Elevation generally is below 6,000 feet. The soils are deep and moderately deep and somewhat poorly drained. The surface layer is medium textured or moderately fine textured. The available water capacity is medium or high. A water table is within the root zone for at least part of the growing season.

The potential plant community is mostly tall grasses, mainly switchgrass, indiangrass, prairie cordgrass, and big bluestem. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent switchgrass, 10 percent big bluestem, 10 percent prairie cordgrass, 10 percent indiangrass, 10 percent alkali sacaton, 10 percent western wheatgrass and slender wheatgrass, 10 percent little bluestem, 10 percent alkali bluegrass, and 10 percent sedges. Other species include rushes, Canada wildrye, saltgrass, and wild licorice.

The total annual production of air-dry vegetation ranges from 4,000 pounds per acre in favorable years to 3,000 pounds per acre in unfavorable years. As much as 90 percent of this production provides forage for cattle.

Sedges, rushes, alkali sacaton, bluegrass, foxtail, and wild licorice are the main increasing species as the range starts to deplete. As the condition declines further foxtail and saltgrass increase and dandelion and annuals invade.

CLAYEY PLAINS RANGE SITE

This site consists mainly of nearly level or gently sloping soils on stream terraces. Elevation is below 5,500 feet. The soils are well drained and deep to moderately deep. The surface layer is moderately fine

textured or fine textured. Permeability is moderately slow or slow, and the available water capacity is medium or high.

The potential plant community is mostly western wheatgrass. Four-wing saltbush and winterfat are also dominant shrubs but are difficult to maintain under yearlong grazing. Blue grama and buffalograss are dominant grasses that increase when overgrazed. Low rabbitbrush, dryland sedges, red three-awn, and pricklypear are also present and increase when overgrazed. The approximate composition of the potential plant community, by percentage of total weight, is 35 percent western wheatgrass, 25 percent blue grama, 10 percent green needlegrass, 10 percent buffalograss, 10 percent squirreltail, and 10 percent sedges. Other species include alkali sacaton, three-awn, low rabbitbrush, snakeweed, four-wing saltbush, winterfat, and pricklypear.

The total annual production of air-dry vegetation ranges from 1,000 pounds per acre in favorable years to 400 pounds per acre in unfavorable years. As much as 90 percent of this production provides forage for cattle.

If the range is overgrazed, pricklypear, low rabbitbrush, and snakeweed increase sharply. When the range is in poor condition annuals and plants such as curlycup gumweed invade.

SHALY PLAINS RANGE SITE

This site consists of gently sloping to moderately steep soils on broken lands. Elevation ranges from 5,000 to 6,000 feet. The soils are shallow and well drained. The surface layer is moderately fine textured. Permeability is slow, and the available water capacity is low.

The potential plant community is mostly blue grama, alkali sacaton, and western wheatgrass. The approximate composition of the potential plant community, by percentage of total weight, is 25 percent blue grama, 25 percent alkali sacaton, 10 percent western wheatgrass, and 10 percent side-oats grama. The remaining 30 percent is buffalograss, sedge, sand dropseed, needleandthread, junegrass, Indian ricegrass, little bluestem, Freemont goldenweed, four-wing saltbush, and winterfat.

The total annual production of air-dry vegetation ranges from 900 pounds per acre in favorable years to 400 pounds per acre in unfavorable years. As much as 90 percent of this production provides forage for cattle.

Heavy grazing results in a decrease in the mid grasses and an increase in blue grama, buffalograss, rabbitbrush, and pricklypear. As the condition declines further snakeweed and annuals invade.

SANDSTONE BREAKS RANGE SITE

This range site consists of gently sloping to moderately steep soils. Elevation ranges from 4,500 to 6,500 feet. The soils are shallow and well drained. The surface layer is moderately coarse textured. Permeability is moderately rapid, and the available water capacity is low.

The potential plant community is mostly mid grasses, such as little bluestem, side-oats grama, and needleandthread. Blue grama is the dominant short grass, and threadleaf sedge is also common. The approximate composition of the potential plant community, by percentage of total weight, is 15 percent side-oats grama, 15 percent little bluestem, 20 percent blue grama, 10 percent prairie sandreed, 10 percent needleandthread, and 10 percent threadleaf sedges. The remaining 20 percent is junegrass, big bluestem, sand dropseed, Indian ricegrass, eriogonum, hairy goldaster, mountainmahogany, and skunkbush.

The total annual production of air-dry vegetation ranges from 1,000 pounds per acre in favorable years to 600 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle.

Blue grama, sand dropseed, three-awn, fringed sage, hairy goldaster, snakeweed, and yucca increase as the range starts to deplete. As the condition declines further snakeweed and annuals invade.

SHALLOW SILTSTONE RANGE SITE

This site consists of strongly sloping or moderately steep soils and is associated with barren exposures of the Brule Formation. Slopes are 5 to 20 percent. Elevation ranges from 4,500 to 6,000 feet. The soils are shallow and well drained. The surface layer is medium textured. Permeability is moderate, and the available water capacity is low.

The potential plant community is mostly blue grama. Threadleaf sedge, side-oats grama, western wheatgrass, needleandthread, sand dropseed, and little bluestem are also prominent. The approximate composition of the potential plant community, by percentage of total weight, is 45 percent blue grama, 10 percent western wheatgrass, 10 percent side-oats grama, 10 percent little bluestem, 10 percent needleandthread, 10 percent sand dropseed, and 5 percent threadleaf sedge. Other species include winterfat and four-wing saltbush.

The total annual production of air-dry vegetation ranges from 700 pounds per acre in favorable years to 400 pounds per acre in unfavorable years. As much as 90 percent of this production provides forage for cattle.

If range begins to deplete, the mid grasses decrease and a low production blue grama sod invades. As the condition declines further the sod breaks up and the bare spots support snakeweed, three-awn, sand dropseed, and such annuals as kochia and Russian-thistle.

LOAMY FOOTHILL RANGE SITE

This site consists mainly of nearly level to moderately steep soils in narrow valleys, on hills, and on large open flats. Elevation ranges from 5,000 to 7,000 feet. The soils are deep and moderately deep and well drained. The surface layer is medium textured. Permeability is moderate, and the available water capacity is medium or high.

The potential plant community is mostly western wheatgrass and green needlegrass. The approximate composition of the potential plant community, by percentage of total weight, is 30 percent western wheatgrass, 15 percent blue grama, 10 percent green needlegrass, 10 percent junegrass, 10 percent Griffith wheatgrass, and 10 percent little bluestem. The remaining 15 percent is needleandthread, side-oats

grama, Sandberg bluegrass, Indian ricegrass, squirreltail, sedge, Drummond milkvetch, and wormwood.

The total annual production of air-dry vegetation ranges from 1,500 pounds per acre in favorable years to 900 pounds per acre in unfavorable years. As much as 85 percent of this production provides forage for cattle.

Blue grama, wormwood, fringed sage, hairy goldaster, and snakeweed are the main species that increase as the range starts to deplete. As the condition declines further buffalograss, sleepygrass, and annuals invade.

GRAVELLY FOOTHILL RANGE SITE

This site consists of strongly sloping to steep soils. Elevation ranges from 5,000 to 7,000 feet. The soils are deep and well drained. The surface layer is moderately coarse textured and is gravelly or cobbly. Permeability is moderate to rapid, and the available water capacity is low or medium.

The potential plant community is mostly needleandthread, prairie sandreed, and little bluestem. The approximate composition of the potential plant community, by percentage of total weight, is 15 percent needleandthread, 15 percent little bluestem, 15 percent prairie sandreed, 15 percent blue grama, 10 percent side-oats grama, 10 percent mountain mulhy, 10 percent Griffith wheatgrass, and 10 percent western wheatgrass. Other species include Sandberg bluegrass, sedge, Geyer larkspur, eriogonum, and fringed sage.

The total annual production of air-dry vegetation ranges from 1,000 pounds per acre in favorable years to 700 pounds per acre in unfavorable years. As much as 85 percent of this production provides forage for cattle.

Western wheatgrass, blue grama, Sandberg bluegrass, and fringed sage increase as range condition declines. As the condition declines further sleepygrass, snakeweed, and annuals invade.

This site is hazardous for cattle grazing in spring and early summer when Geyer larkspur, a poisonous plant, is present.

SHALLOW FOOTHILL RANGE SITE

This site consists of nearly level to steep soils on ridges, hogbacks, and mesas. Elevation ranges from 5,200 to 7,000 feet. The soils are shallow and well drained. The surface layer is medium textured or moderately coarse textured and in places is channery or stony. Permeability is moderate to rapid, and the available water capacity is low.

The potential plant community is mainly browse-type vegetation. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent mountainmahogany, 15 percent big bluestem, 10 percent Griffith wheatgrass, 10 percent side-oats grama, 10 percent little bluestem, 10 percent needleandthread, and 10 percent blue grama. The remaining 15 percent is Sandberg bluegrass, Scribner needlegrass, mountain muhly, junegrass, Indian ricegrass, sedge, skunkbush sumac, wax currant, prickly-pear, and fringed sage.

The total annual production of air-dry vegetation ranges from 500 pounds per acre in favorable years to 300 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

Blue grama, Sandberg bluegrass, and fringed sage are the main plants to increase as the range starts to deplete. As the condition declines further western ragweed, sleepygrass, tall rabbitbrush, and annuals invade.

ROCKY FOOTHILL RANGE SITE

This site consists of moderately steep or steep soils. Slopes range from 10 to 40 percent. Elevation ranges from 5,600 to 7,000 feet. The soils are mainly deep or moderately deep and well drained. The surface layer is generally medium textured or moderately fine textured and in places it is cobbly or stony. Permeability is moderate or moderately slow, and the available water capacity is high.

The potential plant community is mostly big bluestem, little bluestem, Griffith wheatgrass, side-oats grama, needleandthread, blue grama, and western wheatgrass. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent big bluestem, 10 percent little bluestem, 10 percent Griffith wheatgrass, 10 percent side-oats grama, 10 percent needleandthread, 10 percent blue grama, and 10 percent western wheatgrass. The remaining 20 percent is Sandberg bluegrass, switchgrass, indiangrass, junegrass, sedge, mountain sunflower, eriogonum, Geyer larkspur, hairy goldaster, mountainmahogany, skunkbush sumac, and yucca.

The total annual production of air-dry vegetation ranges from 1,500 pounds per acre in favorable years to 1,000 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

Blue grama, western wheatgrass, Sandberg bluegrass, and wormwood increase as the range starts to deplete. As the condition declines further snakeweed, sleepygrass, and annuals invade.

CLAYEY FOOTHILL RANGE SITE

This site consists of nearly level to strongly sloping soils. Elevation ranges from 5,000 to 5,500 feet. The soils are deep and well drained. The surface layer is moderately fine textured. Permeability is moderate to slow, and the available water capacity is high.

The potential plant community is mostly mid grasses, mainly western wheatgrass, green needlegrass, and needleandthread. Blue grama is an important undercover species and smaller amounts of buffalograss, Indian ricegrass, and Sandberg bluegrass are scattered throughout. The approximate composition of the potential plant community, by percentage of total weight, is 45 percent western wheatgrass, 15 percent green needlegrass, 10 percent Sandberg bluegrass, 10 percent needleandthread, 10 percent fourwing saltbush, and 10 percent winterfat. Other species include buffalograss, Indian ricegrass, blue grama, prairie clover, and Drummond milkvetch.

The total annual production of air-dry vegetation ranges from 1,000 pounds per acre in favorable years to 800 pounds per acre in unfavorable years. As much as 90 percent of this production provides forage for cattle.

Blue grama, buffalograss, and three-awn are the

main increasing species as the range starts to deplete. Drummond milkvetch, rabbitbrush, and snakeweed also increase when the range is overgrazed. As the condition declines further, annuals and such plants as curlycup gumweed invade.

MOUNTAIN LOAM RANGE SITE

This site consists mainly of gently sloping to moderately steep soils on side slopes, terraces, and fans. Slopes are mostly 5 to 30 percent. Elevation ranges from 7,000 to 9,500 feet. The soils are deep and well drained. The surface layer is moderately coarse textured. Permeability is moderately rapid, and the available water capacity is medium.

The dominant grasses in the potential plant community are Arizona fescue, Idaho fescue, bearded wheatgrass, bluebunch wheatgrass, slender wheatgrass, western wheatgrass, bromegrasses, and needlegrass. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent Arizona fescue and Idaho fescue, 10 percent bearded wheatgrass and bluebunch wheatgrass, 10 percent slender wheatgrass, 10 percent needlegrasses, 10 percent western wheatgrass, 10 percent mountain brome and nodding brome, 10 percent mountain muhly, and 10 percent big sagebrush. The remaining 10 percent is Parry oatgrass, Thurber fescue, Sandberg bluegrass, sheep fescue, balsamroot, eriogonum, bitterbrush, snowberry, serviceberry, low rabbitbrush, and fringed sage.

The total annual production of air-dry vegetation ranges from 1,800 pounds per acre in favorable years to 1,200 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

Continued heavy grazing results in a decrease of grasses and an increase of big sagebrush. As the condition declines further tall rabbitbrush, snakeweed, and annuals invade.

ROCKY LOAM RANGE SITE

This site consists of nearly level to very steep soils on mountains and rolling outwash fans. Slopes are 1 to 55 percent. Elevation ranges from 6,000 to 9,500 feet. The soils are shallow and well drained. The surface layer is medium textured to moderately coarse textured and is gravelly or channery. Permeability is moderate or moderately rapid, and the available water capacity is low.

The potential plant community is mostly Idaho fescue, mountain muhly, Parry oatgrass, and needlegrass. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent Idaho fescue, 20 percent mountain muhly, 10 percent Parry oatgrass, 10 percent needlegrasses, 10 percent nodding brome, 10 percent Sandberg bluegrass, 10 percent junegrass, and 10 percent western wheatgrass. Other species include blue grama, sheep fescue, and sedge.

The total annual production of air-dry vegetation ranges from 900 pounds per acre in favorable years to 500 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

Blue grama, junegrass, sedge, and three-awn increase as the range starts to deplete. As the condition declines further ring muhly, sleepygrass, cactus, and gumweed invade.

LOAMY PARK RANGE SITE

This site consists of level to steep soils on fans, on terraces, in mountain valleys, on foot slopes, and on tablelands. Slopes are 0 to 30 percent. The soils are moderately deep and deep and well drained. The surface layer is medium textured or moderately coarse textured. Permeability is moderate to rapid, and the available water capacity is medium or high.

Mountain bunchgrasses give a grassy park appearance to this site. The potential plant community is mostly Arizona fescue, mountain muhly, and Parry oatgrass. The approximate composition of the potential plant community, by percentage of total weight, is 15 percent Arizona fescue, 15 percent mountain muhly, 15 percent Parry oatgrass, 10 percent western wheatgrass, 10 percent slender wheatgrass, and 10 percent bearded wheatgrass. The remaining 25 percent is junegrass, needlegrasses, mountain brome, nodding brome, blue grama, Sandberg bluegrass, sedges, and fringed sage.

The total annual production of air-dry vegetation ranges from 2,000 pounds per acre in favorable years to 1,200 pounds per acre in unfavorable years. As much as 85 percent of this production provides forage for cattle and sheep.

Blue grama, hairy goldaster, fringed sage, and lupine generally increase as the range starts to deplete. As the condition declines further Kentucky bluegrass and annuals invade.

DRY MOUNTAIN LOAM RANGE SITE

This site consists of level to steep soils on hills. Slopes are 0 to 40 percent. Elevation ranges from 7,500 to 8,500 feet. The soils are deep and well drained. The surface layer is medium textured to coarse textured and is gravelly or cobbly in places. Permeability is moderate to rapid. The available water capacity is mainly low to medium, but it is high in some of the soils.

Bluebunch wheatgrass, sheep fescue, pine needlegrass, streambank wheatgrass, Nevada bluegrass, junegrass, muttongrass, and sedges give a sparse, grassland appearance to the potential plant community. Sagebrush is dominant. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent bluebunch wheatgrass, 10 percent streambank wheatgrass, 10 percent pine needlegrass, 10 percent sheep fescue, 10 percent Nevada bluegrass, 10 percent muttongrass, and 10 percent junegrass. The remaining 20 percent is Sandberg bluegrass, sedge, Indian ricegrass, low rabbitbrush, bitterbrush, serviceberry, and snowberry.

The total annual production of air-dry vegetation ranges from 1,000 pounds per acre in favorable years to 500 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

As the range starts to deplete, sage, low rabbitbrush, and streambank wheatgrass increase. As the condition declines further tall rabbitbrush and annuals invade.

STONY LOAM RANGE SITE

This site consists of moderately steep and steep, stony soils on mountainsides. Slopes are 10 to 50 percent. Elevation ranges from 7,000 to 9,000 feet. The soils are generally moderately deep or deep and well drained. The surface layer is mostly moderately fine textured or moderately coarse textured. Permeability is generally moderate or moderately slow, and the available water capacity is medium or high.

Serviceberry, bitterbrush, big sagebrush, snowberry, and Douglas rabbitbrush give the appearance of a shrub plant community. Grasses and forbs, however, are dominant. The approximate composition of the potential plant community, by percentage of total weight, is 20 percent bluebunch wheatgrass, 10 percent Indian ricegrass, 10 percent Idaho fescue, 10 percent needlegrasses, 10 percent muttongrass, and 10 percent serviceberry. The remaining 30 percent is junegrass, western wheatgrass, sedge, bitterbrush, big sagebrush, and snowberry.

The total annual production of air-dry vegetation ranges from 2,000 pounds per acre in favorable years to 1,000 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

As the range starts to deplete, western wheatgrass, junegrass, big sagebrush, and fringed sage increase. As the condition declines further, annuals invade and fringed sage continues to increase.

MOUNTAIN MEADOW RANGE SITE

This site consists of level to gently sloping soils in valleys and swales. Slopes are 0 to 5 percent. Elevation ranges from 7,000 to 11,500 feet. The soils are deep and poorly drained or somewhat poorly drained. The surface layer is moderately fine textured to moderately coarse textured and is gravelly in places. Permeability is slow to rapid, and the available water capacity is low to high. A water table is within the root zone during most of the growing season.

The potential plant community is mostly tufted hairgrass, Nebraska sedge, ovalhead sedge, slender wheatgrass, Baltic rush, and Canada bluegrass. Some forbs occur in small amounts, and willows and shrubby cinquefoil are also present. The approximate composition of the potential plant community, by percentage of total weight, is 30 percent tufted hairgrass, 20 percent Nebraska sedge, 15 percent slender wheatgrass, 10 percent ovalhead sedge, 5 percent Baltic rush, and 5 percent willows. The remaining 15 percent is Canada bluegrass and shrubby cinquefoil.

The total annual production of air-dry vegetation ranges from 4,000 pounds per acre in favorable years to 2,000 pounds in unfavorable years. As much as 90 percent of this production provides forage for cattle.

As the range starts to deplete, Baltic rush, ovalhead sedge, and several forbs increase. As the condition declines further timothy, smooth brome, redtop, Kentucky bluegrass, and Canada thistle invade.

MOUNTAIN SHALE RANGE SITE

This site consists of level to steep soils on shale hills. Slopes are 0 to 30 percent. Elevation ranges from 7,000 to 9,000 feet. The soils are moderately deep and well drained. The surface layer is moderately fine textured. Permeability is slow, and the available water capacity is low or medium.

The potential plant community is mostly bluebunch wheatgrass, western wheatgrass, Indian ricegrass, squirreltail, and muttongrass. The approximate composition of the potential plant community, by percentage of total weight, is 25 percent bluebunch wheatgrass, 10 percent western wheatgrass, 10 percent Indian ricegrass, 10 percent squirreltail, 10 percent muttongrass, 10 percent Sandberg bluegrass, 10 percent needlegrasses, and 10 percent serviceberry. The remaining 5 percent is lupine, milkvetch, eriogonum, big sagebrush, Douglas rabbitbrush, and winterfat.

The total annual production of air-dry vegetation ranges from 700 pounds per acre in favorable years to 200 pounds per acre in unfavorable years. As much as 80 percent of this production provides forage for cattle and sheep.

As the range starts to deplete, big sagebrush increases. As the condition declines further annuals invade.

SUBALPINE LOAM RANGE SITE

This site consists of nearly level to moderately steep soils in open parks and on mountainsides. Slopes are 2 to 15 percent. Elevation ranges from 8,000 to 9,000 feet. The soils are deep or moderately deep and well drained. The surface layer is moderately coarse textured. Permeability is moderately rapid to moderately slow, and the available water capacity is low to high.

The potential plant community is mostly Thurber fescue, Parry oatgrass, Idaho fescue, and big bluegrass. Shrubs are of minor importance, although a few are generally scattered throughout. The approximate composition of the potential plant community, by percentage of total weight, is 35 percent Thurber fescue, 20 percent Parry oatgrass, 10 percent Idaho fescue, 10 percent big bluegrass, and 10 percent Columbia needlegrass and Letterman needlegrass. The remaining 15 percent is slender wheatgrass, western wheatgrass, nodding brome, and snowberry.

The total annual production of air-dry vegetation ranges from 3,500 pounds per acre in favorable years to 2,000 pounds per acre in unfavorable years. As much as 85 percent of this production provides forage for cattle and sheep.

As the range starts to deplete, mountain big sage is dominant. Lupine, fringed sage, cinquefoil, and yarrow also increase. As the condition declines further, Kentucky bluegrass, Douglas rabbitbrush, rubber rabbitbrush, and annuals invade.

Woodland [5]

Most of the woodland in Larimer County Area is in the western and northwestern parts of the survey area. The main native trees at the lower elevations are ponderosa pine, Douglas-fir, and Rocky Mountain juniper. Douglas-fir is mainly on the northern slopes. Engelmann spruce, subalpine fir, and lodgepole pine are the main trees at higher elevations. Aspen also

[5] SHERMAN J. FINCH, woodland conservationist, Soil Conservation Service, helped to prepare this section.

grows, mainly in small groves or as scattered trees. One small isolated grove of pinyon, northwest of the city of Fort Collins, is unique in that it is the most northwestern location in the United States for this tree.

The woodland areas are about equally divided between private and government ownership. Most of the government-administered land is national forest, but some is State and county owned.

Much of this woodland was logged by early settlers. Little of the privately owned woodland is managed for timber production, although it is used for poles, fenceposts, and firewood. Almost all of the area is used for grazing, recreation, and wildlife habitat. In recent years much of the privately owned woodland has been used as sites for summer and year-round homes.

Woodland suitability groups

The soils in the mountainous part of Larimer County Area have been placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need about the same management, and that have the same potential production.

Each woodland group is identified by a three-part symbol, for example, 6o1. The potential productivity of the soils in the group is indicated by the first numeral in the symbol: 1 is very high; 2, high; 3, moderately high; 4, moderate; 5, moderately low; and 6, low. These ratings are based on field determination of average site index. Site index of a given soil is the height, in feet, that the taller trees of a given species reach in a natural, essentially unmanaged stand in a stated number of years.

The second part of the symbol is a small letter. In this survey, *x*, *d*, and *o* are used. The small letter indicates an important soil property that imposes a hazard or limitation in managing the soils for trees. The letter *x* indicates that the soil has major limitations because of rockiness or stoniness. The letter *d* indicates that the soil has a restricted rooting depth. The letter *o* shows that the soils have few limitations that restrict their use for trees.

The third part of the symbol, another numeral, differentiates groups that have the same first and second parts in their identifying symbols.

Soils that have not been placed in a woodland suitability group are not suited to or are not used for woodland. The woodland suitability group is shown at the end of the mapping unit description for applicable soils.

The woodland suitability groups in the survey area are briefly described in the following paragraphs.

Woodland suitability group 6o1.—The soils in this group are suited to the production of ponderosa pine. They are capable of producing about 2,020 cubic feet per acre, or 7,800 board feet, in a managed, even-aged stand of 100-year-old trees. There are no major limitations to the use of the soils for woodland.

Woodland suitability group 6x1.—The soils in this group are suited to the production of ponderosa pine. They are capable of producing about 1,610 cubic feet per acre, or 5,300 board feet, in a managed, even-aged stand of 100-year-old trees. The hazard of erosion is high, and equipment limitations and seedling mortality are moderate.

Woodland suitability group 6x2.—The soils in this group are suited to the production of Engelmann spruce. They are capable of producing about 3,300 cubic feet per acre, or 9,000 board feet, in managed, even-aged stands of 90-year-old trees. Seedling mortality is severe, and the equipment limitations and windthrow hazard are moderate.

Woodland suitability group 6d1.—The soils in this group are suited to the production of ponderosa pine. They are capable of producing about 1,610 cubic feet per acre, or 5,300 board feet, in a managed, even-aged stand of 100-year-old trees. Seedling mortality is severe, and the hazard of erosion, equipment limitations, and windthrow hazard are moderate.

Woodland suitability group 6d2.—The soils in this group are suited to the production of lodgepole pine. They are capable of producing about 2,490 cubic feet per acre, or 4,900 board feet, in a managed, even-aged stand of 90-year-old trees. Seedling mortality is severe, and the hazard of erosion, equipment limitations, and windthrow hazard are moderate.

Windbreaks [6]

The native vegetation on the plains in Larimer County Area is grass. Early settlers planted trees for beautification and protection, mainly around farmsteads. Many of these trees still survive, although most of them, mainly cottonwood and willows, in the plains are along the streams and drainageways.

Windbreaks and tree plantings can be very beneficial to landowners. They help to reduce home heating costs by reducing winds. They help to protect livestock from winter storms and drifting snow. They provide habitat for wildlife and birds and enhance the beauty and value of homesteads.

If windbreaks are planted, care is needed establishing them. Evergreens are among the most desirable trees because they are long lived and resist damage by wind, snow, and disease. They provide protection from winds, which occur before deciduous trees leaf. Evergreens grow much more slowly than deciduous trees for the first few years and should, therefore, be planted in rows separate from the faster growing but short-lived broadleaf trees.

Climatic conditions limit the kinds of trees and shrubs that can be grown, and careful selection, therefore, is necessary. Cultivation reduces competition from weeds and grass and also the hazard of destructive fires.

Replacing trees lost in the first years to develop a continuous, uniform wind barrier. Pruning should be limited to the removal of dead branches.

Protection of newly planted trees from livestock and other animals is important. Rabbits, mice, deer, and antelope can damage trees. Repellants can be applied in fall to help protect the young trees. Providing supplemental water to newly planted trees is beneficial and increases survival. Adequate water should be sup-

[6] SHERMAN J. FINCH, woodland conservationist, Soil Conservation Service, helped to prepare this section.

plied during the first year to help the plants develop a good root system.

Assistance in planning windbreaks is available through the local office of the Soil Conservation Service or the Colorado State Forest Service.

Windbreak suitability groups

Soils in the eastern part of the survey area have been placed in five groups based on soil properties. The group in which each soil has been placed is shown at the end of the mapping unit description. The soils in each group are suited to similar species and have similar response to management. Table 3 lists the expected performance of a few of the species. The height, growth, and survival estimates are based on general observations and estimates. Group 4 is not rated in this table because it consists of soils on which establishment is marginal or not recommended. Group 5 is not rated in table 3, but the soils in this group have some native trees, mainly cottonwood and willows. The table also gives the expected height that trees and shrubs of each species reach at about 20 years of age and the survival rate of new trees that can reasonably be expected after 1 or 2 years, if replanting is required. The rating in the "Vigor" column refers to the density of foliage, freedom from disease or damage from insects, and the general appearance of the tree.

Soils on foothills and in the mountainous part of the Area have not been placed in windbreak groups, because windbreaks are seldom planted in these areas. Soils on the foothills that are similar to those on the plains can be expected to have growth rates equal to or better than those on plains because of somewhat better moisture relationships.

The windbreak suitability groups in the survey area are briefly described in the following paragraphs.

WINDBREAK SUITABILITY GROUP 1

This group consists of deep and moderately deep, well drained loams, silt loams, and clay loams. It occupies a large part of the plains part of the survey area.

WINDBREAK SUITABILITY GROUP 2

This group consists of deep and moderately deep, well drained sandy loams and fine sandy loams. This group is relatively small in extent and is mainly in the extreme eastern part of the survey area. Soil blowing is a hazard in some places. Leaving a strip of vegetation or stubble between rows of trees helps to overcome this hazard.

WINDBREAK SUITABILITY GROUP 3

This group consists of shallow soils and clayey soils that are well drained but that either have low available water capacity or lack good aeration for tree roots. Also included in this group are some complexes that include soils that are suitable for tree planting and soils that are not. Careful onsite investigation is necessary before planting on the soils of these complexes.

WINDBREAK SUITABILITY GROUP 4

This group consists of soils that are generally unsuitable or unfavorable for tree planting because of one or more limitations. These limitations are salinity, alkalinity, shallowness, and low available water capacity.

WINDBREAK SUITABILITY GROUP 5

This group consists of deep and moderately deep, poorly drained soils on bottom lands, on low terraces, and in upland valleys. The water table is within the root zone of trees and shrubs. Salinity is slight to moderate. Many of the soils are subject to flooding. These factors limit the establishment of trees, and only water- and salt-tolerant trees and shrubs are suitable for planting. Cottonwood and willows generally grow on these soils, but these trees are seldom planted.

Wildlife [7]

Wildlife is a product of the soil on which it lives. From the soil must come the various components that make up areas where wildlife can find places to feed, breed, rear young, escape enemies, and otherwise survive. Basically, the soil must provide food, cover, and water; these make up wildlife habitat.

The quality and quantity of habitat available largely determine the kinds of wildlife that are present. Although the soils largely determine the availability and kinds of habitat, land use and management and availability of water also greatly influence wildlife populations in Larimer County Area.

Land use, to a large extent, determines the kinds of wildlife that are present and their populations.

The availability of water for irrigation has resulted in land use changes that greatly affected the kinds and numbers of wildlife. Irrigation has changed substantial areas from range, which has limited natural precipitation, to cropland. Wheat, barley, dry beans, corn, and hay are the main irrigated crops. The introduction of grain and, to a lesser extent, forage crops has allowed an excellent population of waterfowl and at least a fair population of pheasants to become established where previously only wildlife species native to range existed.

Soils directly influence the kinds and amounts of vegetation and the amount of water available, and in this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are thickness of the soil useful to crops, surface texture, available water capacity, wetness, surface stoniness or rockiness, hazard of flooding, slope, and permeability.

In table 4 the soils of this survey area are rated for producing seven elements of wildlife habitat and four groups or kinds of wildlife. The ratings indicate relative suitability for various elements. These ratings are good, fair, poor, and very poor.

A rating of *good* means that habitat is easily improved, maintained, or created. There are few or no soil limitations in habitat management, and satisfactory results can be expected.

A rating of *fair* means that habitat can be improved, maintained, or created on these soils, but that moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention is required to ensure satisfactory results.

[7] By ELDIE W. MUSTARD, biologist, Soil Conservation Service.

TABLE 3.—*Suitability of windbreak suitability*

Soils	Ponderosa pine			Rocky Mountain juniper		
	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor
	Feet	*Percent*		*Feet*	*Percent*	
Group 1	18–20	80	Good	8–12	80	Good
Group 2	20–22	90	Good	10–14	90	Good
Group 3	12–15	75	Fair	8–10	80	Good

A rating of *poor* means that habitat can be improved, maintained, or created on these soils, but the soil limitations are severe. Habitat management is difficult and expensive and requires intensive effort in places. Results are questionable.

A rating of *very poor* means that under the prevailing soil conditions it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

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

The elements of wildlife habitat for which the soils are rated in table 4 are briefly described in the following paragraphs.

Grain and seed crops are annual grain-producing plants, such as barley, wheat, corn, and dry beans.

Grasses and legumes are domestic grasses and legumes that are established by planting and provide food and cover for wildlife. Grasses include tall and intermediate wheatgrasses, meadow foxtail, Russian wildrye, reed canary-grass, and timothy. Legumes commonly used are alfalfa, sweetclover, red clover, and alsike clover.

Wild herbaceous plants are native or introduced perennial grasses and forbs that provide food and cover for upland wildlife. Examples are Indian ricegrass, western wheatgrass, alkali sacaton, blue grama, saltgrass, foxtail barley, alkali cordgrass, and switchgrass. Forbs include loco, fringed sage, hairy goldaster, sunflower, yucca, and pricklypear.

Coniferous plants are cone-bearing trees and shrubs that provide cover and frequently furnish food in the form of browse, seeds, or fruitlike cones. They commonly grow in their natural environment, but can be planted and managed. Examples are pines, juniper, and ornamental trees and shrubs.

Shrubs produce buds, twigs, barks, or foliage that is used as food by wildlife, or they provide cover and shade for some wildlife species. These plants most commonly grow in their natural environment. Examples are four-wing saltbush, rabbitbrush, big sagebrush, mountainmahogany, bitterbrush, and serviceberry.

Wetland plants are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Examples are smartweed, tufted hairgrass, spikerush and other rushes, sedges, cattails, and northern reedgrass. Submerged and floating aquatics are not included in this category.

Shallow water areas are areas of surface water that have an average depth of less than 5 feet that are useful to wildlife. They are natural wet areas or those created by dams or levees or by water-control devices in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

Table 4 also rates soils according to their suitability as habitat for the four kinds of wildlife in the survey area—open-land, woodland, wetland, and rangeland. These ratings are related to ratings made for the elements of habitat. For example, soils rated as *very poor* for shallow water developments are rated *very poor* for wetland wildlife.

Open-land wildlife consists of birds and mammals in areas of cropland, pasture, meadow, lawns and in areas overgrown with grasses, herbs, shrubs, and vines. Examples are robin, house finch, American kestrel, red-tailed hawk, pheasant, western meadowlark, mourning dove, killdeer, cottontail, jackrabbit, and red fox.

Woodland wildlife consists of birds and mammals in wooded areas containing either hardwood or coniferous trees and shrubs, or a mixture of both. Examples are blue grouse, Steller's jay, Clark's nutcracker, thrushes, vireos, woodpeckers, snowshoe hare, bobcat, mule deer, and black bear.

Wetland wildlife consists of birds and mammals in swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, rails, red-winged blackbird, kingfishers, muskrat, mink, beaver, and raccoon.

Rangeland wildlife consists of birds and mammals in natural range. Examples are pronghorn antelope, coyote, jackrabbit, mountain plover, lark bunting, golden eagle, and western meadowlark.

groups for tree and shrub plantings

Siberian elm			Russian-olive			Common lilac			Squawbush (Quailbush)		
Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor*
Feet	*Percent*		*Feet*	*Percent*		*Feet*	*Percent*		*Feet*	*Percent*	
20–25	90	Fair	16–20	85	Fair	6–8	90	Good	5–7	90	Good.
25–30	95	Good	16–20	90	Good	6–8	90	Good	5–7	90	Good.
15–20	80	Fair	12–18	80	Good	5–7	85	Fair	4–6	85	Good.

Recreation [8]

Knowledge of soils and their properties is necessary in planning, developing, and maintaining areas that are used for recreation. In table 5 the soils in Larimer County Area are rated according to their limitations to use for playgrounds, camp areas, picnic areas, and paths and trails. Additional soil interpretations for use in planning recreational developments are also found in this table.

In table 5 the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that the soil properties are generally favorable and limitations are so minor that they can be easily overcome. A *moderate* limitation is one that can be overcome or modified by planning, by design, or by special maintenance. A limitation of *severe* means that costly soil reclamation, special design, or intensive maintenance, or a combination of these, is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils for this use have mild slopes, have good drainage, have a surface free of rocks and coarse fragments, are free from flooding during periods of heavy use, and have a surface that is firm after rain but not dusty when dry.

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

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

Paths and trails include areas used for local and cross-country footpaths, as well as bridle paths. It is assumed that these trails are used as they occur in nature, with little or no soil preparation. Wetness, flooding, slope, surface texture, coarse fragments on the surface, and surface rockiness or stoniness are the main limitations.

[8] By ELDIE W. MUSTARD, biologist, Soil Conservation Service.

Soil Properties

Extensive data about soil properties collected during the soil survey are summarized in this section. The two main sources of these data are the many thousands of soil borings made during the coarse of the survey and the laboratory analyses of samples from representative soil profiles.

When the soil scientist makes soil borings during field mapping, he can identify several soil properties. These properties include the seasonal moisture condition, or the presence of free water and its depth in the profile; the thickness of the soil and its color; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; the consistence of soil in place under the existing moisture conditions; the root depth of existing plants; soil pH or reaction; and content of free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observations. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data, and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area.

Engineering properties

Table 6 gives estimates of engineering properties

TABLE 4.—*Wildlife*

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated. Asterisk behavior of the whole

Soil name and map symbol	Potential for habitat elements [1]—			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Altvan:				
1, 2	Fair	Good	Good	
*3, 4:				
Altvan part	Fair	Good	Good	
Satanta part	Fair	Good	Fair	
Aquepts:				
5	Very poor	Poor	Fair	
6	Very poor	Poor	Fair	
Ascalon:				
7, 8	Fair	Good	Fair	
Bainville:				
*9:				
Bainville part	Fair	Fair	Fair	
Epping part	Poor	Poor	Fair	
*10:				
Bainville part	Fair	Fair	Fair	
Keith part	Fair	Good	Fair	
Baller:				
*11:				
Baller part	Very poor	Very poor	Poor	
Carnero part	Poor	Fair	Fair	
*12:				
Baller part	Very poor	Very poor	Poor	
Rock outcrop part.				
Blackwell:				
13	Poor	Poor	Fair	
Boyle:				
14, 15	Very poor	Very poor	Poor	
*16, 17:				
Boyle part	Very poor	Very poor	Poor	
Ratake part	Poor	Poor	Poor	
Breece:				
18, 19, 20	Fair	Fair	Good	
Carnero:				
21	Poor	Fair	Fair	
Caruso:				
22	Fair	Fair	Good	
Clergern:				
23	Poor	Poor	Fair	
Connerton:				
*24, 25:				
Connerton part	Poor	Fair	Fair	
Barnum part	Poor	Fair	Good	
Cushman:				
26, 27	Fair	Good	Fair	
Driggs:				
28, 29	Poor	Poor	Good	

habitat potentials

indicates mapping unit consists of two or more dominant kinds of soil. See mapping unit description for composition and mapping unit]

Potential for habitat elements [1]—Continued			Potential as wildlife habitat for—			
Shrubs	Wetland plants	Shallow water areas	Open-land	Woodland	Wetland	Rangeland
Good	Poor	Very poor	Good		Very poor	Good.
Good Poor	Poor Very poor	Very poor Very poor	Good Fair		Very poor Very poor	Good. Fair.
Very poor Very poor	Good Good	Poor Good	Fair Fair		Fair Fair	Poor. Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair ----------	Poor Very poor	Very poor Very poor	Fair Fair		Very poor Very poor	Fair. Poor.
Fair Good	Poor Very poor	Very poor Very poor	Fair Good		Very poor Very poor	Fair. Good.
Fair Poor	Very poor Poor	Very poor Very poor	Very poor Fair		Very poor Very poor	Poor. Fair.
Fair	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Good	Good	Poor		Good	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Poor.
Fair Good	Very poor Poor	Very poor Very poor	Poor Fair		Very poor Very poor	Poor. Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Poor	Poor	Very poor	Fair		Very poor	Fair.
Fair	Fair	Fair	Fair		Fair	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair Good	Poor Poor	Very poor Very poor	Poor Fair		Very poor Very poor	Fair. Good.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Good	Poor	Very poor	Fair		Very poor	Good.

TABLE 4.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements [1]—			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Elbeth:				
*30:				
Elbeth part	Poor	Fair	Good	Good
Moen part	Poor	Poor	Good	
Farnuf:				
31	Fair	Good	Good	
*32:				
Farnuf part	Fair	Good	Good	
Boyle part	Very poor	Very poor	Poor	
Rock outcrop part.				
Fluvaquents:				
33	Very poor	Poor	Fair	
Fort Collins:				
34, 35, 36, 37	Fair	Fair	Fair	
Foxcreek:				
38	Very poor	Poor	Fair	
Gapo:				
39	Very poor	Poor	Good	
Garrett:				
40, 41	Fair	Good	Good	
Gravel pits:				
42.				
Haploborolls:				
*43:				
Haploborolls part	Very poor	Very poor	Very poor	
Rock outcrop part.				
Haplustolls:				
44	Very poor	Very poor	Very poor	
*45:				
Haplustolls part	Very poor	Very poor	Very poor	
Rock outcrop part.				
Harlan:				
46, 47	Fair	Good	Good	
Heldt:				
48, 49	Fair	Fair	Poor	
Keith:				
50	Good	Good	Fair	
Kildor:				
51	Poor	Poor	Good	
*52:				
Kildor part	Poor	Poor	Good	
Shale outcrop part.				
Kim:				
53, 54, 55	Poor	Fair	Fair	
*56:				
Kim part	Poor	Fair	Fair	
Thedalund part	Poor	Poor	Fair	

potentials—Continued

Potential for habitat elements [1]—Continued			Potential as wildlife habitat for—			
Shrubs	Wetland plants	Shallow water areas	Open-land	Woodland	Wetland	Rangeland
Good	Very poor	Very poor	Fair	Good	Very poor	Good.
Good	Very poor	Very poor	Fair		Very poor	Good.
Good		Very poor	Good		Very poor	Good.
Good		Very poor	Good		Very poor	Good.
Fair	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Good	Good	Poor		Good	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Good	Good	Poor		Good	Fair.
Good	Very poor	Very poor	Good		Very poor	Good.
Good	Very poor	Very poor	Good		Very poor	Good.
Fair	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Very poor	Very poor	Very poor		Very poor	Poor.
Good	Poor	Very poor	Good		Very poor	Good.
Poor	Poor	Very poor	Fair		Very poor	Poor.
Good	Very poor	Very poor	Good		Very poor	Good.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.

TABLE 4.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements [1]—			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Kirtley:				
57	Fair	Good	Good	
*58:				
Kirtley part	Fair	Good	Good	
Purner part	Very poor	Poor	Fair	
LaPorte:				
*59:				
LaPorte part	Poor	Fair	Fair	
Rock outcrop part.				
Larim:				
60	Poor	Fair	Fair	
Larimer:				
61	Poor	Fair	Fair	
*62:				
Larimer part	Poor	Fair	Fair	
Stoneham part	Poor	Poor	Good	
Longmont:				
63	Very poor	Poor	Fair	
Loveland:				
64	Very poor	Poor	Good	
Midway:				
65	Poor	Fair	Fair	
Minnequa:				
66	Poor	Poor	Fair	
*67:				
Minnequa part	Poor	Poor	Fair	
LaPorte part	Poor	Fair	Fair	
Miracle:				
68	Poor	Poor	Good	
Naz:				
69, 70	Poor	Poor	Good	
Nelson:				
71	Poor	Fair	Fair	
Newfork:				
72	Very poor	Poor	Fair	
Nunn:				
73, 74, 75	Fair	Fair	Fair	
76	Fair	Fair	Fair	
Otero:				
77, 78, 79	Poor	Fair	Fair	
*80:				
Otero part	Poor	Fair	Fair	
Nelson part	Poor	Fair	Fair	
Paoli:				
81	Fair	Fair	Fair	
Pendergrass:				
*82:				
Pendergrass part	Very poor	Very poor	Poor	
Rock outcrop part.				

potentials—Continued

Potential for habitat elements [1]—Continued			Potential as wildlife habitat for—			
Shrubs	Wetland plants	Shallow water areas	Open-land	Woodland	Wetland	Rangeland
Good	Very poor	Very poor	Good		Very poor	Fair.
Good Fair	Very poor Poor	Very poor Very poor	Good Poor		Very poor Very poor	Fair. Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair Fair	Very poor Very poor	Very poor Very poor	Fair Fair		Very poor Very poor	Fair. Fair.
Poor	Good	Good	Very poor		Good	Poor.
Fair	Good	Good	Poor		Good	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Poor.
Poor	Poor	Very poor	Poor		Very poor	Poor.
Poor Fair	Poor Very poor	Very poor Very poor	Poor Fair		Very poor Very poor	Poor. Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Good	Very poor	Very poor	Fair		Very poor	Good.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Good	Good	Poor		Good	Fair.
Fair Fair	Poor Good	Very poor Poor	Fair Fair		Very poor Fair	Fair. Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair Fair	Poor Poor	Very poor Very poor	Fair Fair		Very poor Very poor	Fair. Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Poor.

TABLE 4.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements [1]—			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Pinata:				
*83:				
Pinata part	Very poor	Very poor	Fair	Fair
Rock outcrop part.				
Poudre:				
84	Poor	Fair	Good	
Purner:				
85	Very poor	Poor	Fair	
*86:				
Purner part	Very poor	Poor	Fair	
Rock outcrop part.				
Ratake:				
*87:				
Ratake part	Very poor	Very poor	Poor	
Rock outcrop part.				
Redfeather:				
88	Very poor	Very poor	Poor	Very poor
Renohill:				
89, 90	Fair	Good	Fair	
*91:				
Renohill part	Fair	Good	Fair	
Midway part	Poor	Fair	Fair	
Riverwash:				
92	Very poor	Very poor	Poor	
Rock outcrop:				
93.				
Satanta:				
94, 95, 96, 97	Fair	Good	Fair	
Satanta Variant:				
98	Good	Good	Fair	
Schofield:				
*99:				
Schofield part	Poor	Poor	Good	Good
Redfeather part	Very poor	Very poor	Poor	Very poor
Rock outcrop part.				
Stoneham:				
100, 101, 102, 103	Poor	Fair	Fair	
Sunshine:				
104	Poor	Poor	Good	
Table Mountain:				
105	Fair	Fair	Fair	
Tassel:				
106	Very poor	Poor	Poor	
Thedalund:				
107, 108	Poor	Poor	Fair	

potentials—Continued

Potential for habitat elements [1]—Continued			Potential as wildlife habitat for—			
Shrubs	Wetland plants	Shallow water areas	Open-land	Woodland	Wetland	Rangeland
Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair.
Good	Good	Good	Fair		Good	Good.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Good	Very poor	Very poor	Poor		Very poor	Fair.
Poor	Very poor	Very poor	Very poor	Very poor	Very poor	
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair Fair	Poor Very poor	Very poor Very poor	Fair Fair		Very poor Very poor	Fair. Fair.
Very poor	Fair	Very poor	Very poor		Poor	Poor.
Poor	Very poor	Very poor	Fair		Very poor	Fair.
Good	Fair	Fair	Good		Fair	Fair.
Fair Poor	Poor Very poor	Very poor Very poor	Fair Very poor	Good Very poor	Very poor Very poor	
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Good	Poor	Very poor	Fair		Very poor	Fair.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.

TABLE 4.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements [1]—			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Thiel:				
109	Poor	Fair	Good	
Tine:				
110, 111	Poor	Poor	Fair	
Trag:				
*112:				
Trag part	Very poor	Very poor	Fair	
Moen part	Poor	Poor	Good	
Ulm:				
113, 114	Fair	Fair	Good	
Weld:				
115	Fair	Fair	Fair	
Wetmore:				
*116:				
Wetmore part	Very poor	Very poor	Poor	Poor
Boyle part	Very poor	Very poor	Poor	
Moen part	Poor	Poor	Good	
*117:				
Wetmore part	Very poor	Very poor	Poor	Poor
Boyle part	Very poor	Very poor	Poor	
Rock outcrop part.				
Wiley:				
118, 119	Poor	Fair	Fair	

[1] If irrigated, potential will be higher.

and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a typical profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in the section "Descriptions of the Soils."

Soil texture is described in table 6 in standard terms used by the Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering are the Unified soil classification system (*1*) and the system of the American Association of State Highway and Transportation Officials (AASHTO) (*2*). In table 6 soils in the survey area are classified according to both systems.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. The soils are grouped into 5 classes. There are eight classes of coarse-grained soils, identified as GW GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example CL–ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are coarse grained soils that are low in content of fines. At the other extreme, in group A–7, are fine grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection. When laboratory data are available, the A–1, A–2, and A–7 groups are further classified as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. The estimated classification of soils in the survey area is given

potentials—Continued

Potential for habitat elements [1]—Continued			Potential as wildlife habitat for—			
Shrubs	Wetland plants	Shallow water areas	Open-land	Woodland	Wetland	Rangeland
Good	Very poor	Very poor	Fair		Very poor	Good.
Fair	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Good	Very poor	Very poor	Fair		Very poor	Good.
Good	Poor	Poor	Fair		Very poor	Fair.
Poor	Very poor	Poor	Fair		Very poor	Poor.
Good	Very poor	Very poor	Very poor	Poor	Very poor.	
Fair	Very poor	Very poor	Poor		Very poor	Poor.
Good	Very poor	Very poor	Fair		Very poor	Good.
Good	Very poor	Very poor	Very poor	Poor	Very poor.	
Fair	Very poor	Very poor	Poor		Very poor	Poor.
Poor	Poor	Very poor	Fair		Very poor	Poor.

in table 6. Also in table 6 the percentage, by weight, of cobbles or rock fragments more than 3 inches in diameter are estimated for each major horizon. These estimates are determined largely by observing the volume percentage in the field and then converting it, by formula, to weight percentage.

The percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil. These indexes are used in both the Unified and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observation of the many soil borings made during the survey.

All estimates in table 6 have been rounded to the nearest 5 percent. Thus, when the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percentage points), the classification in the marginal zone has been omitted.

Physical and chemical properties

Table 7 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field, particularly soil structure, porosity, and gradation or texture, that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not