SOIL SURVEY OF

Rio Grande County Area, Colorado

United States Department of Agriculture
Soil Conservation 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 1966-71. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Rio Grande and Center 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 soil 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 and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of the Rio Grande 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 with a number on the Index to Map Sheets.

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

Finding and Using Information

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

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

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

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 names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for picnic areas, camp sites, and other recreational uses of the soils in the section "Recreation."

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

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

Necomers in the Rio Grande County Area may be especially interested in the section "General Nature of the Area."

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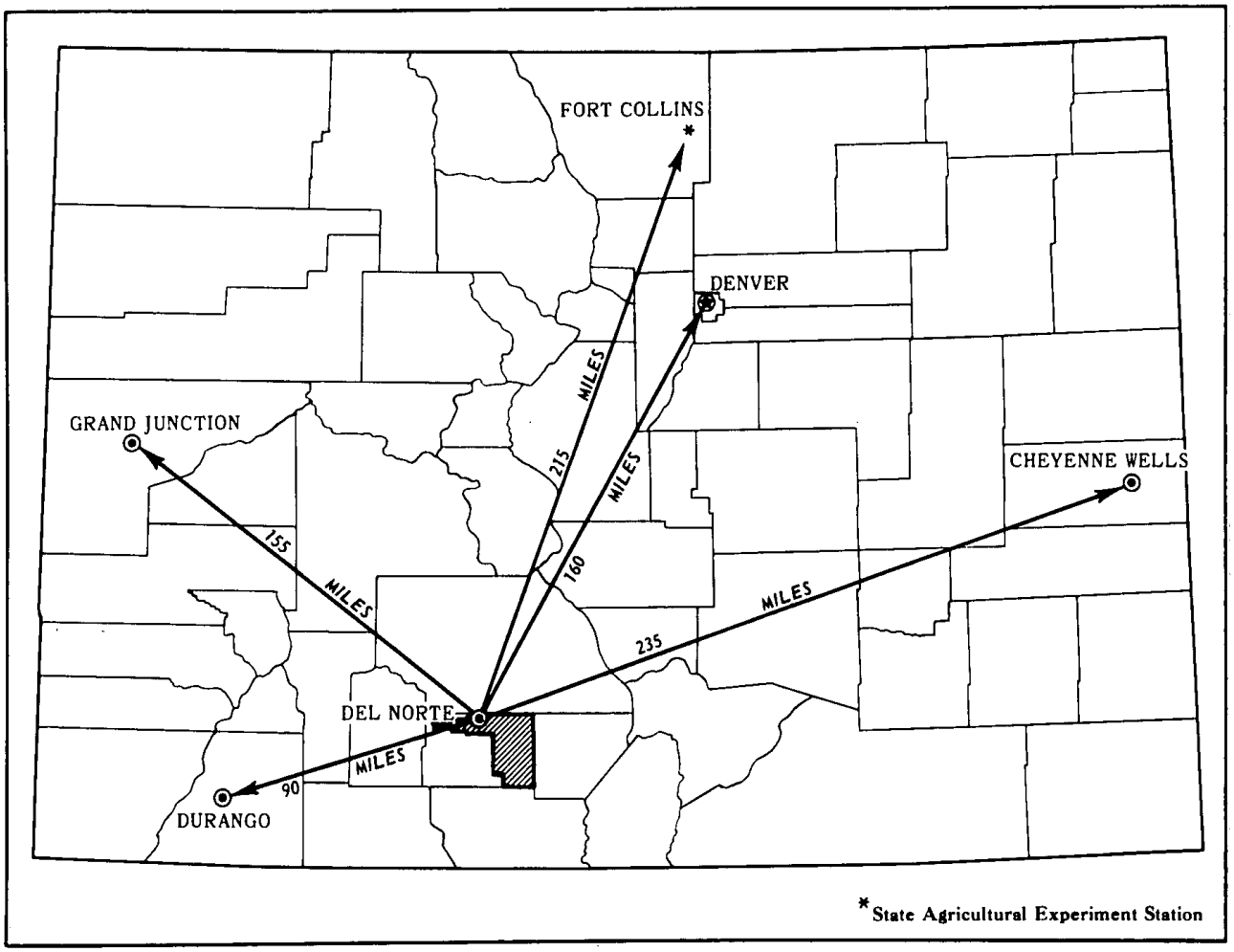

Location of Rio Grande County Area in Colorado.

SOIL SURVEY OF RIO GRANDE COUNTY AREA, COLORADO

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United States Department of Agriculture, Soil Conservation Service, in Cooperation With Colorado Agricultural Experiment Station

THE RIO GRANDE COUNTY AREA is along the west-central part of a broad, high mountain valley. This is the San Luis Valley, in the south-central part of the State. The survey area covers about 435 square miles, or 279,840 acres. It is within Rio Grande County (see facing page). The eastern part of the survey area, in the nearly level valley, has an elevation of about 7,600 feet. The western part, in the foothills and mountains of the San Juan Mountain Range, rises to an elevation of about 11,100 feet.

The Rio Grande River crosses the Area from west to east, and along with its small tributaries, drains the entire survey area. The eastern part of the survey area has a high water table. Some areas are very strongly alkaline.

The climate is dry and cold. The average annual temperature at Del Norte is 43° F. The lowest recorded temperature is −26°. The average annual precipitation at Del Norte is 8.65 inches, and the average snowfall in the valley is about 35 inches. The average growing season is about 110 days at Del Norte and about 95 days at Monte Vista.

The Area is crossed from east to west by U.S. Highway 160. U.S. Highway 285 enters the county from the north. The Denver and Rio Grande Western Railroad serves the Area in hauling freight and produce. Del Norte is the county seat.

The Rio Grande County Area is mainly a farming area. The principal farm enterprises are livestock and irrigated crops. Potatoes, barley, alfalfa, oats, and lettuce are the main crops. Cattle and sheep are the main livestock.

How This Survey Was Made

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in this survey (*10*).[1]

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

Soils of one series can differ in texture of the surface 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, Luhon loam, 1 to 3 percent slopes, is one of two phases within the Luhon 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.

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

Some mapping units are made up of soils of different series, or of different phases within one series. One

[1] Italic numbers in parentheses refer to Literature Cited, p. 87.

such kind of mapping unit is soil complexes and is shown on the soil map of the Rio Grande 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. Norte-Dunul complex is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land areas and are given descriptive names. Rock outcrop is an example.

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

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

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. 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 can occur in other associations, but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that 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 for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey area are described on the pages that follow.

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

Nearly Level and Very Gently Sloping Soils in the Valley

The soils in this group are excessively drained to poorly drained, shallow to deep, and coarse textured to moderately fine textured. Elevations are mainly 7,600 to 8,300 feet. The annual precipitation is 7 to 11 inches, and the frost-free season is 90 to 105 days. The six soil associations in this group make up about 63 percent of the survey area.

1. Gunbarrel-Mosca-San Luis association

Nearly level, well drained to poorly drained, coarse textured and moderately coarse textured soils that are 20 to 60 inches deep over sand and gravel; on low alluvial fans and old flood plains

This association is in the northeastern and east-central part of the survey area. The landscape is one of nearly level, low alluvial fans and old flood plains. The soils formed in alluvium. Elevation is about 7,600 to 7,700 feet. The annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days. The native vegetation is greasewood, rabbitbrush, alkali sacaton, and saltgrass.

This association makes up about 7 percent of the Area. It is about 45 percent Gunbarrel soils, 30 percent Mosca soils, 20 percent San Luis soils, and 5 percent Norte and Quamon soils, both of which are north of the Rio Grande, and Arena soils, which are south of the Rio Grande.

Gunbarrel soils are deep and coarse textured. They have a high water table during most of the year. They are 30 to 60 inches deep over sand and gravel.

Mosca soils are deep and have a coarse textured surface layer and a moderately coarse textured subsoil. They are seeped from irrigation and have a high water table part of the year. They are 30 to 40 inches deep over sand and gravel.

San Luis soils have a moderately coarse textured surface layer and a moderately fine textured subsoil. They are saline and alkali and have a high water table. They are 20 to 40 inches deep over sand and gravel.

This association is used mainly for irrigated crops, chiefly potatoes, small grain, and alfalfa. Areas that are not farmed are used as range.

2. *Norte-Quamon-San Arcacio association*

Nearly level, moderately well drained to somewhat excessively drained, moderately coarse textured soils that are 15 to 40 inches deep over sand and gravel; on broad alluvial fans and old flood plains

This association is in the northeastern part of the survey area, at the lower end of broad alluvial fans and old flood plains. The soils formed in alluvium. Elevation is about 7,600 to 7,700 feet. The annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days. In nonfarmed areas the vegetation is mainly blue grama, Indian ricegrass, and low rabbitbrush.

This association makes up about 13 percent of the Area. It is about 60 percent Norte soils, 25 percent Quamon soils, and 15 percent San Arcacio soils.

Norte soils have a gravelly, moderately coarse textured surface layer and gravelly underlying layers. They are 24 to 40 inches deep over sand and gravel. A seasonal high water table occurs at a depth of about 36 to 60 inches.

Quamon soils have a gravelly, moderately coarse textured surface layer and gravelly underlying layers. They are 15 to 25 inches deep over sand and gravel. A seasonal high water table occurs at a depth of 36 to 60 inches.

San Arcacio soils have a moderately coarse textured surface layer and a moderately fine textured subsoil. They are 20 to 40 inches deep over sand and gravel. A seasonal water table occurs at a depth of 36 to 60 inches.

This association is used mainly for irrigated crops, chiefly potatoes, small grain, alfalfa, and vegetables. It is an important potato-producing area. Small areas that are not farmed are used as range.

3. *Torrifluvents-Torsido-Alamosa association*

Nearly level to very gently sloping, excessively drained to poorly drained, moderately coarse textured to moderately fine textured soils that are 10 to 60 inches deep over sand and gravel; on flood plains, alluvial fans, and terraces

This association is along the Rio Grande River and Rock Creek. The landscape is one of nearly level flood plains and nearly level or very gently sloping alluvial fans and terraces. The soils formed in mixed alluvium. Elevation is about 7,600 to 8,300 feet. The annual precipitation is 7 to 11 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days. The native vegetation is cottonwoods and willows along the Rio Grande and sedges, rushes, tufted hairgrass, slender wheatgrass, and alkali sacaton in meadows.

This association makes up about 16 percent of the Area. It is about 25 percent Torrifluvents, 23 percent Torsido soils, 15 percent Alamosa soils, and 37 percent Gerrard, Shawa, Schrader, Vastine, Mishak, and Acasco soils and Typic Fluvaquents.

The nearly level Torrifluvents are on flood plains bordering the Rio Grande. They are excessively drained in most places. They have a moderately coarse textured to medium textured surface layer and underlying layer. They are about 10 to 20 inches deep over sand and gravel. They are subject to flooding late in spring and early in summer.

The nearly level or very gently sloping Torsido soils are on alluvial fans and terraces. They are poorly drained. They have a moderately fine textured surface layer and subsoil. Areas that have not been plowed have a medium surface layer. The depth to sand and gravel is 20 to 40 inches. Depth to the seasonal high water table is about 12 to 24 inches.

The deep, nearly level Alamosa soils are on flood plains. They are poorly drained or somewhat poorly drained. They have a medium textured surface layer and a moderately fine textured subsoil. The water table is about 12 to 36 inches below the surface. Some areas are subject to flooding late in spring and early in summer.

This association is used for irrigated meadow, small grain, and alfalfa and for range and wildlife.

4. *Zinzer-San Arcacio-Villa Grove association*

Nearly level, well drained, moderately coarse textured to moderately fine textured soils that are 20 to more than 60 inches deep over sand and gravel; on broad alluvial fans

This association is at the lower end of broad alluvial fans. It occurs as two areas, one in the southeastern part of the survey area and one just to the south of Monte Vista. The soils formed in alluvium. Elevation is 7,600 to 7,800 feet. The annual precipitation is about 7 inches, the mean annual air temperature is about 40° F, and the frost-free season is 90 to 100 days. The native vegetation is alkali sacaton, saltgrass, greasewood, and rabbitbrush.

This association (fig. 1) makes up about 9 percent of the Area. It is about 45 percent Zinzer soils, 30 percent San Arcacio soils, 20 percent Villa Grove soils, and 5 percent Arena, Acacio, and Laney soils.

Zinzer soils are deep. They have a medium textured surface layer and medium textured underlying layers. Many areas are seeped from irrigation and have a seasonal water table at a depth of about 24 to 60 inches. Seeped areas are saline.

San Arcacio soils have a medium textured or moderately coarse textured surface layer and a moderately fine textured subsoil. They are 20 to 40 inches deep over sand and gravel. Many areas are seeped from irrigation and have a seasonal water table at a depth of 20 to 48 inches. Seeped areas are saline.

Villa Grove soils are deep and have a moderately fine textured surface layer and subsoil. Many areas are seeped from irrigation and have a seasonal water table at a depth of 24 to 60 inches. Seeped areas are saline.

This association is used for irrigated crops and for range. Small grain, alfalfa, potatoes, and vegetables are the chief crops.

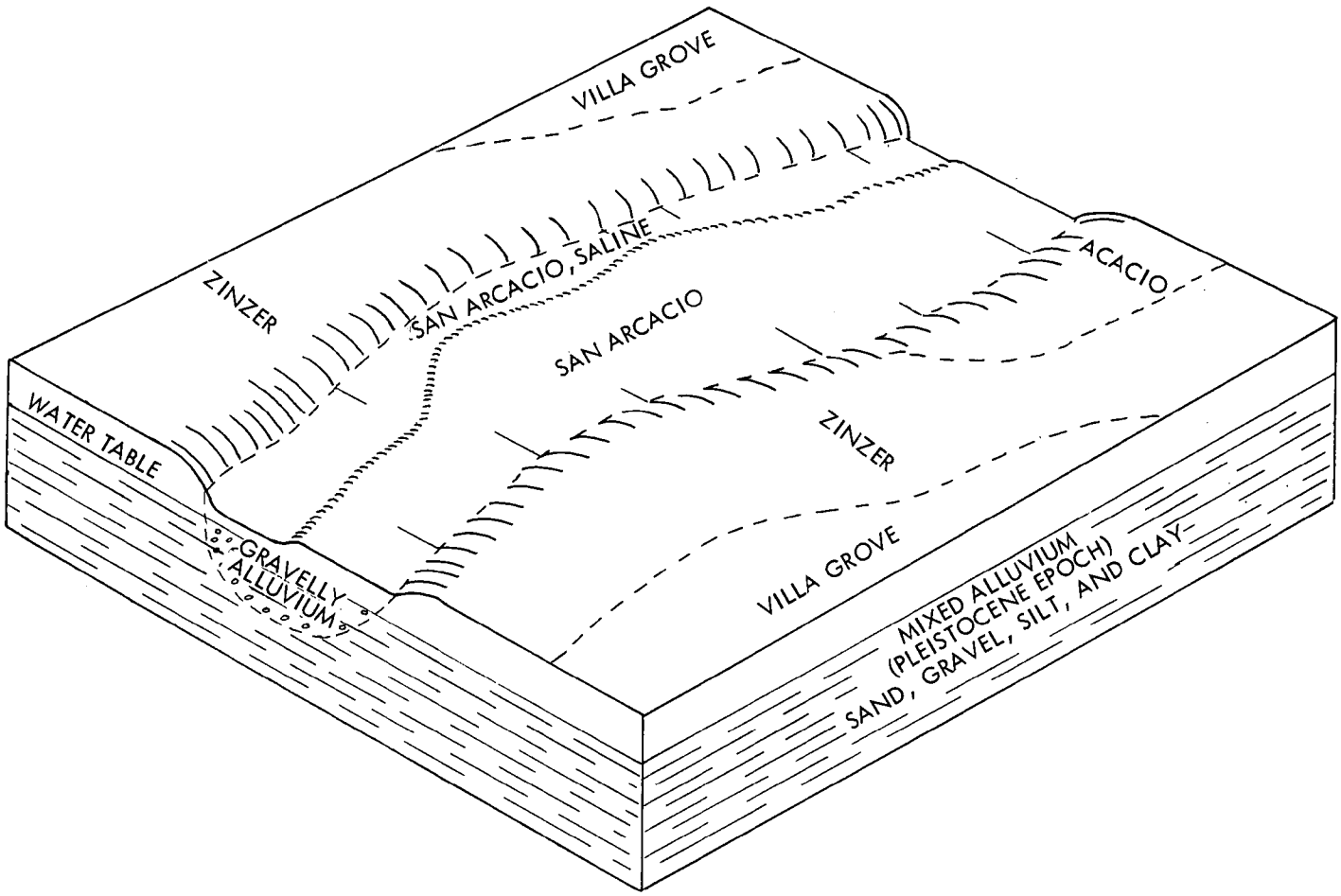

***Figure 1.*—Pattern of soils and parent material in Zinzer-San Arcacio-Villa Grove association.**

5. *Hooper-Arena-San Luis association*

Nearly level, well drained to poorly drained, moderately fine textured to coarse textured, alkali soils that are 20 to more than 60 inches deep over sand and gravel; on alluvial fans and old flood plains

This association is in the southeastern part of the survey area, at the lower end of alluvial fans and on old flood plains on the valley floor. The soils formed in mixed alluvium. Elevation is 7,600 to 7,800 feet. The annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days. The vegetation in nonirrigated areas is greasewood, rabbitbrush, alkali sacaton, and saltgrass.

This association makes up about 4 percent of the Area. It is about 40 percent Hooper soils, 35 percent Arena soils, 20 percent San Luis soils, and 5 percent Villa Grove, Mishak, and Alamosa soils.

Hooper soils are on old flood plains. They have a moderately fine textured to coarse textured surface layer and a moderately fine textured to fine textured subsoil. They are 20 to 40 inches deep over sand and gravel. They are highly alkali. The moderately fine textured surface layer is dispersed and water penetrates very slowly. The water table occurs at a depth of about 48 to 60 inches.

The deep Arena soils are on old flood plains and at the lower end of alluvial fans. They have a medium textured layer and medium textured underlying layers that are stratified. A duripan occurs at a depth of 20 to 40 inches. The soils are highly alkali and are also saline. The water table occurs at a depth of about 12 to 60 inches.

San Luis soils are on flood plains of the valley floor. They have a moderately coarse textured surface layer and a moderately fine textured subsoil. They are 20 to 40 inches deep over sand and gravel. They are saline and alkali. The water is at a depth of 24 to 60 inches.

This association is used mainly for range, irrigated meadow, and wildlife. Some small areas are used for irrigated crops.

6. *Dunul-Platoro-Graypoint association*

Nearly level to very gently sloping, well drained to excessively drained, moderately coarse textured to medium textured, cobbly soils that are 10 to 40 inches deep over gravel and cobbles; on alluvial fans and terraces

This association is in the north-central and south-central parts of the survey area. The landscape is one

of nearly level or very gently sloping alluvial fans and terraces. The soils formed in alluvium. Elevation is about 7,600 to 8,000 feet. The annual precipitation is about 7 or 8 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days. The native vegetation is blue grama, Indian ricegrass, ring muhly, low rabbitbrush, and snakeweed.

This association makes up about 14 percent of the Area. It is about 50 percent Dunul soils, 20 percent Platoro soils, 15 percent Graypoint soils, and 15 percent mainly Derrick, Norte, and Quamon soils.

The nearly level Dunul soils are at the upper end of alluvial fans. They are cobbly and moderately coarse textured. They are 10 inches deep over gravel and cobbles.

The nearly level or very gently sloping Platoro soils are on alluvial fans and terraces. They have a medium textured surface layer and a moderately fine textured subsoil. They are 20 to 40 inches deep over gravel and cobbles.

The nearly level Graypoint soils are at the upper end of alluvial fans. They are gravelly and have a moderately coarse textured surface layer and a moderately fine textured subsoil. They are 10 to 20 inches deep over gravel and sand.

This association is used for irrigated crops and for range. Potatoes, small grain, and alfalfa are the chief crops.

Very Gently Sloping to Steep Soils on the Foothills and Mountains

The soils in this group are well drained and somewhat excessively drained, shallow to deep, and medium textured or moderately coarse textured. Elevations are mainly 7,700 to 11,100 feet. The annual precipitation is 8 to 20 inches, and the frost-free season is 60 to 115 days. The three soil associations in this group make up about 37 percent of the survey area.

7. *Luhon-Garita-Travelers association*

Very gently sloping to moderately steep, well drained to somewhat excessively drained, medium textured to moderately coarse textured, deep to shallow, cobbly and stony soils on alluvial fans, foothills, and mesas

This association is in the western and northwestern parts of the Area. The landscape is one of very gently sloping to moderately steep alluvial fans, foothills, and mesas. Many gullies have formed in the steeper hills and in valley bottoms. The soils formed in mixed alluvium and in residuum weathered from basalt. Elevation is 7,700 to 8,800 feet. The annual precipitation is about 8 or 9 inches, the mean annual air temperature is about 41° to 43° F, and the frost-free season is 90 to 115 days. The vegetation is winterfat, low rabbitbrush, blue grama, Indian ricegrass, ring muhly, and snakeweed.

This association (fig. 2) makes up 27 percent of the Area. It is about 35 percent Luhon soils, 30 percent Garita soils, 25 percent Travelers soils, and 10 percent Stunner, Monte, and Platoro soils and Rock outcrop.

Luhon soils are on alluvial fans and valley-fill side slopes. They are deep and very gently sloping to gently sloping. They have a medium textured surface layer and underlying layers and a layer of high lime concentration.

Garita soils are on alluvial fans and foothills. They are deep, cobbly and gravelly, and very gently sloping to moderately steep. They have a medium textured surface layer and underlying layer and a layer of high lime concentration.

Travelers soils are on foothills and mesas. They are gently sloping to moderately steep and are shallow over basalt. The surface layer is stony and medium textured to moderately coarse textured, and the subsoil is medium textured. Bedrock is at a depth of 10 to 20 inches.

This association is used for range, irrigated small grain and alfalfa, and wildlife.

8. *Celeste-Tolman-Empedrado association*

Gently sloping to moderately steep, well drained to somewhat excessively drained, medium textured, shallow to deep, stony and nonstony soils on foothills and mountains

This association is in the western part of the survey area. The landscape is one of gently sloping to moderately steep foothills and mountainsides. The soils formed mostly in residuum weathered from rhyolite, andesite, and latite. Elevation is 8,000 to 9,200 feet. The annual precipitation is about 12 inches, the mean annual air temperature is about 41° to 43° F, and the frost-free season is about 80 to 100 days. The vegetation is pinon trees, western wheatgrass, blue grama, mountain muhly, junegrass, and currant.

This association makes up about 5 percent of the Area. It is about 40 percent Celeste soils, 25 percent Tolman soils, 20 percent Empedrado soils, and 15 percent mainly Jodero and Travelers soils and Rock outcrop.

The shallow, sloping to moderately steep Celeste soils are on mountainsides. The have an extremely stony, medium textured surface layer. Bedrock is at a depth of 10 to 20 inches.

The shallow, moderately steep Tolman soils are on foothills. They have a very stony, medium textured layer and a moderately fine textured subsoil. Bedrock is at a depth of 10 to 20 inches.

The deep, gently sloping to sloping Empedrado soils are on foothills. They have a medium textured surface layer and a moderately fine textured subsoil. In places, weathered rhyolite occurs at a depth of 40 to 60 inches.

This association is used for range, wildlife, and woodland. Wooded areas provide fenceposts and firewood.

9. *Seitz-Embargo-Fulcher association*

Gently sloping to steep, well drained, medium textured, deep to moderately deep, stony and cobbly soils on mountains and alluvial fans

This association is in the southwestern part of the survey area. The landscape is one of gently sloping to steep mountainsides and gently sloping or sloping alluvial fans. The soils formed in colluvium, alluvium, and residuum. Elevation is about 8,300 to 11,100 feet. The annual precipitation is 15 to 20 inches, the mean annual air temperature is 34° to 40° F, and the frost-free season is 60 to 90 days. The native vegetation is Engelmann spruce, Douglas–fir, aspen, currant, Arizona fes-

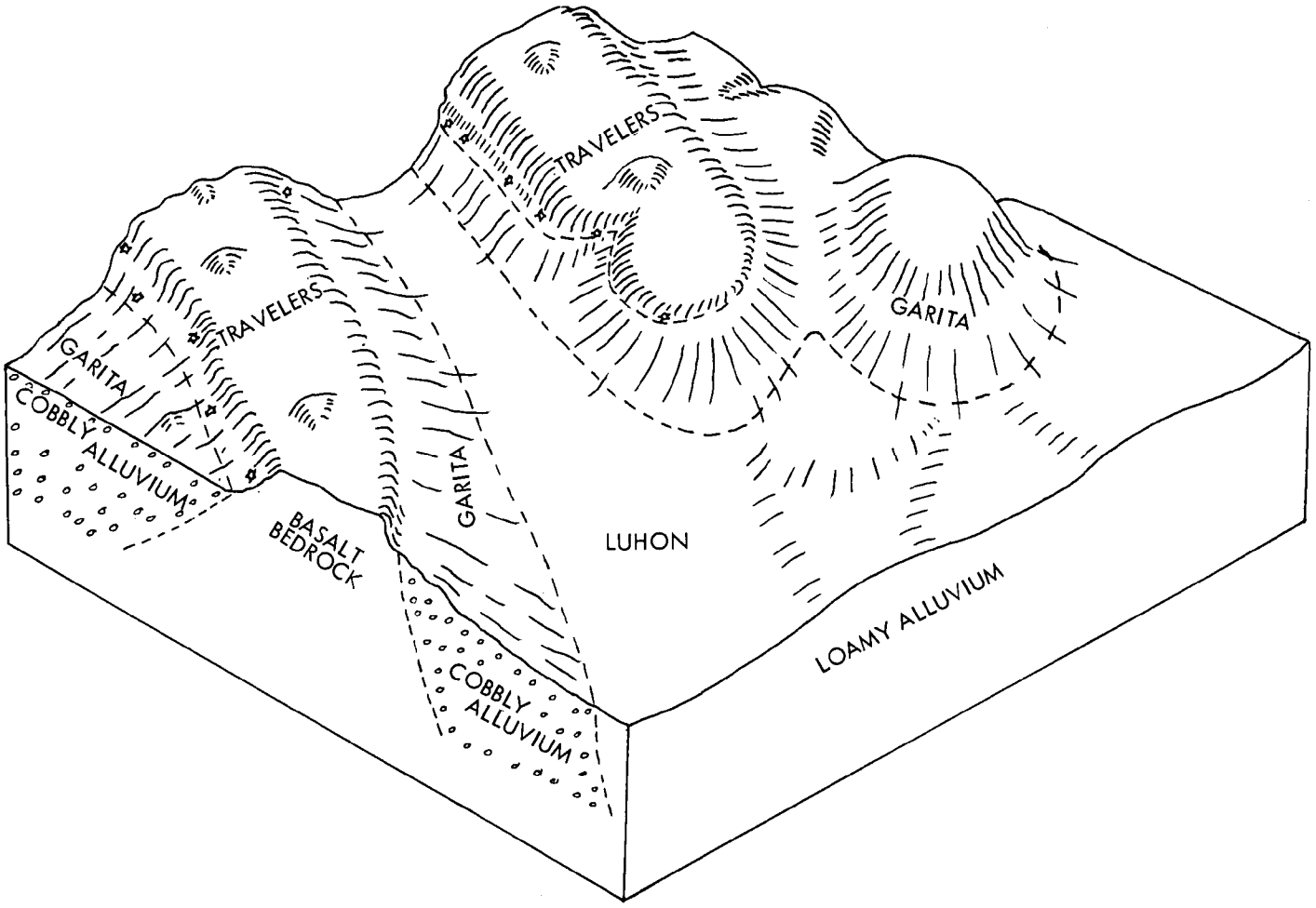

***Figure 2.*—Pattern of soils and parent material in Luhon-Garita-Travelers association.**

cue, mountain muhly, Parry oatgrass, junegrass, and rabbitbrush.

This association makes up about 5 percent of the Area. It is about 45 percent Seitz soils, 25 percent Embargo soils, 20 percent Fulcher soils, and 10 percent Tolman and Empedrado soils and Rock outcrop. Seitz soils are in wooded areas. Embargo and Fulcher soils are in open parks and on grassy slopes.

The deep, moderately steep and steep Seitz soils are on wooded mountainsides. They have a medium textured surface layer and a fine textured subsoil. They are very stony on the surface and throughout the profile.

The moderately deep, moderately steep Embargo soils are on mountainsides. They have a medium textured surface layer and a fine textured subsoil. They are very stony on the surface and throughout the profile. Bedrock is at a depth ranging from 20 to 40 inches.

The deep, gently sloping or sloping Fulcher soils are on alluvial fans and the lower part of mountainsides. They have a medium textured surface layer and a fine textured subsoil. They are cobbly on the surface and throughout the profile.

This association is used for woodland, wildlife, recreation, and range.

Descriptions of the Soils

This section describes the soil series and mapping units in the Rio Grande 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 in the brief description are for moist soil. Color terms in the more detailed profile descriptions are for dry soil unless otherwise stated. The profile described is representative for mapping units in that series. If the profile of a given mapping unit differs from the one described for the series, differences

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

Soil	Acres	Percent	Soil	Acres	Percent
Acacio sandy loam	552	0.2	Quamon gravelly sandy loam	9,081	3.2
Acasco clay loam	2,504	.9	Rock outcrop	2,447	.9
Alamosa loam	3,494	1.2	San Arcacio sandy loam	10,443	3.7
Alamosa loam, saline	819	.3	San Arcacio sandy loam, saline	3,589	1.3
Arena loam	2,513	.9	San Arcacio loam	2,999	1.1
Arena loam, drained	771	.3	San Luis sandy loam	2,894	1.0
Celeste-Rock outcrop complex, 5 to 25 percent slopes	7,901	2.8	San Luis sandy loam, drained	838	.3
Derrick cobbly loam	3,456	1.2	San Luis-Quamon complex	1,295	.5
Dunul cobbly sandy loam	17,335	6.2	Schrader sandy loam	3,046	1.1
Embargo very stony loam, 10 to 25 percent slopes	3,008	1.1	Seitz very stony loam, 20 to 65 percent slopes	7,720	2.8
Fulcher cobbly loam, 3 to 10 percent slopes	2,570	.9	Shawa loam, 0 to 1 percent slopes	3,884	1.4
Garita cobbly loam, 1 to 3 percent slopes	1,228	.4	Shawa loam, 1 to 3 percent slopes	724	.3
Garita cobbly loam, 3 to 25 percent slopes	13,632	4.9	Stunner loam, 1 to 3 percent slopes	3,617	1.3
Gerrard loam	2,675	1.0	Stunner loam, 3 to 6 percent slopes	780	.3
Gravel pits	267	.1	Terrace escarpments	619	.2
Graypoint gravelly sandy loam	4,074	1.4	Tolman-Empedrado complex, 3 to 25 percent slopes	9,834	3.5
Gunbarrel loamy sand	6,207	2.2	Torsido clay loam	6,007	2.2
Hooper loamy sand	2,732	1.0	Travelers very stony sandy loam, 3 to 25 percent slopes	6,188	2.2
Hooper clay loam	1,314	.5	Travelers-Garita complex, 5 to 25 percent slopes	18,249	6.5
Jodero loam	2,199	.8	Typic Fluvaquents	2,713	1.0
Laney loam	781	.3	Typic Torrifluvents	9,738	3.5
Luhon loam, 1 to 3 percent slopes	16,097	5.7	Vastine loam	904	.3
Luhon loam, 3 to 6 percent slopes	6,664	2.4	Villa Grove sandy clay loam	1,390	.5
Marsh	1,114	.4	Villa Grove sandy clay loam, saline	2,408	.9
Mishak loam	1,723	.6	Zinzer loam	3,827	1.3
Monte loam, 0 to 1 percent slopes	2,056	.7	Zinzer loam, saline	5,559	2.0
Monte loam, 1 to 3 percent slopes	4,208	1.5	Water areas, ponds, lakes, river	2,427	.9
Mosca loamy sand	5,017	1.8	Miscellaneous, sewage lagoons, city dumps	80	(1)
Norte gravelly sandy loam	28,282	10.1			
Norte-Dunul complex	4,845	1.7	Total	279,840	100.0
Platoro loam, 0 to 1 percent slopes	5,312	1.9			
Platoro loam, 1 to 3 percent slopes	1,190	.4			

[1] Less than 0.05 percent.

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. Typic Fluvaquents, for example, does not belong to a soil series, but nevertheless, is 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 and range site to which the mapping unit has been assigned. The page for the description of each capability unit or range site can be found be referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*12*).

Acacio Series

The Acacio series consists of deep, well drained soils. These soils formed in loamy alluvium on slightly elevated ridges of alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 7,700 feet. Natural vegetation is dominantly rabbitbrush, greasewood, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark grayish brown sandy loam about 4 inches thick. The subsoil is dark brown clay loam about 8 inches thick. The substratum is about 18 inches of pale brown loam over brown sandy clay loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. Reaction ranges from mildly alkaline to moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for irrigated crops and range.

Representative profile of Acacio sandy loam, 2,140 feet south and 100 feet west of the northeast corner sec. 24, T. 37 N., R. 8 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak very fine granular structure; soft, very friable; mildly alkaline; abrupt smooth boundary.

B2t—4 to 12 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3 moist; moderate medium subangular blocky structure; slightly hard, friable; thin nearly continuous clay films on peds; few gypsum crystals; calcareous; mildly alkaline; clear smooth boundary.

C1cacs—12 to 30 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; very weak medium subangular blocky structure; slightly hard, friable; approximately 10 percent gypsum present in crystals and seams; visible calcium carbonate as soft masses and in seams; calcareous; moderately alkaline; clear smooth boundary.

C2cs—30 to 60 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive, slightly hard, very friable; approximately 2 percent gypsum occurring mainly as crystals; calcareous; moderately alkaline.

The A horizon is 4 to 8 inches thick. The B2t horizon is 6 to 10 inches thick and is clay loam or sandy clay loam. The content of gypsum ranges from 6 to 30 percent and generally is within 20 inches of the surface. The Ccs horizon is 10 to 30 inches thick. In some small areas the soil is underlain by sand and gravel below a depth of 48 inches. Salinity ranges from low to moderate.

Aa—Acacio sandy loam. This nearly level soil occupies small areas on slightly elevated ridges at the lower end of alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent.

Included with this soil in mapping are small areas where high concentrations of gypsum occur within 10 inches of the surface, especially in leveled fields and areas where the surface layer is sandy clay loam. Also included are areas of Zinzer loam and small areas of Villa Grove sandy clay loam, which make up about 10 percent of the unit, and some areas where salinity is moderate to high because of the salts seeped from irrigation.

Runoff is slow. The hazard of soil blowing is slight to moderate.

This soil is used for irrigated alfalfa, small grain, potatoes, and other vegetables. Some areas are used for range. Capability unit IIIs–1 irrigated, VIIs–3 nonirrigated; Salt Flats range site.

Acasco Series

The Acasco series consists of poorly drained or somewhat poorly drained soils 20 to 36 inches deep over sand and gravel. These soils formed in loamy alluvium on alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 7,800 feet. Natural vegetation is dominantly sedges, rushes, and reed grasses. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is very dark brown heavy clay loam about 14 inches thick. It is mottled with dark yellowish brown in the lower part. The subsoil is dark grayish brown gravelly heavy clay loam about 10 inches thick. It is mottled with dark yellowish brown. Below this is sand and gravel that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is moderate. Reaction is neutral. The effective rooting depth is 20 to 36 inches. The water table is 2 to 3 feet below the surface in summer and drops to 4 to 5 feet in winter. In some small areas the soils are slightly saline.

These soils are used for irrigated meadow, irrigated crops, and range.

Representative profile of Acasco clay loam, 1,300 feet south and 1,200 feet east of the northwest corner sec. 1, T. 37 N., R. 7 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) heavy clay loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable; 10 percent gravel; neutral; clear wavy boundary.

A12g—6 to 14 inches; grayish brown (10YR 5/2) heavy clay loam, very dark brown (10YR 2/2) moist; common medium distinct mottles of dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; 10 percent gravel; neutral; gradual wavy boundary.

B2g—14 to 24 inches; light brownish gray (10YR 6/2) gravelly heavy clay loam, dark grayish brown (10YR 4/2) moist; many large prominent mottles of dark yellowish brown (10YR 4/4) and dark gray (2.5Y 4/1) moist; weak medium subangular blocky structure; hard, friable; 20 percent gravel; neutral; diffuse wavy boundary.

IIC—24 to 60 inches; sand and gravel.

The A horizon is very dark brown to black. The B2g horizon is gravelly, dark grayish brown to black heavy clay loam or light clay. The content of gravel and cobbles ranges from 5 to 15 percent in the A horizon and from 10 to 30 percent in the B2g horizon.

Ac—Acasco clay loam. This nearly level soil occurs as large areas near natural drainageways on alluvial fans, mainly in the south-central part of the Area. Slopes are 0 to 1 percent.

Included with this soil in mapping are small areas where the soil is shallower over sand and gravel and has more gravel in the profile than is described as representative of the series. Also included are areas of Alamosa loam, which make up about 5 percent of the mapping unit.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated meadow and irrigated alfalfa, barley, and oats. Some areas are used as range. Capability units IVw–1 irrigated, Vw–1 nonirrigated; Wet Meadow range site.

Alamosa Series

The Alamosa series consists of deep, poorly drained or somewhat poorly drained soils. These soils formed in loamy alluvium on flood plains. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly sedges, rushes, tufted hairgrass, and slender wheatgrass. Saline areas also have alkali sacaton. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days.

In a representative profile the surface layer is very dark brown loam about 9 inches thick. The subsoil is very dark brown silty clay loam and black clay loam about 30 inches thick. It is mottled with yellowish brown in the lower part. The substratum is about 9 inches of very dark grayish brown sandy clay loam mottled with yellowish brown over sand and gravel that extends to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is mainly high. In saline areas the available water capacity is moderate or high. Reaction ranges from neutral to moderately alkaline. The effective rooting depth is 40 to 60 inches. The water table is

about 1 foot below the surface late in spring and in summer and drops to about 4 feet in winter.

These soils are used for irrigated meadow, irrigated crops, and range.

Representative profile of Alamosa loam, 1,180 feet north and 140 feet west of the southeast corner sec. 36, T. 39 N., R. 8 E.

A1—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, friable; slightly calcareous; neutral; clear smooth boundary.

B1—9 to 13 inches; grayish brown (10YR 5/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable; thin nearly continuous clay films on peds; slightly calcareous; mildly alkaline; clear smooth boundary.

B2tg—13 to 28 inches; gray (10YR 5/1) clay loam, black (10 YR 2/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; noncalcareous; thin nearly continuous clay films on peds; mildly alkaline; clear smooth boundary.

B3g—28 to 39 inches; gray (10YR 5/1) clay loam, black (10YR 2/1) moist; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; hard, friable; moderately alkaline; clear smooth boundary.

C1g—39 to 48 inches; light brownish gray (10YR 6/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; common medium distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm; moderately alkaline; clear smooth boundary.

IIC2—48 to 60 inches; sand and gravel.

The A horizon is 6 to 10 inches thick and is very dark grayish brown to black loam to sandy loam. The B horizon is 20 to 40 inches thick and is heavy loam to sandy clay loam, clay loam, or silty clay loam. The C1 horizon is clay loam to sandy loam. Sand and gravel is at a depth of 40 to 60 inches or more. Salinity ranges from none to high.

Am—Alamosa loam. This soil occupies low areas along the Rio Grande and some of the other major drainageways. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series.

This soil is subject to flooding in spring when runoff is high from melting snow in the mountains. Areas that have not been leveled are undulating, and there are many old river channels, oxbows, and swales. Some of the lower swales have water in them most of the year. The water table is generally 12 to 24 inches below the surface in summer, but drops to 36 to 48 inches in winter and in drained areas. Salinity is none to slight.

Included with this soil in mapping are many small areas where the depth to sand and gravel is only 20 to 36 inches. In some leveled areas sand and gravel bars are exposed. Also included are small saline and alkali areas generally on higher spots in fields that are not flooded or irrigated as often as the other soils. About 15 percent of the mapping unit is included areas of Gerrard loam, Schrader sandy loam, and Shawa loam. Any combination of these included soils can occur in any one mapped area.

Runoff is slow. The erosion hazard is slight.

This soil is used mainly for irrigated meadow and crops. Irrigated meadows are either cut for hay or used for grazing. The chief irrigated crops are alfalfa and small grain. Some small areas are used as range. Potatoes and other vegetables are not well suited. Capability unit IIIw–1 irrigated, Vw–1 nonirrigated; Wet Meadow range site.

Ao—Alamosa loam, saline. This soil occupies low areas along the Rio Grande and some of the other major drainageways. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but salinity is moderate to high because of a high water table.

This soil is generally in slightly higher areas than Alamosa loam and is not flooded or irrigated so often. It is subject to flooding in many places in spring when runoff is high from melting snow in the mountains. The soil is undulating, and there are many old channels, oxbows, and swales. The water table is generally at a depth of 24 to 36 inches in summer, but drops to 36 to 48 inches in winter.

About 10 percent of this unit is included areas of Alamosa loam that is less saline; 15 percent areas of Gerard loam, Schrader sandy loam, and Shawa loam; and some small areas where sand and gravel is at a depth of 20 to 36 inches. Any combination of these included soils can occur in any one mapped area.

Runoff is slow. The hazard of erosion is slight.

This soil is used mainly for irrigated meadow and crops. Irrigated meadows are cut for hay or used for grazing. The chief irrigated crops are small grain and alfalfa. Some areas are used for range. Potatoes and other vegetables are not suited because of salinity and wetness. Capability unit IIIw–2 irrigated, VIw–1 nonirrigated; Salt Meadow range site.

Arena Series

The Arena series consists of deep, poorly drained soils. These soils formed in loamy alluvium on flood plains and alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly greasewood, rabbitbrush, saltgrass, and alkali sacaton. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is grayish brown loam about 7 inches thick. The underlying material is brown and dark yellowish brown, stratified fine sandy loam to clay loam about 16 inches thick. Below this is a light brown duripan about 23 inches thick over brown sandy loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is low. Reaction ranges from strongly alkaline to very strongly alkaline. The soils are moderately saline to very highly saline. The effective rooting depth is 16 to 30 inches. The water table is about 18 to 36 inches below the surface in summer and drops to more than 36 inches in undrained areas.

These soils are used for range, wildlife, and irrigated crops.

Representative profile of Arena loam, 140 feet north and 2,400 east of the southwest corner sec. 7, T. 38 N., R. 8 E.

Ap—0 to 7 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak fine granular

structure; slightly hard, friable; strongly calcareous; strongly alkaline; clear smooth boundary.

AC—7 to 13 inches; pinkish gray (7.5YR 6/2) fine sandy loam, brown (7.5YR 4/2) moist; weak fine blocky structure; hard, firm; strongly calcareous; strongly alkaline; clear smooth boundary.

C1cag—13 to 23 inches; light yellowish brown (10YR 6/4) loam stratified with clay loam and fine sandy loam, dark yellowish brown (10YR 4/4) moist; many large prominent yellowish brown (10YR 5/6) and dark gray (10YR 4/1) mottles; moderate medium and fine subangular blocky structure; hard, firm; strongly calcareous; brittle even when moist; strongly alkaline; about 5 percent gravel; clear smooth boundary.

C2casi—23 to 46 inches; pink (7.5YR 7/4) and light brown (7.5YR 6/4) moist; duripan that can be penetrated with a spade when moist but is difficult to penetrate when dry; 30 to 70 percent gravel-size cemented concretions that do not slake in water or acid but soften after alternate treatment with strong base and acid; strongly calcareous; clear smooth boundary.

C3g—46 to 60 inches; light brown (7.5YR 6/4) sandy loam, brown (7.5YR 4/4) moist; massive; hard, friable; very strongly calcareous; strongly alkaline; few fine faint yellowish brown (10YR/ 5/6) mottles.

The A horizon is 4 to 10 inches thick and is loam or fine sandy loam. In some cultivated areas the A horizon is light clay loam. Depth to the duripan ranges from 20 to 40 inches. Concretions and cemented layers in the duripan are ¼ inch to several inches thick, vary in quantity, and are very hard or extremely hard when dry and very firm when moist. Exchangeable sodium ranges from 30 to 80 percent. Salinity is moderate to very high.

Ar—Arena loam. This nearly level soil occupies flood plains and the lower end of alluvial fans, mainly in the southeastern part of the Area. Slopes are 0 to 1 percent. Salinity is high or very high. The profile of this soil is the one described as representative of the series.

About 15 percent of the mapping unit is included areas of Hooper clay loam, 10 percent San Luis sandy loam, and 5 percent Zinzer loam. Also included are small areas of Arena loam, drained.

Runoff is slow. The erosion hazard is slight.

Most of the acreage is used for range and wildlife. A few small tracts are used for irrigated meadow, pasture, and crops. Small grain and alfalfa are the only irrigated crops. Capability unit IIIs–6 irrigated, VIw–4 nonirrigated; Salt Flats range site.

As—Arena loam, drained. This nearly level soil occupies flood plains and the lower end of alluvial fans along the Rio Grande and some major tributaries, mainly in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but it has been drained and is partly leached of salts. Salinity is moderate. The water table is generally at a depth of 30 to 60 inches and is highest in summer.

About 10 percent of this unit is included areas of Zinzer loam and 5 percent areas of Hooper soils and San Luis sandy loam. Also included are small undrained areas of Arena loam.

Runoff is slow. The erosion hazard is slight.

Most of the acreage is used for irrigated crops, chiefly alfalfa and small grain. Some is used for irrigated pasture. Some areas are used as range. Capability unit IIIs–4 irrigated, VIw–1 nonirrigated; Salt Flats range site.

Celeste Series

The Celeste series consists of shallow, somewhat excessively drained soils. The soils formed in loamy residuum on mountainsides. Slopes are 5 to 25 percent. Elevation is 8,000 to 9,200 feet. Natural vegetation is dominantly western wheatgrass, blue grama, mountain muhly, junegrass, currant, and pinon trees. The average annual precipitation is about 12 inches, the mean annual air temperature is about 43° F, and the frost-free season is 80 to 95 days.

In a representative profile the surface layer is about 4 inches of very dark grayish brown extremely stony loam over about 10 inches of dark reddish brown loam. Rhyolite is at a depth of about 14 inches. The soils are about 50 percent stones throughout.

Permeability is moderate, and the available water capacity is low. Reaction is mildly alkaline. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife.

Representative profile of Celeste extremely stony loam in an area of Celeste-Rock outcrop complex, 5 to 25 percent slopes, in the southern half sec. 26, T. 38 N., R. 6 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) extremely stony loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable; 50 percent stones; mildly alkaline; clear smooth boundary.

A12—4 to 14 inches, reddish gray (5YR 5/2) extremely stony loam, dark reddish brown (5YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable; 50 percent stones; mildly alkaline; abrupt smooth boundary.

R—14 inches; hard rhyolite bedrock.

The content of stones and cobbles in the A horizon ranges from 35 to 65 percent. Depth to rhyolite, andesite, or latite bedrock ranges from 10 to 20 inches. In some pedons a thin C horizon overlies the bedrock.

CrE—Celeste-Rock outcrop complex, 5 to 25 percent slopes. This gently sloping to moderately steep mapping unit is about 50 percent Celeste extremely stony loam and 45 percent Rock outcrop. It is mainly in mountainous areas. In many small areas the slope ranges to 100 percent. There are many narrow valleys and drainageways. Gullies 3 to 8 feet deep and 3 to 12 feet wide have formed in most of the valleys. These gullies carry runoff during and after rains. Rock outcrop consists of exposures of bedrock and vertical cliffs and escarpments with 10- to 70-foot drops. Many large boulders are on the slopes below the escarpments.

Included with this unit in mapping are small areas of Jodero loam in the narrow valleys and small areas of a very shallow soil, less than 10 inches deep over bedrock, that is intermingled with the Rock outcrop. About 5 percent of this unit is included areas of Garita cobbly loam and Travelers very stony loam.

Runoff is rapid. The hazard of water erosion is high.

This mapping unit is used for range and wildlife. It is an important habitat for deer. Capability unit VIIs–1 nonirrigated; Celeste soil in Rocky Foothills range site; Rock outcrop not assigned to a range site.

Derrick Series

The Derrick series consists of well drained soils 10 to 20 inches deep over gravel and cobbles. These soils formed in cobbly alluvium on alluvial fans and terraces. Slopes are 0 to 3 percent. Elevation is 7,600 to 8,200 feet. Natural vegetation is dominantly blue grama, ring muhly, sand dropseed, and low rabbitbrush. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days.

In a representative profile the surface layer is dark grayish brown cobbly loam about 4 inches thick. The subsoil is dark brown very gravelly clay loam or very gravelly loam about 13 inches thick. The substratum is gravel, cobbles, and sand that extend to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is low or moderate. Reaction ranges from neutral to moderately alkaline. The effective rooting depth is 10 to 20 inches.

These soils are used for range, irrigated crops, and wildlife.

Representative profile of Derrick cobbly loam, 1,500 feet west of the northeast corner sec. 2, T. 37 N., R. 7 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) cobbly loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; 35 percent cobbles and gravel; neutral; gradual smooth boundary.

B2t—4 to 14 inches; brown (7.5YR 5/3) very gravelly clay loam, dark brown (7.5YR 4/3) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable; thin nearly continuous clay films on peds and in root channels; 60 percent cobbles and gravel; mildly alkaline; clear wavy boundary.

B3ca—14 to 17 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable; few thin patchy clay films on peds; 70 percent cobbles and gravel; visible secondary calcium carbonate occurring as concretions in thin seams and streaks and as coatings on coarse fragments; calcareous; moderately alkaline; gradual wavy boundary.

IICca—17 to 60 inches; very gravelly sand; carbonate coatings on coarse fragments; 60 percent cobbles and gravel.

The A1 horizon is 3 to 6 inches thick and is cobbly loam to gravelly sandy loam. The B2t horizon is 4 to 12 inches thick and is very cobbly clay loam in some pedons. The content of gravel and cobbles in the A horizon ranges from 35 to 50 percent and from 35 to 70 percent in the B horizon. Depth to lime ranges from 8 to 30 inches.

De—Derrick cobbly loam. This nearly level or very gently sloping soil occupies alluvial fans and terraces. Slopes are 0 to 3 percent. About 15 percent of this unit is included areas of Graypoint gravelly sandy loam and small areas of Platoro loam and Dunul cobbly sandy loam.

Runoff is slow. The erosion hazard is slight.

This soil is used mainly for range and wildlife. Some small areas are used for irrigated crops. Capability unit IVs–1 irrigated, VIIs–7 nonirrigated; Mountain Outwash range site.

Dunul Series

The Dunul series consists of excessively drained soils 6 to 10 inches deep over gravel, cobbles, and sand. These soils formed in cobbly alluvium on alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 7,900 feet. Natural vegetation is dominantly blue grama, Indian ricegrass, snakeweed, and low rabbitbrush. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days.

In a representative profile the surface layer is dark grayish brown cobbly sandy loam about 10 inches thick. The underlying material is dark gray very gravelly sand that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low. Reaction is moderately alkaline. The effective rooting depth is 6 to 12 inches.

These soils are used for irrigated crops and for range.

Representative profile of Dunul cobbly sandy loam, 1,500 feet east and 300 feet north of the southwest corner sec. 18, T. 40 N., R. 8 E.

Ap—0 to 10 inches; grayish brown (10YR 5/2) cobbly sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; 35 percent cobbles and 25 percent gravel; slightly calcareous; moderately alkaline; diffuse smooth boundary.

C—10 to 60 inches; gray (10YR 5/1) very gravelly sand, dark gray (10YR 4/1) moist; single grained; loose; 70 percent gravel and cobbles; calcareous; moderately alkaline.

The A horizon is 4 to 10 inches thick. It is gravelly sandy loam in some fields where most of the cobbles have been removed by rockpicking machinery. The content of gravel and cobbles in the A horizon ranges from 35 to 70 percent. The C horizon is very gravelly sand or very cobbly sand.

Dn—Dunul cobbly sandy loam. This nearly level soil occupies large areas at the upper end of alluvial fans in the north-central part of the Area. Slopes are 0 to 1 percent. About 20 percent of this unit is included areas of Quamon gravelly sandy loam and 10 percent areas of Norte gravelly sandy loam.

Runoff is slow. The erosion hazard is slight.

If water is available, most of the acreage is used for irrigated potatoes, small grain, alfalfa, and vegetables. Some areas are used for range. Capability unit IVs–1 irrigated, VIIs–7 nonirrigated; Mountain Outwash range site.

Embargo Series

The Embargo series consists of moderately deep, well drained soils. These soils formed in residuum weathered from rhyolite on mountainsides. Slopes are 10 to 25 percent. Elevation is 9,000 to 10,000 feet. Natural vegetation is dominantly mountain muhly, Arizona fescue, Parry oatgrass, and needleandthread. The average annual precipitation is about 16 inches, the mean annual air temperature is about 36° F, and the frost-free season is 70 to 90 days.

In a representative profile the surface layer is dark brown very stony loam about 7 inches thick. The subsoil is dark brown very stony loam, clay loam, or clay

about 27 inches thick. It is about 60 percent stones and cobbles. Rhyolite is at a depth of about 34 inches.

Permeability is slow, and the available water capacity is low. Reaction ranges from neutral to mildly alkaline. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife.

Representative profile of Embargo very stony loam, 10 to 25 percent slopes, in the southwest quarter sec. 3, T. 37 N., R. 6 E.

A1—0 to 7 inches; brown (7.5YR 4/2) very stony loam, dark brown (7.5YR 3/2) moist; moderate; moderate very fine granular and crumb structure; soft, very friable; 60 percent stones and cobbles; neutral; clear smooth boundary.

B1—7 to 12 inches; brown (7.5YR 4/2) very stony heavy loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure parting to moderate very fine granular; hard, friable, few thin patchy clay films on peds; 50 percent stones and cobbles; neutral; clear smooth boundary.

B2t—12 to 30 inches; brown (7.5YR 5/2) very stony clay, dark brown (7.5YR 4/2) moist; moderate medium subangular blocky structure parting to strong fine and very fine subangular blocky; hard, firm; thin continuous clay films on peds and on the surfaces of coarse fragments and in root channels; 60 percent stones and cobbles; neutral; gradual wavy boundary.

B3—30 to 34 inches; pinkish gray (7.5YR 6/2) very stony clay loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; hard, friable; few thin patchy clay films on peds and coatings on some rock fragments; 70 percent stones and cobbles; mildly alkaline; clear wavy boundary.

R—34 inches; rhyolite bedrock.

In some pedons the B1 horizon is clay loam. In some, the B2t horizon is 15 to 24 inches of heavy clay loam. In others, part of the B horizon is dark reddish brown. The content of stones and cobbles ranges from 35 to 75 percent in the A and B horizons. Depth to rhyolite, andesite, or latite bedrock ranges from 20 to 40 inches.

EmE—Embargo very stony loam, 10 to 25 percent slopes. This moderately steep soil occupies large areas on mountainsides in the southwestern part of the Area. About 10 percent of this unit is included areas of Tolman very stony loam and 10 percent areas of Empedrado loam. Also included are small areas of Rock outcrop.

Runoff is moderate. The erosion hazard is slight.

This soil is used for range and wildlife. Capability unit VIIs–1 nonirrigated; Shallow Loam range site.

Empedrado Series

The Empedrado series consists of deep, well drained soils. These soils formed in residuum weathered from rhyolite, andesite, and latite on foothills. Slopes are 3 to 15 percent. Elevation is 8,000 to 9,200 feet. Natural vegetation is dominantly pinon-juniper, western wheatgrass, and blue grama. The average annual precipitation is about 12 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is very dark brown loam about 7 inches thick. The subsoil is very dark brown heavy loam, dark brown light clay loam, and dark grayish brown sandy clay loam about 17 inches thick. The substratum is dark grayish brown sandy loam that extends to a depth of 40 inches or more.

Permeability is moderate, and the available water capacity is moderate. Reaction ranges from neutral in the surface layer to moderately alkaline in the substratum. The effective rooting depth is 40 to 60 inches.

These soils are used for range, woodland, and wildlife.

Representative profile of Empedrado loam in an area of Tolman-Empedrado complex, 3 to 25 percent slopes, in the southeast quarter sec. 1, T. 39 N., R. 4 E.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable; neutral; clear smooth boundary.

B1—7 to 10 inches; dark grayish brown (10YR 4/2) heavy loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable; few thin patchy clay films on peds; neutral; clear smooth boundary.

B2t—10 to 20 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, friable; thin nearly continuous clay films on peds and in root channels; neutral; gradual wavy boundary.

B3—20 to 24 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; thin patchy clay films on peds; 5 percent gravel; mildly alkaline; clear wavy boundary.

Cca—24 to 40 inches; light brownish gray (2.5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable; 5 percent gravel; visible secondary calcium carbonate occurring as concretions in thin seams and streaks and as coatings on gravel fragments; calcareous; moderately alkaline.

The A1 horizon is 4 to 10 inches thick. The B2t horizon is 8 to 24 inches thick. The C horizon is sandy loam or gravelly sandy loam above a depth of 40 inches. Coarse fragments are gravel, cobbles, and stones, mainly rhyolite. To a depth of 40 inches, the content of coarse fragments ranges from 0 to 15 percent. Weathered rhyolite occurs in many areas at a depth of 40 to 60 inches. Depth to visible lime ranges from 20 to 40 inches.

Fulcher Series

The Fulcher series consists of deep, well drained soils. These soils formed in alluvium on alluvial fans and mountainsides. Slopes are 3 to 10 percent. Elevation is 8,300 to 9,500 feet. Natural vegetation is dominantly western wheatgrass, junegrass, currant, and rabbitbrush. The average annual precipitation is about 15 inches, the mean annual air temperature is about 40° F, and the frost-free season is 65 to 80 days.

In a representative profile the surface layer is very dark grayish brown cobbly loam about 11 inches thick. The subsoil is dark brown cobbly clay loam and cobbly sandy clay loam about 31 inches thick. The substratum is dark grayish brown cobbly sandy clay loam that extends to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. Reaction ranges from mildly alkaline to moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for range and wildlife.

Representative profile of Fulcher cobbly loam, 3 to 10 percent slopes, in the northeast quarter sec. 12, T. 37 N., R. 6 E.

A11—0 to 5 inches; grayish brown (10YR 5/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; strong fine crumb structure; soft, very friable; 15 percent cobbles and gravel; mildly alkaline; clear smooth boundary.

A12—5 to 11 inches; grayish brown (10YR 5/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to strong fine granular; soft, very friable; 35 percent cobbles and gravel; mildly alkaline; clear smooth boundary.

B1—11 to 17 inches; brown (10YR 5/3) cobbly light clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, very friable; few thin patchy clay films on peds; 15 percent cobbles; mildly alkaline; gradual wavy boundary.

B2t—17 to 37 inches; brown (10YR 5/3) cobbly heavy clay loam, dark brown (10YR 4/3) moist; strong medium angular blocky structure; very hard, very firm; moderate continuous clay films on peds and in root channels; clay films on the underside of coarse fragments; 15 percent cobbles; mildly alkaline; clear wavy boundary.

B3ca—37 to 42 inches; pale brown (10YR 6/3) cobbly sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; very hard, firm; thin patchy clay films on peds and in root channels; 15 percent cobbles; visible secondary carbonate occurring as small concretions and as coatings on cobbles; calcareous; moderately alkaline; gradual wavy boundary.

Cca—42 to 60 inches; light brownish gray (10YR 6/2) cobbly sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; 50 percent cobbles and stones; visible secondary calcium carbonate occurring as concretions in thin seams and streaks and as coatings on coarse fragments; calcareous; moderately alkaline.

The A horizon is 7 to 15 inches thick. The B2t horizon is 10 to 25 inches thick and is cobbly heavy clay loam or cobbly clay. Above a depth of 40 inches, the content of cobbles and gravel ranges from 10 to 35 percent. The size and content of coarse fragments generally increase below 40 inches. The content of cobbles and stones in the C horizon ranges from 35 to 65 percent. Depth to lime ranges from 30 to 50 inches.

FrC—Fulcher cobbly loam, 3 to 10 percent slopes. This gently sloping or sloping soil occupies areas in narrow mountain valleys in the western part of the Area. About 15 percent of this unit is included very cobbly and stony areas and cobble bars, 5 percent areas of Embargo very stony loam, and 5 percent Empedrado loam.

Runoff is moderate. The hazard of water erosion is moderate. There are many small gullies and creek channels.

This soil is used for range and wildlife. Capability unit VIe–1 nonirrigated; Loamy Park range site.

Garita Series

The Garita series consists of deep, well drained soils. These soils formed in alluvium on alluvial fans and foothills. Slopes are 1 to 25 percent. Elevation is 7,700 to 8,600 feet. Natural vegetation is dominantly winterfat, blue grama, ring muhly, rabbitbrush, and snakeweed. The average annual precipitation is about 8 inches, the mean annual air temperature is about 41° F, and the frost-free season is 95 to 115 days.

In a representative profile the surface layer is dark grayish brown cobbly loam about 9 inches thick. The underlying material is light brownish gray and grayish brown gravelly loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate or high. Reaction is moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for range, wildlife, and irrigated crops.

Representative profile of Garita cobbly loam, 1 to 3 percent slopes, 700 feet south and 50 feet west of the northeast corner sec. 28, T. 38 N., R. 7 E.

A1—0 to 9 inches; light brownish gray (10YR 6/2) cobbly loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; 25 percent gravel and cobbles; calcareous; moderately alkaline; gradual wavy boundary.

C1ca—9 to 30 inches; white (10YR 8/2) gravelly loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; 40 percent gravel and cobbles; a large amount of soft visible secondary calcium carbonate; few crystals of calcium sulfate; calcareous; moderately alkaline; gradual wavy boundary.

C2ca—30 to 60 inches; light brownish gray (10YR 6/2) gravelly loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; 40 percent gravel and cobbles; visible secondary calcium carbonate occurring mostly as concretions in thin seams and streaks and as coatings on coarse fragments; calcareous; moderately alkaline.

The A horizon is 5 to 12 inches thick and is loam or sandy loam that is cobbly or gravelly. The Cca horizon is gravelly or cobbly loam. The content of cobbles and gravel in the A horizon ranges from 20 to 75 percent in the A horizon and from 35 to 75 percent in the C horizon. Steeper soils generally have a larger amount of cobbles and gravel on the surface and in the profile than gently sloping soils. Depth to the Cca horizon ranges from 5 to 30 inches. The content of calcium carbonate is 15 to 30 percent.

GaB—Garita cobbly loam, 1 to 3 percent slopes. This very gently sloping soil occupies the upper end of alluvial fans along the western edge of the valley. The profile of this soil is the one described as representative of the series. About 5 percent of this unit is included areas of Stunner loam, 1 to 3 percent slopes, and about 10 percent areas of Luhon loam, 1 to 3 percent slopes. Also included are some small areas of steeper Garita soils.

Runoff is moderate. The erosion hazard is slight.

Most of the acreage is used for range, and a few areas are used for irrigated alfalfa and small grain. Capability unit IVe–3 irrigated, VIIs–8 nonirrigated; Limy Bench range site.

GaE—Garita cobbly loam, 3 to 25 percent slopes. This gently sloping to moderately steep soil occupies alluvial fans and foothills along the western edge of the valley. The steeper slopes are short and the more gentle slopes range to as much as 1 mile in length. The profile of this soil is similar to the one described as representative of the series, but is typically more cobbly and gravelly.

Included with this soil in mapping are areas of Travelers soils, which make up 5 percent of the unit.

Rock crops out in a few areas. About 5 percent of this unit is included areas of Stunner loam, 3 to 6 percent slopes, and about 15 percent areas of Luhon loam, 3 to 6 percent slopes.

Runoff is moderate. The erosion hazard is slight.

This soil is used mostly for range and wildlife habitat (fig. 3). Capability unit VIIs–8 nonirrigated; Limy Bench range site.

Gerrard Series

The Gerrard series consists of somewhat poorly drained or poorly drained soils 12 to 20 inches deep over sand and gravel. These soils formed in alluvium on low terraces, flood plains, and alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly sedges, rushes, tufted hairgrass, and wild iris. The average annual precipitation is about 9 inches, the mean annual air temperature is about 41° F, and the frost-free season is 95 to 110 days.

In a representative profile the surface layer is very dark gray loam about 14 inches thick. It is mottled with brown in the lower part. The underlying material is very gravelly loamy sand that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate. Reaction is neutral or mildly alkaline. The effective rooting depth is 12 to 20 inches. Depth to the seasonal high water table is about 1 to 1½ feet. The table is highest late in spring and in summer.

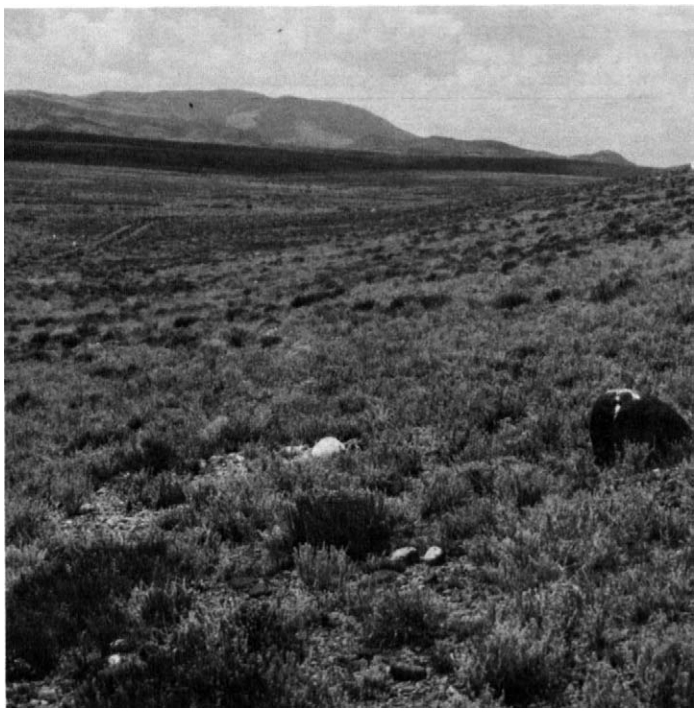

Figure 3.—**Landscape of Garita cobbly loam, 3 to 25 percent slopes, showing typical vegetation of winterfat, low rabbitbrush, and grasses.**

These soils are used for irrigated meadow, irrigated crops, and range.

Representative profile of Gerrard loam, 2,600 feet south and 20 feet east of the northwest corner sec. 25, T. 40 N., R. 5 E.

A11—0 to 5 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; strong fine granular structure; soft, very friable; 5 percent gravel; mildly alkaline; clear smooth boundary.

A12—5 to 14 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; common medium distinct mottles, brown (7.5YR 4/4) moist; weak fine subangular blocky structure parting to moderate medium granular; hard, very friable; neutral; gradual wavy boundary.

IIC—14 to 60 inches; very gravelly loamy sand.

The A horizon is 12 to 20 inches thick and is very dark gray and very dark brown to black loam or light clay loam. The content of gravel and cobbles above the IIC horizon ranges from 3 to 15 percent.

Ge—Gerrard loam. This nearly level soil occupies low terraces, flood plains, and alluvial fans along the Rio Grande and its major tributaries. Slopes are 0 to 1 percent. The soil is subject to flooding in many places during spring and summer when runoff is high from melting snow in the mountains. The water table is about 12 to 18 inches below the surface in spring and summer, but generally drops to the gravel substratum in winter. About 10 percent of this unit is included areas of Shawa loam, 0 to 1 percent slopes, and about 10 percent areas of Alamosa loam and Torsido clay loam.

Runoff is slow. The erosion hazard is slight.

This soil is used mostly for irrigated meadow. Irrigated meadows are cut for hay or used for grazing. Some areas are used for cultivated alfalfa and small grain. A few areas are used for range. Capability unit IVw–1 irrigated, VIw–3 nonirrigated; Wet Meadow range site.

Gravel Pits

Gp—Gravel pits are open excavations from which gravel has been obtained for roadbuilding.

Graypoint Series

The Graypoint series consists of well drained soils 10 to 20 inches deep over sand and gravel. These soils formed in gravelly alluvium on alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly blue grama, ring muhly, sand dropseed, and low rabbitbrush. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 95 to 105 days.

In a representative profile (fig. 4) the surface layer is dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil is dark brown gravelly sandy clay loam about 6 inches thick. The substratum is 6 inches of dark yellowish brown gravelly sandy loam over sand and gravel that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is low. Reaction ranges from mildly alkaline

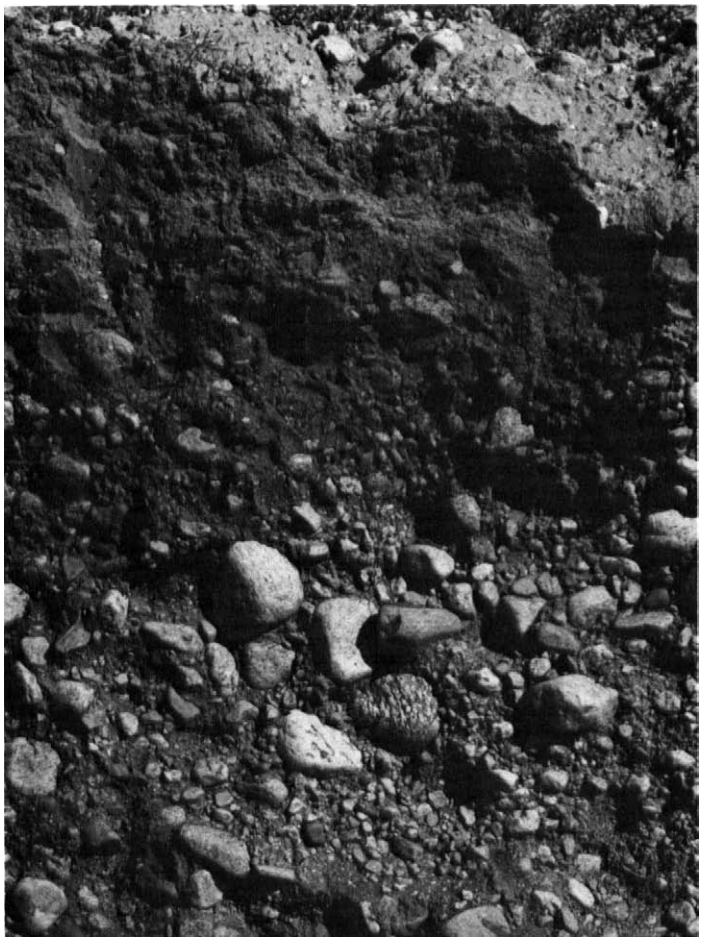

Figure 4.—**Profile of Graypoint gravelly sandy loam.**

to moderately alkaline. The effective rooting depth is 10 to 20 inches.

These soils are used for range and irrigated crops.

Representative profile of Graypoint gravelly sandy loam, 2,780 feet east and 750 feet south of the northwest corner sec. 25, T. 37 N., R. 7 E.

A1—0 to 6 inches; light brownish gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable; about 18 percent gravel; mildly alkaline; clear smooth boundary.

B2t—6 to 12 inches; brown (7.5YR 4/4) gravelly sandy clay loam, dark brown (7.5YR 3/4) moist; moderate medium and fine subangular blocky structure; very thin patchy clay films on peds; slightly hard, friable; about 30 percent gravel; mildly alkaline; clear smooth boundary.

C1ca—12 to 18 inches; yellowish brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable; visible calcium carbonate occurring as concretions, streaks, and coatings on gravel; calcareous; 70 percent gravel; moderately alkaline; clear smooth boundary.

IIC2—18 to 60 inches; gravel and sand; calcareous in places on the underside of gravel.

The A horizon is gravelly sandy loam or gravelly loam. In most cultivated fields it is gravelly loam. The B2t horizon is gravelly sandy clay loam or gravelly clay loam. The content of gravel and cobbles in the A and B horizons ranges from 15 to 35 percent. Depth to lime ranges from 8 to 20 inches. In some areas lime occurs only as a coating on the underside of gravel and cobbles.

Gr—Graypoint gravelly sandy loam. This nearly level soil occupies the upper end of alluvial fans along the western edge of the valley. Slopes are 0 to 1 percent. About 15 percent of this unit is included areas of Platoro loam, 0 to 1 percent slopes, and Derrick cobbly loam, and 5 to 10 percent in some areas is San Arcacio sandy loam.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated potatoes, small grain, alfalfa, and vegetables. It is also used for range. Capability unit IVs–2 irrigated, VIIs–2 nonirrigated; Mountain Outwash range site.

Gunbarrel Series

The Gunbarrel series consists of deep, poorly drained soils. These soils formed in sandy alluvium on alluvial fans and old flood plains. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly rabbitbrush, greasewood, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark grayish brown loamy sand about 9 inches thick. The underlying layer is dark yellowish brown loamy sand about 21 inches thick. Below this is sand and gravel that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low. Reaction ranges from moderately alkaline to strongly alkaline. The effective rooting depth is 24 to 60 inches. Depth to the seasonal high water table is about 2 to 3 feet.

These soils are used for irrigated crops and for range.

Representative profile of Gunbarrel loamy sand, 500 feet west and 100 feet north of the southeast corner sec. 12, T. 38 N., R. 8 E.

A1—0 to 9 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grained; slightly hard, very friable; moderately alkaline; clear smooth boundary.

ACg—9 to 21 inches; brown (10YR 5/3) loamy sand, dark yellowish brown (10YR 3/4) moist; single grained; soft, very friable; common medium faint mottles, yellowish brown (10YR 5/6) and dark brown (10YR 4/3) moist; strongly alkaline; calcareous; clear smooth boundary.

C1cag—21 to 30 inches; yellowish brown (10YR 5/4) loamy sand, dark yellowish brown (10YR 4/4) moist; single grained; loose; common medium distinct mottles, yellowish brown (10YR 5/6) and dark gray (10YR 4/1) moist; visible calcium carbonate occurring as spots; calcareous; strongly alkaline; clear smooth boundary.

C2—30 to 60 inches; sand and fine gravel.

The A horizon is loamy sand or loamy fine sand. Depth to lime ranges from 0 to 20 inches, and depth to sand and gravel ranges from 24 to 60 inches.

Gu—Gunbarrel loamy sand. This nearly level soil occupies the low end of alluvial fans or old flood plains in the eastern part of the Area. Slopes are 0 to 1 per-

cent. The water table is about 24 to 36 inches below the surface in summer. In most areas drainage ditches control the height of the water table. Salinity is low to moderate because of the high water table. Because the salts is easily leached with periodic irrigation, it generally is not a hazard to plant growth.

Included with this soil in mapping are areas of Norte gravelly sandy loam and, generally in the extreme eastern part of the Area, areas of Mosca loamy sand. These included soils make up 10 percent of the unit. About 20 percent of the unit is an included soil that is similar to this Gunbarrel soil but has mottles deeper in the profile.

Runoff is very slow. The soil blowing hazard is high.

This soil is used mainly for irrigated potatoes. Some areas are used for small grain, alfalfa, and vegetables. Some are used for range. Capability unit IVe–1 irrigated, VIIe–1 nonirrigated; Salt Flats range site.

Hooper Series

The Hooper series consists of well drained soils 20 to 40 inches deep over sand and gravel. These soils formed in alluvium on old flood plains. Slopes are 0 to 1 percent. Elevation is 7,600 to 7,800 feet. Natural vegetation is dominantly greasewood, rabbitbrush, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is grayish brown loamy sand about 5 inches thick. The subsoil is dark brown or brown clay loam about 18 inches thick. The substratum is 7 inches of dark grayish brown sandy clay loam over dark grayish brown sand that extends to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is low. Reaction is very strongly alkaline. The soils are strongly alkali. The effective rooting depth is 20 to 40 inches.

These soils are used for range, irrigated meadow, and wildlife.

Representative profile of Hooper loamy sand, 2,640 feet north and 230 feet west of the southeast corner sec. 36, T. 38 N., R. 8 E.

A2—0 to 5 inches; light gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) moist; moderate thick platy structure parting to strong medium granular; hard, very friable; vesicular; weakly calcareous; very strongly alkaline; abrupt smooth boundary.

B2t—5 to 14 inches; brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) moist; moderate medium columnar and moderate medium prismatic structure parting to strong medium blocky; very hard, very firm; thin continuous clay films on peds and in root channels; calcareous; very strongly alkaline; clear smooth boundary.

B3—14 to 23 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, firm; thin patchy clay films on peds; hard, firm; very strongly alkaline; calcareous; clear smooth boundary.

C1—23 to 30 inches; light brownish gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; calcareous; very strongly alkaline; clear smooth boundary.

IIC2—30 to 60 inches; grayish brown (10YR 5/2) sand, dark grayish brown (10YR 4/2) moist; single grained; loose; calcareous; very strongly alkaline.

The A2 horizon is 3 to 8 inches thick and is loamy sand to clay loam. The B2t horizon is 8 to 20 inches thick and is clay or heavy clay loam. The C1 horizon is sandy clay loam or sandy loam. Exchangeable sodium ranges from 15 to 60 percent in the B2t and B3 horizons. In some pedons the loamy sand A horizon has less than 15 percent exchangeable sodium. The soil is strongly to very strongly alkali.

Ho—Hooper loamy sand. This nearly level soil occupies old flood plains in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series. The water table is about 48 to 60 inches below the surface because of irrigation. Salinity is none to moderate in the surface layer. About 30 percent of this unit is included areas of Hooper clay loam, 15 percent areas of Arena loam, and 10 percent areas of San Luis sandy loam. Also included are a few areas of soil that is similar to this Hooper soil but has bright colored mottles in the sand substratum.

Runoff is very slow. The soil blowing hazard is moderate.

This soil is used mostly for range. Some areas are used for irrigated meadow. Some are used as wildlife habitat. Capability unit VIs–1 irrigated, VIIs–5 nonirrigated; Salt Flats range site.

Hp—Hooper clay loam. This nearly level soil occupies old flood plains in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but the surface layer is clay loam and typically has more alkali at the surface (fig. 5). The water table is about 48 to 60 inches below the surface because of irrigation. Salinity is moderate.

About 10 percent of this unit is included areas of Hooper loamy sand or Arena loam. Also included are small areas of San Luis sandy loam and a few areas of a soil that is similar to this Hooper soil but has bright colored mottles in the sand substratum.

Runoff is very slow. The erosion hazard is slight.

This soil is used mostly for wildlife habitat. It provides good nesting areas for ducks. Some areas are used for limited grazing. The vegetation is mostly greasewood. Capability unit VIIs–4 nonirrigated; not assigned to a range site.

Jodero Series

The Jodero series consists of deep, well drained soils. These soils formed in loamy alluvium on alluvial fans and valley bottoms. Slopes are 0 to 6 percent. Elevation is 8,000 to 9,000 feet. Natural vegetation is dominantly rabbitbrush, blue grama, western wheatgrass, and needleandthread. The average annual precipitation is about 12 inches, the mean annual air temperature is about 42° F, and the frost-free season is 80 to 100 days.

In a representative profile the upper 24 inches is dark brown and very dark grayish brown loam. Below this is very dark grayish brown and dark grayish brown loam stratified with fine sandy loam that extends to a depth of 60 inches or more.

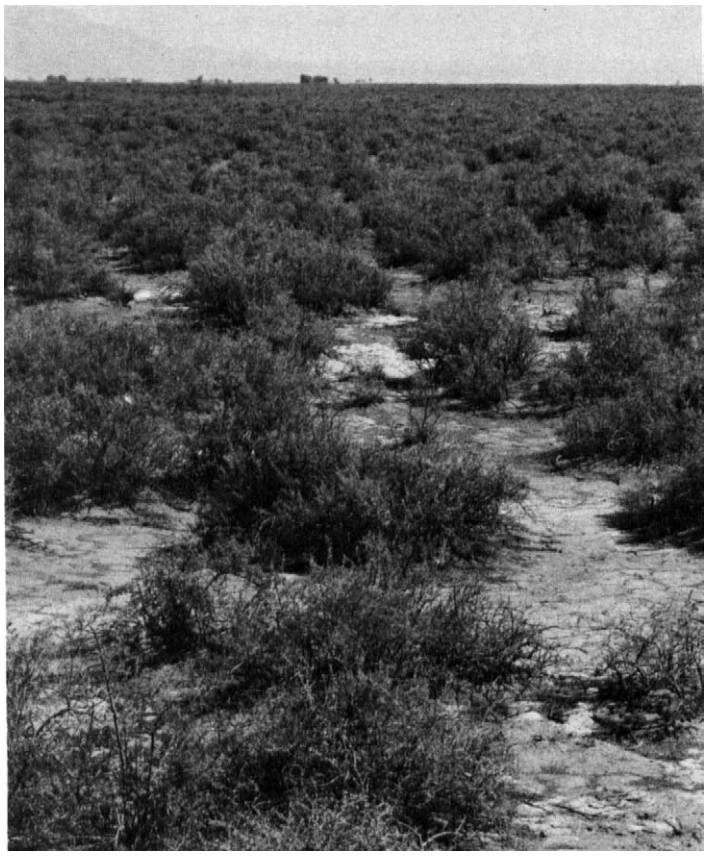

Figure 5.—**Landscape of Hooper clay loam, showing the dispersed surface soil and the vegetation of greasewood.**

Permeability is moderate, and the available water capacity is high. Reaction ranges from mildly alkaline to moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for range, wildlife, and irrigated crops.

Representative profile of Jodero loam, along a dry creek channel in the southwest quarter sec. 34, T. 39 N., R. 6 E.

A11—0 to 8 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; strong medium granular structure; soft, very friable; 5 percent gravel; mildly alkaline; gradual wavy boundary.

A12—8 to 24 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure parting to moderate medium granular; slightly hard, very friable; 5 percent gravel; mildly alkaline; clear wavy boundary.

A13—24 to 60 inches; grayish brown (10YR 5/2) loam stratified with thin lenses of fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, very friable; calcareous; moderately alkaline; gradual wavy boundary.

C—60 to 70 inches; light brownish gray (10YR 6/2) loam stratified with thin lenses of fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; 5 percent gravel; calcareous; moderately alkaline.

The A horizon is 40 to more than 60 inches thick. The content of gravel and cobbles ranges from 0 to 15 percent. In some areas some of the lower horizons are reddish brown. Depth to lime ranges from 10 to 40 inches.

Jo—Jodero loam. This nearly level to gently sloping soil occupies short alluvial fans and narrow valley bottoms in the foothills in the western part of the Area (fig. 6). Slopes are 0 to 6 percent. About 5 percent of this unit is included areas of Luhon loam and about 5 percent areas of Monte loam.

Runoff is moderate, but the soil receives runoff from surrounding hillsides. The hazard of water erosion is moderate. Gullies have formed in most areas.

This soil is used mostly for range and wildlife. Some areas are used for irrigated alfalfa and small grain. Capability unit IVe–2 irrigated, VIe–1 nonirrigated; Foothill Loam range site.

Laney Series

The Laney series consists of deep, well drained soils. These soils formed in alluvium on old flood plains and alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly rabbitbrush, greasewood, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile (fig. 7) the upper 11 inches is brown loam. The upper 39 inches of the underlying material is dark grayish brown sandy loam and stratified loam, clay loam, and sandy loam. Below this is gravelly sand that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate. Reaction ranges from very strongly alkaline to strongly alkaline. The effective rooting depth is 40 to 60 inches.

These soils are used for range, irrigated crops, and wildlife.

Representative profile of Laney loam, 1,100 feet west and 200 feet north of the southeast corner sec. 7, T. 37 N., R. 8 E.

Ap—0 to 7 inches pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate medium granular structure; slightly hard, friable; calcareous; very strongly alkaline; abrupt smooth boundary.

AC—7 to 11 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to moderate medium granular; hard, friable; calcareous; very strongly alkaline; clear smooth boundary.

C1—11 to 24 inches; pinkish gray (7.5YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; hard, friable; calcareous; strongly alkaline; gradual wavy boundary.

C2—24 to 50 inches; pale brown (10YR 6/3) stratified loam, clay loam, and sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; calcareous; strongly alkaline; clear wavy boundary.

IIC3—50 to 60 inches; gravelly sand.

The Ap horizon is 4 to 8 inches thick. The horizon is typically stratified loam, clay loam, and sandy loam, but thickness and arrangement of individual strata are highly variable. Exchangeable sodium ranges from 15 to 50 percent. The content of gravel ranges from 0 to 15 percent

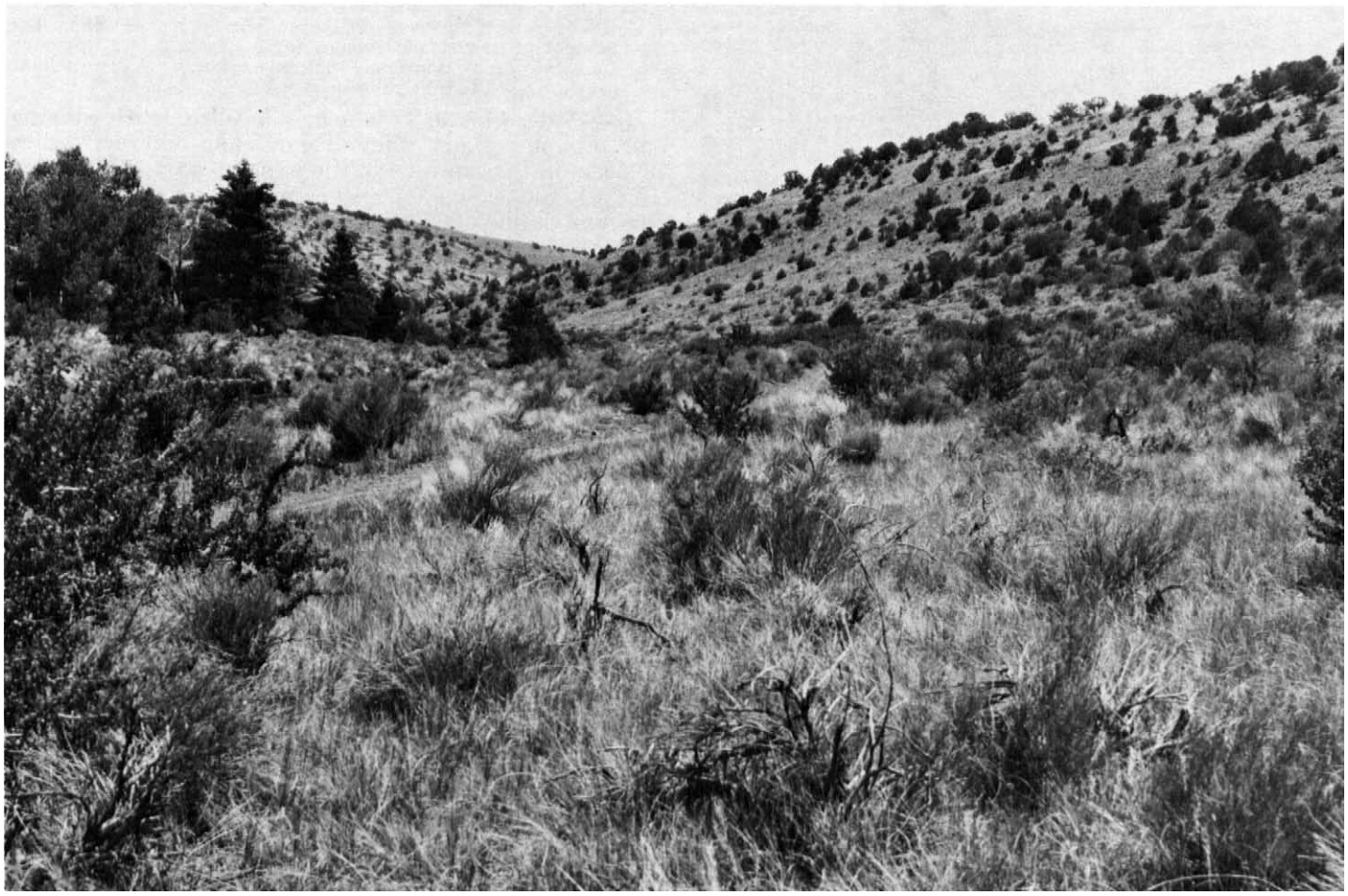

Figure 6.—**Landscape of Jodero loam showing typical vegetation. Jodero loam is in the foreground and Celeste-Rock outcrop complex, 5 to 25 percent slopes, is on the hills in the background.**

above a depth of 40 inches. Depth to a gravelly sand IIC horizon ranges from 40 to 60 inches. Salinity ranges from moderate to high.

La—Laney loam. This nearly level soil occupies old flood plains and the lower end of alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. About 10 percent of this unit is included areas of Zinzer loam and San Arcacio loam and about 5 percent areas of Hooper soils and Arena loam.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used for range and for irrigated alfalfa and small grain. Some areas are used for waterfowl nesting. Capability unit IIIs–4 irrigated, VIIs–3 nonirrigated; Salt Flats range site.

Luhon Series

The Luhon series consists of deep, well drained soils. These soils formed in alluvium on alluvial fans and valley-fill slopes. Slopes are 1 to 6 percent. Elevation is 7,700 to 8,500 feet. Natural vegetation is dominantly winterfat, low rabbitbrush, blue grama, and Indian ricegrass. The average annual precipitation is about 8 inches, the mean annual air temperature is about 43° F, and the frost-free season is 90 to 115 days.

In a representative profile the surface layer is dark grayish brown loam about 5 inches thick. The upper 42 inches of the underlying material is dark brown and pinkish gray loam. Below this is brown gravelly sandy loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. Reaction is moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for range and irrigated crops.

Representative profile of Luhon loam, 1 to 3 percent slopes, 1,320 feet south and 700 feet west of the northeast corner sec. 8, T. 40 N., R. 5 E.

A1—0 to 5 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium platy and weak granular structure; soft, very friable; few pebbles in profile and common pebbles on surface; moderately alkaline; clear smooth boundary.

AC—5 to 17 inches; pinkish gray (7.5YR 6/2) loam, dark brown (7.5YR 4/2) moist; weak coarse subangular blocky structure; hard, friable; 10 percent gravel; visible calcium carbonate occurring as soft masses; calcareous; moderately alkaline; gradual wavy boundary.

Figure 7.—**Profile of Laney loam.**

C1ca—17 to 47 inches; pinkish gray (7.5YR 7/3) loam, pinkish gray (7.5YR 6/3) moist; massive; slightly hard, very friable; much visible calcium carbonate occurring in disseminated form and soft masses; strongly calcareous; 15 percent gravel and cobbles; moderately alkaline; gradual wavy boundary.

C2ca—47 to 60 inches; pinkish gray (7.5YR 7/3) gravelly sandy loam, brown (7.5YR 5/3) moist; massive; soft, very friable; much visible calcium carbonate in seams and in soft masses but less than in C1ca horizon; calcareous; moderately alkaline; gradual smooth boundary.

The A1 horizon is 4 to 10 inches thick. Some pedons have a sandy loam A1 horizon. The C1ca horizon has strata of sandy loam and light clay loam in some pedons. Depth to the calcic horizon ranges from 10 to 24 inches. The content of calcium carbonate ranges from 15 to 40 percent. The content of gravel and cobbles ranges from 5 to 20 percent in the A horizon and from 5 to 35 percent in the C horizon.

LuB—Luhon loam, 1 to 3 percent slopes. This very gently sloping soil occupies alluvial fans along the western edge of the valley and in the foothills. The profile of this soil is the one described as representative of the series. About 10 percent of this unit is included areas of Stunner loam, 1 to 3 percent slopes, and about 10 percent areas of Garita cobbly loam, 1 to 3 percent slopes.

Runoff is moderate. The soil blowing hazard is moderate.

This soil is used for range, irrigated pasture, and irrigated alfalfa (fig. 8), small grain, potatoes, and other vegetables. Capability unit IIIe–1 irrigated, VIIs–3 nonirrigated; Limy Bench range site.

LuC—Luhon loam, 3 to 6 percent slopes. This gently sloping soil occupies the upper end of alluvial fans and valley-fill slopes along the western edge of the valley and in the foothills. The profile of this soil is similar to the one described as representative of the series (fig. 9). About 10 percent of this unit is included areas of Stunner loam, 3 to 6 percent slopes, and 10 percent areas of Garita cobbly loam, 3 to 25 percent slopes. Also included are small areas of Luhon loam that is steeper than this soil in places.

Runoff is moderate. The soil blowing and water erosion hazards are moderate.

This soil is used mostly for range. Some areas are used for irrigated small grain and alfalfa. Capability unit IVe–2 irrigated, VIIs–3 nonirrigated; Limy Bench range site.

Marsh

Ma—Marsh is covered with water most of the year. The natural vegetation is cattails and sedges. Capability unit VIIIw–1 nonirrigated; not assigned to a range site.

Mishak Series

The Mishak series consists of deep, somewhat poorly drained soils. These soils formed in alluvium on flood plains and alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 7,800 feet. Natural vegetation is dominantly alkali sacaton, sedges, and rushes. The average annual precipitation is about 8 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark grayish brown loam about 12 inches thick. It is mottled with dark brown and has thin lenses of sandy clay loam in the lower part. The underlying material is mottled grayish brown loam and sandy clay loam stratified with sandy loam and clay loam to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate or high. Reaction ranges from very strongly alkaline in the surface layer to moderately alkaline in the underlying material. The effective rooting depth is 36 to 48 inches. The water table is at a depth of 12 to 24 inches in summer, but drops below 24 inches in winter. The soils are saline and alkali.

These soils are used for irrigated meadow and for range.

Figure 8.—**Alfalfa on Lubon loam, 1 to 3 percent slopes. Garita cobbly loam is on hill and Travelers very stony sandy loam is in background.**

Representative profile of Mishak loam, 150 feet south and 150 feet west of the northeast corner sec. 11, T. 38 N., R. 7 E.

A1—0 to 4 inches; light gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure parting to coarse granular; soft, very friable; more than 15 percent exchangeable sodium; calcareous; very strongly alkaline; gradual smooth boundary.

A12g—4 to 12 inches; light gray (10YR 7/2) loam stratified with thin lenses of sandy clay loam, dark grayish brown (10YR 4/2) moist; common medium distinct mottles, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure parting to coarse granular; hard, friable; more than 15 percent exchangeable sodium; calcareous; very strongly alkaline; gradual wavy boundary.

C1cag—12 to 30 inches; light brownish gray (10YR 6/2) loam stratified with lenses of sandy clay loam and clay loam, grayish brown (10YR 5/2) moist; many medium distinct mottles, brown (10YR 4/3 and 7.5YR 4/4) moist; massive; hard, friable; less than 15 percent exchangeable sodium decreasing with depth; large amount of visible secondary calcium carbonate as concretions, seams, and in finely divided forms; calcareous; moderately alkaline; diffuse wavy boundary.

C2cag—30 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam stratified with lenses of loam, sandy loam, and clay loam, grayish brown (10YR 5/2) moist; many medium distinct mottles, brown (10YR 4/3 and 7.5YR 4/4) moist; massive; hard, friable; visible calcium carbonate as concretions and in seams but less than in horizon above; calcareous; moderately alkaline.

The A horizon is 6 to 15 inches thick and is loam or light clay loam. The C horizon is typically loam stratified with sandy clay loam, clay loam, and sandy loam, but thickness and arrangement of the individual strata vary. Depth to mottles ranges from 4 to 12 inches. Depth to the Cca horizon ranges from 6 to 15 inches. The content of gravel ranges from 0 to 10 percent. Exchangeable sodium ranges from 15 to 30 percent in the A horizon and is less than 15 percent in the C horizon. Salinity is high or very high.

Mh—Mishak loam. This nearly level soil occupies flood plains and the lower end of alluvial fans along the Rock Creek drainageway in the central part of the Area. Slopes are 0 to 1 percent. Salinity is high or very high. The water table is about 12 to 24 inches below the surface in summer but drops below 24 inches in winter. About 5 percent of this unit is included areas of Zinzer loam, saline, and 10 percent areas of Arena loam.

Runoff is slow. The erosion hazard is slight.

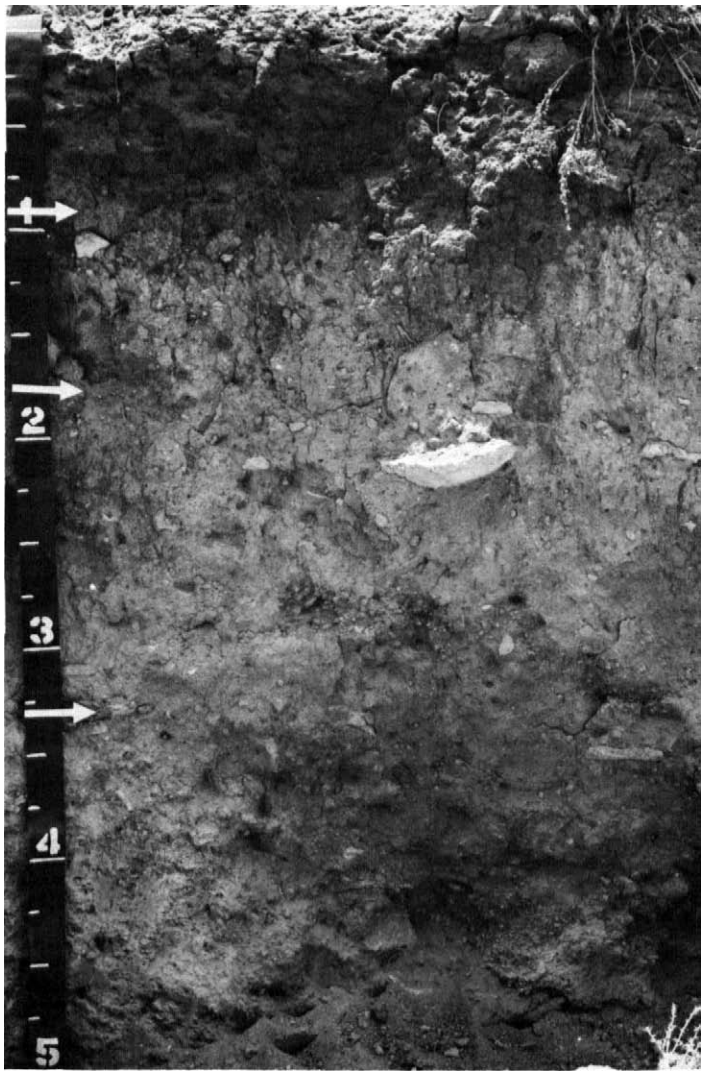

Figure 9.—**Profile of Luhon loam, 3 to 6 percent slopes.**

This soil is used mainly for irrigated meadow and for range. Irrigated meadows are cut for hay or used for grazing. Capability unit IIIs–6 irrigated, VIw–1 nonirrigated; Salt Meadow range site.

Monte Series

The Monte series consists of deep, well drained soils. These soils formed in alluvium on alluvial fans and flood plains. Slopes are 0 to 3 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly rabbitbrush, blue grama, western wheatgrass, and Indian ricegrass. The average annual precipitation is about 8 inches, the mean annual air temperature is about 42° F, and the frost-free season is 90 to 110 days.

In a representative profile the surface layer and underlying material are brown loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. Reaction is moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for irrigated crops and for range and wildlife.

Representative profile of Monte loam, 1 to 3 percent slopes, 1,400 feet east and 100 feet south of the northwest corner sec. 14, T. 40 N., R 5 E.

A1—0 to 7 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; moderate fine granular structure, moderate thin platy in lower part; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

AC—7 to 16 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C1ca—16 to 27 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable; calcareous; some visible calcium carbonate in fine seams; moderately alkaline; clear smooth boundary.

C2—27 to 60 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The A1 horizon is 5 to 12 inches thick. The C horizon is loam, silt loam, or light sandy clay loam and is weakly stratified in some pedons. Some pedons do not have a horizon of visible lime. The content of gravel ranges from 0 to 15 percent.

MoA—Monte loam, 0 to 1 percent slopes. This nearly level soil occupies the lower part of alluvial fans and old flood plains in the central and northwestern parts of the Area.

About 15 percent of this mapping unit is included areas of Luhon loam where the slope is 0 to 1 percent and as much as 5 percent is areas of Laney loam. Also included in small valleys in the foothills are small areas where the soil contains more gravel and cobbles and is underlain by gravel within a depth of 40 inches.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used for irrigated potatoes, small grain, alfalfa, and vegetables and for range. Capability units IIIs–1 irrigated, VIIs–3 nonirrigated; Mountain Outwash range site.

MoB—Monte loam, 1 to 3 percent slopes. This very gently slopping soil occupies the upper part of alluvial fans and old flood plains in the central and northwestern parts of the Area. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are areas of Luhon loam, which make up about 15 percent of the unit, and areas of Laney loam, which make up about 5 percent. Also included in small valleys in the foothills are some small areas where the soil contains more gravel and cobbles and is underlain by gravel within a depth of 40 inches.

Runoff is moderate. The soil blowing and water erosion are moderate hazards. Many areas are cut by one or more gullies.

This soil is used for irrigated small grain, alfalfa, and vegetables (fig. 10) and for range. Capability unit IIIe–1 irrigated, VIIs–3 nonirrigated; Mountain Outwash range site.

Mosca Series

The Mosca series consists of deep, well drained soils that have a water table resulting from irrigation. These soils formed in alluvium on old flood plains and broad

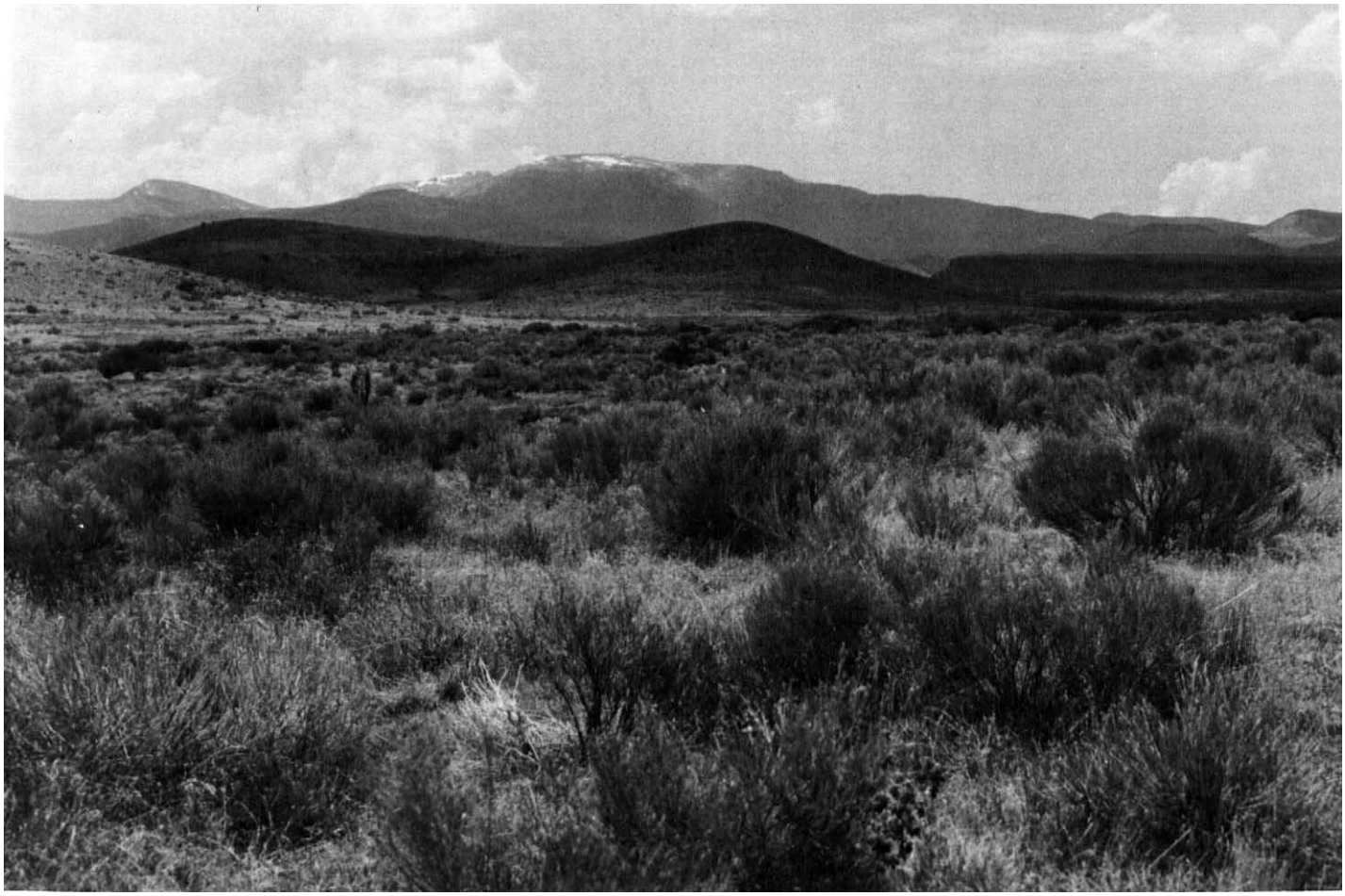

Figure 10.—**Landscape of Monte loam, 1 to 3 percent slopes, showing typical vegetation in range.**

alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly rabbitbrush, greasewood, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface and subsurface layers are dark grayish brown loamy sand about 6 inches thick. The subsoil is dark brown and dark grayish brown sandy loam about 22 inches thick. The substratum is brown fine sandy loam and grayish brown stratified sandy loam and loamy sand that extend to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. Reaction ranges from moderately alkaline in the surface layer to very strongly alkaline in the subsoil and substratum. The effective rooting depth is 40 to 60 inches.

These soils are used for irrigated crops and for range.

Representative profile of Mosca loamy sand, 400 feet west and 2,670 feet north of the southeast corner sec. 24, T. 38 N., R. 8 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grained; loose; weakly calcareous; moderately alkaline; abrupt smooth boundary.

A2—4 to 6 inches; light gray (10YR 7/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium platy and granular structure parting to single grained; hard, very friable; weakly calcareous; moderately alkaline; clear smooth boundary.

B2t—6 to 13 inches; pinkish gray (7.5YR 6/2) sandy loam, dark brown (7.5YR 3/2) moist; weak coarse and very coarse prismatic structure parting to medium subangular blocky; slightly hard, very friable; thin patchy clay films on peds; weakly calcareous; strongly alkaline; abrupt smooth boundary.

B3ca—13 to 28 inches light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable; visible calcium carbonate occurring in soft masses; strongly calcareous; strongly alkaline; clear smooth boundary.

C1—28 to 38 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable; strongly calcareous; strongly alkaline; gradual smooth boundary.

C2—38 to 60 inches; gray (10YR 5/1) and grayish brown (10YR 5/2) stratified sandy loam and loamy sand; common fine distinct mottles, yellowish brown (10 YR 5/6) and dark grayish brown (10YR 4/2)

moist; massive; slightly hard, friable; calcareous; very strongly alkaline.

The A horizon is 4 to 8 inches thick. In cultivated areas the A2 horizon has been mixed into the plow layer. The B2t horizons is 7 to 16 inches thick. Exchangeable sodium in the B horizon and in the upper part of the C horizon ranges from 15 to 30 percent. Depth to the sandy C horizon is generally 30 to 40 inches.

Ms—Mosca loamy sand. This nearly level soil occupies old flood plains and the lower end of broad alluvial fans in the east-central and northeastern parts of the Area. Slopes are 0 to 1 percent. The water table is at a depth of 48 to 60 inches. About 10 percent of this unit is included areas of San Luis sandy loam, Norte gravelly sandy loam, and Gunbarrel loamy sand. Some areas are about 5 percent areas of Hooper loamy sand. Spots of Zinzer and San Arcacio soils occur in places.

Runoff is slow. The soil blowing hazard is high.

This soil is used for irrigated potatoes, small grain, alfalfa, and vegetables and for range. Capability unit IIIe–2 irrigated, VIIe–1 nonirrigated; Salt Flats range site.

Norte Series

The Norte series consists of moderately well drained soils 24 to 40 inches deep over gravel and sand. These soils formed in gravelly alluvium on broad alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,500 to 8,300 feet. Natural vegetation is dominantly blue grama, Indian ricegrass, and low rabbitbrush. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer and underlying material to a depth of 30 inches are dark grayish brown gravelly sandy loam. Below this is very gravelly loamy sand that extends to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is low or moderate. Reaction is moderately alkaline. The effective rooting depth is 24 to 40 inches. The seasonal high water table is at a depth of 36 to 60 inches.

These soils are used for irrigated crops and for range.

Representative profile of Norte gravelly sandy loam, 300 feet east and 2,340 feet north of the southwest corner sec. 18, T. 40 N., R. 8 E.

Ap—0 to 4 inches light brownish gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; 15 percent gravel; calcareous; moderately alkaline; clear smooth boundary.

AC—4 to 12 inches; light brownish gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; 20 percent gravel; calcareous; moderately alkaline; gradual wavy boundary.

C1—12 to 30 inches light brownish gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; 30 percent gravel; some discontinuous accumulations of visible secondary carbonate as concretions and coatings on gravel fragments; calcareous; moderately alkaline; gradual wavy boundary.

IIC2—30 to 60 inches; very gravelly loamy sand; gravel and sand give a grayish cast on exposure; 50 to 80 percent gravel and cobbles.

The A horizon is gravelly sandy loam or sandy loam. The content of gravel ranges from 5 to 25 percent in the A and C horizons and from 15 to 35 percent in the C1 horizon. Depth to the IIC horizon is 24 to 40 inches. This horizon is very gravelly loamy sand or sand that is 50 to 80 percent gravel and cobbles.

No—Norte gravelly sandy loam. This nearly level soil occupies the low end of broad alluvial fans, mainly in the northeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series. The water table is commonly at a depth of 36 to 60 inches and is highest in summer. It is manipulated by a system of drains and checks. About 25 percent of this unit is included areas of Quamon gravelly sandy loam, 10 percent areas of Dunul cobbly sandy loam, and 10 percent San Arcacio sandy loam.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used mostly for irrigated crops, chiefly potatoes. Small grain, alfalfa, and vegetables are also grown. Some small areas are used for range. Capability unit IIIs–2 irrigated, VIIs–7 nonirrigated; Mountain Outwash range site.

Nr—Norte-Dunul complex. This nearly level mapping unit occupies the upper end of broad alluvial fans, mainly in the north-central part of the Area. Slopes are 0 to 1 percent. This unit is about 40 percent Norte gravelly sandy loam and 40 percent Dunul cobbly sandy loam. In unleveled areas there are many small swales and ridges. The ridges are 1 to 2 feet higher than the swales. Norte gravelly sandy loam and Dunul cobbly sandy loam have the profiles described as representative of their respective series. About 20 percent of this unit is included areas of Quamon gravelly sandy loam.

Runoff is slow. The soil blowing hazard is low to moderate.

This mapping unit is used for irrigated potatoes, small grain, alfalfa, and vegetables and for range. Capability unit IVs–1 irrigated, VIIs–7 nonirrigated; Mountain Outwash range site.

Platoro Series

The Platoro series consists of well drained soils 20 to 40 inches deep over gravel and sand. These soils formed in alluvium over gravelly alluvium on alluvial fans and terraces. Slopes are 0 to 3 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly blue grama, Indian ricegrass, ring muhly, and western wheatgrass. The average annual precipitation is about 8 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days.

In a representative profile the surface layer and upper 3 inches of the subsoil are dark grayish brown loam. The lower 11 inches of the subsoil is dark brown light clay loam. The substratum is about 8 inches of dark brown very gravelly loam over very gravelly sand that extends to a depth of 60 inches or more.

These soils are used for irrigated crops and for range.

Representative profile of Platoro loam, 0 to 1 percent slopes, 400 feet east and 50 feet south of the northwest corner sec. 36, T. 37 N., R. 7 E.

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

B1—4 to 7 inches; light brownish gray (10YR 6/2) heavy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable; a few patchy clay films on some peds; 5 percent gravel; calcareous; moderately alkaline; clear smooth boundary.

B2t—7 to 15 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; thin patchy clay films on peds and in root channels; 5 percent gravel; calcareous; moderately alkaline; gradual wavy boundary.

B3ca—15 to 18 inches; brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; very hard, friable; thin patchy clay films on peds; discontinuous clay films in root channels; 10 percent gravel; visible secondary calcium carbonate occurring as concretions and as coatings on gravel; calcareous; moderately alkaline; gradual wavy boundary.

C1ca—18 to 26 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 4/3) moist; massive; hard, friable; 60 percent gravel; visible secondary calcium carbonate occurring as concretions in thin seams and streaks and as coatings in the gravel; calcareous; moderately alkaline; gradual wavy boundary.

IIC2ca—26 to 60 inches; very gravelly sand; visible secondary calcium carbonate occurring as coatings on coarse fragments.

The A1 horizon is 3 to 6 inches thick. In cultivated areas, however, it is slightly thicker. It is clay loam in some pedons in cultivated fields and is sandy loam in some areas of range. The B2t horizon is 8 to 12 inches thick. The A and B horizons are 3 to 20 percent gravel and in some areas 10 percent cobbles. Depth to the gravelly IIC horizon ranges from 20 to 40 inches. Depth to visible lime ranges from 10 to 40 inches.

PaA—Platoro loam, 0 to 1 percent slopes. This nearly level soil occupies alluvial fans along the western edge of the valley and terraces along the Rio Grande west of Del Norte. The profile of this soil is the one described as representative of the series. About 10 percent of this unit is included areas of Graypoint gravelly sandy loam and 5 percent areas of Derrick cobbly loam.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated potatoes, small grain, alfalfa, and vegetables and for range. Capability unit IIIs–3 irrigated, VIIs–2 nonirrigated; Mountain Outwash range site.

PaB—Platoro loam, 1 to 3 percent slopes. This very gently sloping soil occupies alluvial fans along the western edge of the valley and terraces along the Rio Grande west of Del Norte. About 10 percent of this unit is included areas of Graypoint gravelly sandy loam and about 5 percent areas of Derrick cobbly loam.

Runoff is moderate. The erosion hazard is slight.

This soil is used for irrigated potatoes, small grain, and alfalfa and for range. Capability unit IIIe–3 irrigated, VIIs–2 nonirrigated; Mountain Outwash range site.

Quamon Series

The Quamon series consists of somewhat excessively drained soils 12 to 25 inches deep over gravel and sand. These soils formed in gravelly alluvium on broad alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly blue grama, low rabbitbrush, and Indian ricegrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark brown gravelly sandy loam about 5 inches thick. The underlying material is 11 inches of dark brown gravelly sandy loam over yellowish brown very gravelly sand that extends to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is low. Reaction is moderately alkaline. The effective rooting depth is 12 to 25 inches. The water table fluctuates between depths of 36 and 60 inches.

These soils are used for irrigated crops and for range.

Representative profile of Quamon gravelly sandy loam, 100 feet west and 1,300 feet south of the northeast corner sec. 18, T. 40 N., R. 8 E.

Ap—0 to 5 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; moderate fine granular structure; soft, very friable; 30 percent gravel and cobbles; slightly calcareous; moderately alkaline; gradual smooth boundary.

C1—5 to 16 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to fine granular; soft, very friable; 25 percent gravel and cobbles; slightly calcareous; moderately alkaline; gradual smooth boundary.

IIC2—16 to 60 inches; light yellowish brown (10YR 6/4) very gravelly sand, yellowish brown (10YR 5/4) moist; single grained; loose; 65 percent gravel and cobbles; calcareous; moderately alkaline.

The Ap horizon is 5 to 10 inches thick in cultivated areas. The content of coarse fragments, dominantly gravel, ranges from 15 to 30 percent in the A horizon and from 10 to 35 percent in the C1 horizon. In some areas the content of cobbles is as much as 10 percent. Coarse fragments in the IIC horizon are dominantly gravel.

Qa—Quamon gravelly sandy loam. This nearly level soil occupies the lower end of broad alluvial fans, mainly in the northeastern part of the Area. Slopes are 0 to 1 percent. The water table is generally at a depth of 36 to 6 inches and is highest in summer. It is manipulated by a system of drains and checks. About 25 percent of this unit is included areas of Norte gravelly sandy loam and 15 percent areas of Dunul cobbly sandy loam. Also included are small areas of San Arcacio sandy loam.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used mostly for irrigated crops, chiefly potatoes. Other crops are small grain, alfalfa, and vegetables. Some small areas are used for range. Capability unit IVs–2 irrigated, VIIs–7 nonirrigated; Mountain Outwash range site.

Figure 11.—**Rock outcrop provides shelter, concealment, and limited grazing for wildlife.**

Rock Outcrop

Ro—Rock outcrop consists of mostly latite, andesite, rhyolite, or basalt rock. Most areas have scattered pockets of shallow soils. There are a few widely scattered trees and small patches of grass (fig. 11).

Runoff is very rapid. Rock outcrop provides cover and food for wildlife and is best suited to wildlife and recreational uses. Capability unit VIIIs–1 nonirrigated; not assigned to a range site.

San Arcacio Series

The San Arcacio series consists of well drained soils 20 to 40 inches deep over sand and gravel. These soils formed in alluvium on old flood plains and broad alluvial fans. Some areas are seeped from irrigation and have a high water table. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly greasewood, rabbitbrush, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark grayish brown sandy loam about 8 inches thick. The subsoil is dark brown sandy clay loam about 10 inches thick. The substratum is 7 inches of dark brown gravelly sandy loam over gravelly sand that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate. In saline areas the available water capacity is low. Reaction is moderately alkaline. The effective rooting depth is 20 to 40 inches. Depth to the water table ranges from 20 to 60 inches.

These soils are used for irrigated crops and for range.

Representative profile of San Arcacio sandy loam, 450 feet north and 2,090 feet east of the southwest corner sec. 18, T. 40 N., R. 8 E.

Ap—0 to 8 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; weakly calcareous; moderately alkaline; clear smooth boundary.

B2t—8 to 15 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable; thin patchy clay films on peds; weakly calcareous; moderately alkaline; clear smooth boundary.

B3ca—15 to 18 inches; brown (10YR 5/3) light sandy clay loam, dark brown (10YR 4/3) moist; weak medium

subangular blocky structure; hard, very friable; few thin patchy clay films on peds; 10 percent gravel; visible calcium carbonate occurring as soft masses; strongly calcareous; moderately alkaline; clear smooth boundary.

C1ca—18 to 25 inches; dark brown (10YR 4/3) moist; gravelly sandy loam; weak fine granular structure; soft, very friable; about 45 percent gravel; visible calcium carbonate occurring as soft masses and in seams; strongly calcareous; moderately alkaline; clear smooth boundary.

IIC2—25 to 60 inches; gravelly sand.

The A horizon is 4 to 8 inches thick and is sandy loam, loam, or light clay loam. The B2t horizon is sandy clay loam, clay loam, or heavy loam. The content of gravel ranges from 0 to 15 percent in the A horizon and B horizons. Depth to visible lime ranges from 15 to 40 inches. Salinity ranges from none to high.

Sa—San Arcacio sandy loam. This nearly level soil occupies old flood plains and the lower end of broad alluvial fans throughout the eastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series. The water table is at a depth ranging from 36 inches to 60 inches and is highest in summer. Salinity is slight in places. About 15 percent of this unit north of the Rio Grande is included areas of Norte gravelly sandy loam and Quamon gravelly sandy loam. About 10 percent south of the Rio Grande is areas of Zinzer loam or Platoro loam.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used mostly for irrigated potatoes, small grain, alfalfa, and vegetables. Some areas are used for range. Capability unit IIIs–2 irrigated, VIIs–2 nonirrigated; Salt Flats range site.

Sb—San Arcacio sandy loam, saline. This nearly level soil occupies old flood plains and the lower end of broad alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but salinity is moderate to high because of seepage. The water table ranges from 20 to 48 inches below the surface and is highest in summer. About 10 percent of this unit is included areas of Zinzer loam or Platoro loam. Also included are small areas of San Arcacio loam.

Runoff is slow. The erosion hazard is slight.

This soil is used mostly for range. Some areas are used for irrigated small grain, alfalfa, potatoes, and vegetables. Capability units IIIs–5 irrigated, VIw–2 nonirrigated; Salt Flats range site.

Sc—San Arcacio loam. This nearly level soil occupies the lower end of broad alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is similiar to the one described as representative of the series, but the surface layer is loam or light clay loam 6 to 8 inches thick. Salinity is slight in places. The water table is at a depth of about 48 to 60 inches and is highest in summer. About 10 percent of this unit is included areas of Zinzer loam or Platoro loam and about 5 percent areas of Villa Grove sandy clay loam.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used for irrigated small grain, alfalfa, potatoes, and vegetables and for range. Capability unit IIIs–3 irrigated, VIIs–2 nonirrigated; Salt Flats range site.

San Luis Series

The San Luis series consists of somewhat poorly drained soils 20 to 40 inches deep over sand and gravel. These soils formed in alluvium on old flood plains on the valley floor. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly greasewood, rabbitbrush, alkali sacaton, and saltgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark brown sandy loam about 6 inches thick. The subsoil is brown or dark brown clay loam about 13 inches thick. The substratum is 5 inches of brown or dark brown sandy clay loam over sand and gravel that extends to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is low or moderate. In drained areas the available water capacity is moderate. Reaction ranges from strongly alkaline to very strongly alkaline. The effective rooting depth is 20 to 40 inches. Depth to the water table is 24 to 60 inches. The soils are saline and alkali.

These soils are used for range, wildlife, and irrigated crops.

Representative profile of San Luis sandy loam, 575 feet north and 2,525 feet west of the southeast corner sec. 12, T. 37 N., R. 8 E.

A1—0 to 6 inches; brown (10YR 5/3) sandy loam, brown or dark brown (10YR 4/3) moist; moderate very fine granular structure; soft, friable; calcareous; strongly alkaline; clear smooth boundary.

B1—6 to 10 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, firm; caleareous; strongly alkaline; clear smooth boundary.

B2t—10 to 15 inches; brown (7.5YR 5/4) clay loam, brown or dark brown (7.5YR 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; thin nearly continuous clay films on peds and in root channels; calcareous; strongly alkaline; clear smooth boundary.

B3ca—15 to 19 inches; pale brown (10YR 6/3) clay loam, brown or dark brown (10YR 4/3) moist; few small prominent mottles, reddish brown (5YR 4/4 moist; weak medium subangular blocky structure; hard, firm; thin patchy clay films on peds; visible calcium carbonate occurring as soft masses; strongly calcareous; very strongly alkaline; clear smooth boundary.

C1ca—19 to 24 inches; pale brown (10YR 6/3) sandy clay loam, brown or dark brown (10YR 4/3) moist; massive; common medium prominent yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles; visible calcium carbonate occurring as soft masses; strongly calcareous; very strongly alkaline; clear smooth boundary.

IIC2—24 to 60 inches; calcareous, mottled sand and gravel.

The A horizon is 4 to 9 inches thick and is sandy loam, clay loam, loam, or sandy clay loam. Unplowed areas in range typically have a grayish brown A2 horizon about 2 inches thick below the A1 horizon. The B2t horizon is 5 to 14 inches thick and is clay loam or sandy clay loam. The C1 horizon is sandy clay loam or loam. Exchangeable sodium in the B and C1 horizons ranges from 15 to 60 percent. Salinity ranges from low to very high.

Sd—San Luis sandy loam. This nearly level soil occupies old flood plains on the valley floor, mainly in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series. Salinity is moderate to very high. The water table is at a depth of 24 to 36 inches and is highest in summer.

Included with this soil in mapping are areas of Villa Grove sandy clay loam, saline, and Almosa loam, saline, which make up 10 percent of the mapping unit. Also included are small areas of Mishak loam. In many areas, especially in irrigated meadows, this San Luis soil has a surface layer of clay loam.

Runoff is slow. The erosion hazard is slight.

This soil is used for range and irrigated meadow. Meadows are cut for hay or used for grazing. Some areas are used for waterfowl nesting, and some small areas are used for irrigated small grain, alfalfa, and potatoes. Capability unit IIIs–6 irrigated, VIw–2 nonirrigated; Salt Flats range site.

Se—San Luis sandy loam, drained. This nearly level soil occupies old flood plains on the valley floor, mainly in the northeastern part of the Area. Some small areas are in the southeastern part. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but the soil has been drained and the water table lowered. The water table is at a depth of about 36 to 60 inches and is highest in summer. Salinity is low. A few small areas are in higher positions and do not have a high water table. In some areas the surface layer is loam.

Included with this soil in mapping in the northeastern part of the Area are areas of Mosca loamy sand, which make up as much as 10 percent of the mapping unit, and areas of Gunbarrel loamy sand, which make up about 5 percent. Some areas in the southeastern part are about 10 percent Villa Grove and Alamosa soils.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used for irrigated small grain, alfalfa, and potatoes and for range. Capability unit IIIs–7 irrigated, VIw–2 nonirrigated; Salt Flats range site.

Sf—San Luis-Quamon complex. This nearly level or undulating mapping unit occupies the lower end of broad alluvial fans in the eastcentral part of the Area and north of the Rio Grande. It is in areas that have been drained. Slopes are 0 to 1 percent. The unit is about 40 percent San Luis sandy loam, drained, and about 30 percent Quamon gravelly sandy loam. The San Luis soil has a profile similar to the one described as representative of the series, but it has been drained and the water table lowered. The Quamon soil has the profile described as representative of the series. About 20 percent of this unit is included areas of Mosca loamy sand, 10 percent areas of Dunul cobbly sandy loam, and 5 percent Gunbarrel loamy sand.

Runoff is slow. The soil blowing hazard is moderate.

This mapping unit is used mostly for irrigated small grain, alfalfa, and potatoes. A few small areas are used for range. Capability unit IVs–2 irrigated, VIIs–7 nonirrigated; San Luis soil in Salt Flats range site; Quamon soil in Mountain Outwash range site.

Schrader Series

The Schrader series consists of deep, somewhat poorly drained soils. These soils formed in alluvium on flood plains and low terraces. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly cottonwood trees, willows, wild rose, wild iris, and tufted hairgrass. The average annual precipitation is about 8 inches, the mean annual air temperature is about 43° F, and the frost-free season is 95 to 110 days.

In a representative profile the upper 7 inches of the soil is very dark grayish brown sandy loam. Below this is very dark grayish brown or dark gray fine sandy loam stratified with loam that extends to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is high. Reaction ranges from neutral to mildly alkaline. The effective rooting depth is 36 to 48 inches. Depth to the water table is about 12 to 24 inches late in spring and in summer.

These soils are used for irrigated meadow, range, and irrigated crops.

Representative profile of Schrader sandy loam, 1,500 feet north and 200 feet east of the southwest corner sec. 23, T. 40 N., R. 4 E.

A11—0 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

A12—7 to 33 inches; grayish brown (10YR 5/2) fine sandy loam stratified with lenses of loam, very dark grayish brown (10YR 3/2) moist; common medium distinct mottles, dark yellowish brown (10YR 3/4) and dark gray (2.5Y 4/1) moist; very weak coarse subangular blocky structure; slightly hard; friable; neutral; gradual wavy boundary.

Cg—33 to 60 inches; gray (2.5Y 6/1) fine sandy loam stratified with lenses of loam, dark gray (2.5Y 4/1) moist; many large prominent mottles, dark yellowish brown (10YR 3/4) and light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable; neutral.

The A horizon is sandy loam or fine sandy loam that is stratified with loam in the lower part. The thickness of individual strata in the lower part of the A horizon and in the C horizon varies. In some pedons the soil is stratified with thin lenses of loamy sand and sand. Depth to mottles ranges from 6 to 14 inches.

Sh—Schrader sandy loam. This nearly level soil occupies flood plains and low terraces along the Rio Grande and some of its major tributaries. Slopes are 0 to 1 percent. The water table is at a depth of about 12 to 24 inches late in spring and in summer but drops below 24 inches in winter. The soil is subject to flooding late in spring when runoff is high from melting snow in the mountains. About 10 percent of this unit is included areas of Shawa loam and Vastine loam.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated meadow, range, and irrigated small grain and alfalfa. Meadows are cut for hay or used for grazing. Capability unit IIIw–1 irrigated, Vw–1 nonirrigated; Wet Meadow range site.

Seitz Series

The Seitz series consists of deep, well drained soils. These soils formed in colluvium derived mainly from

rhyolite, andesite, and trachite on mountainsides. Slopes are 20 to 65 percent. Elevation is 8,300 to 11,100 feet. Natural vegetation is dominantly spruce, fir, aspen, Arizona fescue, and mountain muhly. The average annual precipitation is about 15 to 20 inches, the mean annual air temperature is about 34° F, and the frost-free season is 60 to 75 days.

In a representative profile about 2 inches of organic matter overlies a 2-inch surface layer of black very stony loam. The subsurface layer is brown very stony very fine sandy loam about 7 inches thick. The next layer is brown and dark brown very stony loam about 5 inches thick. The subsoil is dark brown very stony clay about 18 inches thick. The substratum is dark brown very stony clay loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is moderate. Reaction is neutral. The effective rooting depth is more than 60 inches.

These soils are used for woodland, wildlife, and range.

Representative profile of Seitz very stony loam, 20 to 65 percent slopes, near the center sec. 30, T. 37 N., R. 7 E.

O1—2 inches to 0; partly decomposed organic matter, mainly bark, twigs, and needles.

A1—0 to 2 inches; dark gray (10YR 4/1) very stony loam, black (10YR 2/1) moist; strong fine granular structure; soft, very friable; 60 percent stones and cobbles; neutral; abrupt smooth boundary.

A2—2 to 9 inches; pinkish gray (7.5YR 7/2) very stony very fine sandy loam, brown (7.5YR 5/2) moist; weak thick platy structure parting to strong fine granular; soft, very friable; 60 percent stones and cobbles; neutral; diffuse wavy boundary.

A&B—9 to 14 inches; mixed pinkish gray (7.5YR 7/2) and brown (7.5YR 5/3) very stony loam, brown (7.5YR 5/2) and dark brown (7.5YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable; the more clayey peds are hard; thin patchy clay films on some peds; 60 percent stones and cobbles; neutral; gradual wavy boundary.

B2t—14 to 32 inches; brown (7.5YR 5/3) very stony clay, dark brown (7.5YR 4/3) moist; moderate fine subangular blocky structure; extremely hard, firm; thin continuous clay films on peds and in root channels; clay films on coarse fragments; 55 percent stones and cobbles; neutral; gradual wavy boundary.

C—32 to 60 inches; brown (7.5YR 5/4) very stony clay loam, dark brown (7.5YR 4/4) moist; massive; very hard, friable; 65 percent stones and cobbles; neutral.

The O1 horizon is 1 inch to 4 inches thick. It is lacking in many areas where tree cover is thin. The A1 horizon is 0 to 3 inches thick and is black or very dark brown. It is lacking in areas where tree cover is thin. The A2 horizon is very stony very fine sandy loam or very stony silt loam. The B2t horizon is 12 to 29 inches thick and is very stony clay or very stony heavy clay loam. The content of stones and cobbles ranges from about 40 to 80 percent. Coarse fragments are dominantly angular rhyolite, andesite, or latite stones.

SkF—Seitz very stony loam, 20 to 65 percent slopes. This moderately steep and steep soil occupies mountainsides in the southwestern part of the Area. About 20 percent of this unit is included areas of Rock outcrop and slide rock and about 15 percent areas of a soil that is similar to this Seitz soil but is less than 40 inches deep over bedrock. Also included are small areas of Tolman and Embargo soils.

Runoff is slow. The erosion hazard is slight.

This soil is used mainly for woodland and wildlife. It is also used to a limited extent for grazing. Capability unit VIIs–6 nonirrigated; not assigned to a range site.

Shawa Series

The Shawa series consists of deep, well drained or moderately well drained soils. These soils formed in alluvium on terraces and alluvial fans. Slopes are 0 to 3 percent. Elevation is 7,600 to 8,200 feet. Natural vegetation is dominantly western wheatgrass, needleandthread, sedges, and rabbitbrush. The average annual precipitation is about 11 inches, the mean annual air temperature is about 41° F, and the frost-free season is 95 to 110 days.

In a representative profile the upper 8 inches of the soil is black loam. Below this is very dark gray and dark grayish brown loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. Reaction is neutral or mildly alkaline. The effective rooting depth is more than 60 inches.

These soils are used for irrigated meadow, irrigated crops, and range.

Representative profile of Shawa loam, 0 to 1 percent slopes, 2,640 feet west and 2,000 feet south of the northeast corner sec. 35, T. 40 N., R. 3 E.

A11—0 to 8 inches; dark grayish brown (10YR 4/2) loam, black (10YR 2/1) moist; strong medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

A12—8 to 25 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

A13—25 to 40 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; massive; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; neutral.

The thickness of the dark colored A horizon ranges from 20 to 50 inches. The A11 horizon is loam or clay loam and the lower part of the A horizon is loam or silt loam and is weakly stratified in some pedons. The C horizon is stratified with thin lenses of sand, sandy loam, and clay loam in some pedons. The content of gravel ranges from 0 to 15 percent.

SmA—Shawa loam, 0 to 1 percent slopes. This nearly level soil occupies low terraces and alluvial fans along the Rio Grande and its major tributaries in the western part of the Area. The profile of this soil is the one described as representative of the series. In some areas the seasonal high water table is at a depth of about 18 to 36 inches for a short period in spring and early in summer during periods of heavy irrigation.

Included with this soil in mapping are areas of a soil that is similar to this Shawa soil but has a high water table and is somewhat poorly drained. This included soil makes up about 30 percent of the unit. Also included are spots of Gerrard, Schrader, and Vastine soils

in the low lying areas and Platoro soils in the higher lying areas.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated meadow; irrigated small grain, potatoes, alfalfa, and vegetables; and for range. Meadows are cut for hay or used for grazing. Capability units IIIs-1 irrigated, VIs-2 nonirrigated; Foothill Loam range site.

SmB—Shawa loam, 1 to 3 percent slopes. This very gently sloping soil occupies alluvial fans along major tributaries of the Rio Grande in the western part of the Area. In some areas the water table is at a depth of about 18 to 36 inches for a short period in spring and early in summer during periods of heavy irrigation. About 10 percent of this unit is included areas of Schrader sandy loam and 10 percent areas of Jodero loam.

Runoff is slow. The erosion hazard is slight.

This is soil used for irrigated meadow; irrigated small grain, alfalfa, and vegetables; and for range. Meadows are cut for hay or used for grazing. Capability unit IIIe–1 irrigated, VIs–2 nonirrigated; Foothill loam range site.

Stunner Series

The Stunner series consists of deep, well drained soils. These soils formed in alluvium on alluvial fans and valley-fill slopes. Slopes are 1 to 6 percent. Elevation is 7,700 to 8,300 feet. Natural vegetation is dominantly winterfat, blue grama, ring muhly, low rabbitbrush, and snakeweed. The average annual precipitation is about 9 inches, the mean annual air temperature is about 41° F, and the frost-free season is 95 to 110 days.

In a representative profile the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is dark brown clay loam about 21 inches thick. The substratum is pale brown and brown loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. Reaction ranges from neutral in the surface layer to moderately alkaline in the substratum. The effective rooting depth is more than 60 inches.

These soils are used for range and irrigated crops.

Representative profile of Stunner loam, 1 to 3 percent slopes, 2,140 feet north and 500 feet west of the southeast corner sec. 13, T. 39 N., R. 6 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular structure; soft, very friable; 3 percent gravel; neutral; clear smooth boundary.

B1—4 to 7 inches; brown (10YR 5/3) heavy loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure parting to moderate medium granular; slightly hard, very friable; few thin patchy clay films on peds and in some root channels; 2 percent gravel; neutral; clear smooth boundary.

B2t—7 to 14 inches; brown (7.5YR 5/3) light clay loam, dark brown (7.5YR 4/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; nearly continuous clay films on peds and in many root channels; mildly alkaline; clear smooth boundary.

B3ca—14 to 25 inches; brown (7.5YR 5/3) light clay loam, dark brown (7.5YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable; thin patchy clay films on some peds; visible secondary calcium carbonate as concretions and in thin seams and streaks; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—25 to 36 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; large amount of finely divided secondary carbonate; strongly calcareous; moderately alkaline; gradual wavy boundary.

C2ca—36 to 60 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; slightly hard, friable; visible secondary carbonate as concretions and in thin seams and streaks; less carbonate than in C1ca horizon; calcareous; moderately alkaline.

The A horizon is 2 to 5 inches thick in areas of range and 7 to 8 inches thick in cultivated areas. The B2t horizon is 4 to 16 inches thick. Depth to the calcic horizon ranges from 20 to 40 inches. The content of calcium carbonate in the C1ca horizon ranges from 15 to 35 percent and decreases in the lower part of the C horizon. To a depth of 40 inches, the content of gravel and cobbles ranges from 0 to 15 percent. Below a depth of 40 inches, it ranges from 0 to 25 percent.

SnB—Stunner loam, 1 to 3 percent slopes. This very gently sloping soil occupies alluvial fans along the western edge of the valley and in the foothills. The profile of this soil is the one described as representative of the series. About 15 percent of this unit is included areas of Luhon loam, 1 to 3 percent slopes, and 5 percent areas of Garita cobbly loam, 1 to 3 percent slopes.

Runoff is moderate. The soil blowing hazard is moderate.

This soil is used mainly for range. Some areas are used for irrigated alfalfa, small grain, potatoes, and other vegetables. Capability unit IIIe-1 irrigated, VIIs-3 nonirrigated; Limy Bench range site.

SnC—Stunner loam, 3 to 6 percent slopes. This gently sloping soil occupies the upper end of alluvial fans and valley-fill slopes along the western edge of the valley and in the foothills. About 15 percent of this unit is included areas of Luhon loam, 3 to 6 percent slopes, and 5 percent areas of Garita cobbly loam. Also included are some small areas where the soil is steeper than is typical.

Runoff is moderate. The hazard of water erosion is moderate.

This soil is used mainly for range. Some areas are used for irrigated small grain and alfalfa. Capability unit IVe-2 irrigated, VIIs-3 nonirrigated; Limy Bench range site.

Terrace Escarpments

Ta—Terrace escarpments occupy moderately steep and steep terrace edges along the Rio Grande in the western part of the Area. The soil material is gravelly and cobbly sandy loam. Slopes are 10 to 50 percent. Areas are generally long and narrow.

Permeability is moderately rapid or rapid, and the available water capacity is low. Runoff is rapid. The erosion hazard is high, but is moderate in most places where there are numerous small gullies and escarpments.

Terrace escarpments are used for range. Capability unit VIIs–8 nonirrigated; not assigned to a range site.

Tolman Series

The Tolman series consists of shallow, well drained soil. These soils formed in residuum weathered from mixed rocks on foothills. Slopes are 10 to 25 percent. Elevation is 8,000 to 9,200 feet. Natural vegetation is dominantly pinon-juniper trees, junegrass, and mountain muhly. The average annual precipitation is about 12 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark brown very stony loam about 4 inches thick. The subsoil is dark brown very cobbly clay loam about 4 inches thick. The substratum is dark grayish brown very cobbly loam about 4 inches thick. Bedrock is at a depth of about 12 inches.

Permeability is moderate, and the available water capacity is low. Reaction is neutral. The effective rooting depth is 10 to 20 inches.

These soils are used for range, woodland, and wildlife.

Representative profile of Tolman very stony loam in an area of Tolman-Empedrado complex, 3 to 25 percent slopes, 1,000 feet east of the southwest corner sec. 1, T. 39 N., R. 4 E.

A1—0 to 4 inches; brown (7.5YR 5/2) very stony loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; 60 percent stones and cobbles; neutral; clear smooth boundary.

B2t—4 to 8 inches; brown (7.5YR 5/3) very cobbly clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; hard, firm; thin nearly continuous clay films on peds and on coarse fragments; 55 percent stones and cobbles; neutral; clear smooth boundary.

C—8 to 12 inches; light brownish gray (10YR 6/2) very cobbly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; 70 percent stones and cobbles; neutral; clear smooth boundary.

R—12 to 16 inches; weathered rhyolitic bedrock becoming hard at a depth of 16 inches.

The A horizon is 3 to 8 inches thick. The B2t horizon is 3 to 12 inches thick and in some pedons rests abruptly on bedrock. The content of coarse fragments, mainly rhyolite or latite stones and cobbles, ranges from 50 to 75 percent. Depth to rhyolite or latite bedrock ranges from 10 to 20 inches.

TeE—Tolman-Empedrado complex, 3 to 25 percent slopes. This gently sloping to moderately steep mapping unit occupies foothills in the western part of the Area. It is about 45 percent Tolman very stony loam and 40 percent Empedrado loam. Tolman very stony loam occupies the steeper parts of the unit, and slopes are generally 10 to 25 percent. Empedrado loam occupies the less sloping parts of the unit, and slopes are generally 3 to 15 percent. About 12 percent of this unit is included areas of Jodero, Stunner, and Travelers soils and about 3 percent areas of Rock outcrop.

Runoff is moderate to rapid. The erosion hazard is slight.

This mapping unit is used for range, woodland, and wildlife. Capability unit VIIs-1 nonirrigated; Empedrado soil in Foothill Loam range site; Tolman soil not assigned to a range site.

Torsido Series

The Torsido series consists of poorly drained to somewhat poorly drained soils 20 to 40 inches deep over gravel and sand. These soils formed in alluvium on alluvial fans and terraces. Slopes are 0 to 3 percent. Elevation is 7,600 to 8,300 feet. Natural vegetation is dominantly sedges, rushes, tufted hairgrass, and slender wheatgrass. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is very dark brown clay loam about 6 inches thick. The subsoil is very dark brown and very dark grayish brown clay loam and dark grayish brown loam about 17 inches thick. The substratum is 7 inches of grayish brown loam over very gravelly sand that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate. Reaction is neutral. The effective rooting depth is 20 to 40 inches.

These soils are used for irrigated meadow, irrigated crops, and range.

Representative profile of Torsido clay loam, 2,490 feet west and 600 feet south of the northeast corner sec. 23, T. 38 N., R. 7 E.

A1—0 to 6 inches; dark gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable; about 8 percent gravel and cobbles; neutral; clear smooth boundary.

B1—6 to 11 inches; dark grayish brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable; about 8 percent gravel and cobbles; few thin patchy clay films on peds and some discontinuous clay films in root channels; neutral; clear smooth boundary.

B2tg—11 to 19 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; common medium distinct mottles, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; about 8 percent gravel and cobbles; thin nearly continuous clay films on peds and in root channels; neutral; gradual smooth boundary.

B3g—19 to 23 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; many large prominent mottles, brown (7.5YR 4/4) and light olive brown (2.5Y 5/4) moist; weak coarse subangular blocky structure; hard, friable; few thin patchy clay films on peds; neutral; gradual smooth boundary.

C1g—23 to 30 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; many large prominent mottles, brown (7.5YR 4/4) and light olive brown (2.5Y 5/6) moist; massive; hard, friable; about 20 percent cobbles and gravel; neutral; gradual wavy boundary.

IIC2—30 to 60 inches; very gravelly sand.

The A1 horizon is 4 to 8 inches thick and is loam or clay loam. In cultivated areas the A horizon is typically clay loam about 11 inches thick. The B2tg horizon is 7 to 18 inches thick. The content of gravel and cobbles in the A and B horizons ranges from 5 to 15 percent. The IIC horizon is very gravelly or very cobbly sand or loamy sand.

To—Torsido clay loam. This nearly level to very gently sloping soil occupies alluvial fans and terraces

along some of the major drainageways in the western part of the Area. Slopes are 0 to 3 percent. The water table is at a depth of 12 to 24 inches late in spring and in summer, but drops below 24 inches in winter.

About 10 percent of this mapping unit is included areas of Acasco clay loam, 10 percent areas of Alamosa loam, and 15 percent Vastine loam and Gerrard loam. Also included are small areas of Platoro loam.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated meadow, irrigated small grain and alfalfa, and for range. Meadows are cut for hay or used for grazing. Capability unit IIIw-1 irrigated, Vw-1 nonirrigated; Wet Meadow range site.

Travelers Series

The Travelers series consists of shallow, well drained or somewhat excessively drained soils. These soils formed in residuum weathered from basalt on foothills and mesas. Slopes are 3 to 25 percent. Elevation is 7,800 to 8,800 feet. Natural vegetation is dominantly blue grama, snakeweed, low rabbitbrush, Indian ricegrass, and winterfat. The average annual precipitation is about 9 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 105 days.

In a representative profile the surface layer is dark brown very stony loam about 3 inches thick. The subsoil is dark brown very stony loam about 6 inches thick. The substratum is grayish brown loam about 7 inches thick. Basalt is at a depth of about 16 inches.

Permeability is moderate, and the available water capacity is low. Reaction is moderately alkaline. The effective rooting depth is 10 to 20 inches.

These soils are used for range, wildlife, and recreation.

Representative profile of Travelers very stony loam in an area of Travelers-Garita complex, 5 to 25 percent slopes, 2,140 feet east and 2,000 feet north of the southwest corner sec. 34, T. 37 N., R. 7 E.

A1—0 to 3 inches; brown (10YR 5/3) very stony loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable; 30 percent stones, mostly basalt; calcareous; moderately alkaline; clear smooth boundary.

B2—3 to 9 inches; brown (10YR 5/3) very stony loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable; 40 percent stones and cobbles; calcareous; moderately alkaline; gradual wavy boundary.

Cca—9 to 16 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; hard, friable; 40 percent stones and cobbles, mostly basalt; visible secondary calcium carbonate occurring as concretions in thin seams and streaks and as coatings on gravel fragments; strongly calcareous; moderately alkaline; abrupt wavy boundary.

R—16 inches; basalt bedrock.

The A1 horizon is 2 to 5 inches thick and is very stony loam or very stony sandy loam. The B2 horizon is 4 to 15 inches thick and is loam or light clay loam. The content of coarse fragments, dominantly basalt stones and cobbles, range from 25 to 75 percent in the B and C horizons. Depth to bedrock ranges from 10 to 20 inches. Bedrock is dominantly basalt, but andesite and latite occur in some pedons.

TrE—Travelers very stony sandy loam, 3 to 25 percent slopes. This gently sloping to moderately steep soil occupies foothills and small mesas along the western edge of the valley. The profile of this soil is similar to the one described as representative of the series, but the surface layer is very stony sandy loam. About 15 percent of this unit is included areas of Garita cobbly loam, 3 to 25 percent slopes, and about 10 percent areas of Rock outcrop.

Runoff is moderate. The hazard of water erosion is moderate.

This soil is used for range and wildlife. Capability unit VIIs-8 nonirrigated; Basalt Hills range site.

TsE—Travelers-Garita complex, 5 to 25 percent slopes. This gently sloping to moderately steep mapping unit occupies foothills and small mesas along the western edge of the valley. It is 30 to 60 percent Travelers very stony loam and 20 to 40 percent Garita cobbly loam. The Travelers soil has the profile described as representative of the series. The Garita soil has a profile similar to the one described as representative of the series, but slopes are 5 to 25 percent. It occurs mostly on foot slopes near the bottom of hills.

Included with this unit in mapping are steep soils that have slopes of 25 to 75 percent. About 15 percent of this unit is included areas of Luhon loam generally at the bottom of hills or in narrow valleys, 25 percent areas of Rock outcrop mostly on hilltops and at the edge of mesas, and 15 percent Celeste extremely stony loam in areas at the higher elevations.

Runoff is moderate to rapid. The hazard of water erosion is moderate. Small gullies have formed on many of the steeper slopes. Most of the small valleys are cut by gullies 2 to 8 feet deep and 3 to 10 feet wide.

This mapping unit is used for range and wildlife. Some areas are used for recreation. Capability unit VIIs-8 nonirrigated; Travelers soil in Basalt Hills range site; Garita soil in Limy Bench range site.

Typic Fluvaquents

Tt—Typic Fluvaquents are somewhat poorly drained or poorly drained and occupy low, nearly level flood plains along the Rio Grande and some of its major tributaries. Slopes are 0 to 1 percent. Fluvaquents formed in alluvium more than 20 inches thick over sand and gravel. The surface layer and underlying layer range from loam to clay loam. In many places the soil material is highly stratified. There are many old stream channels and oxbows.

Salinity is low to moderate. The water table is at a depth of 12 to 24 inches late in spring and in summer, but drops to 36 to 60 inches in winter. Flooding is a hazard in spring when runoff is high from melting snow in the mountains. Permeability is moderate to moderately slow, and available water capacity is moderate. Runoff is slow. The erosion hazard is slight.

Typic Fluvaquents are used for irrigated meadow, irrigated small grain and alfalfa, and for range. Meadows are cut for hay or used for grazing. Vegetables and potatoes are not suited. Natural vegetation is alkali sacaton, sedges, rushes, and western wheatgrass. Capability unit IIIw–2 irrigated, VIw–1 nonirrigated; Salt Meadow range site.

Typic Torrifluvents

Tu—Typic Torrifluvents are nearly level and excessively drained and occupy the flood plain of the Rio Grande. Slopes are 0 to 1 percent. The soils range from loam to sandy loam and are generally stratified and underlain by sand and gravel at a depth of 8 to 20 inches. On about 20 percent of this unit the soil material is deeper over sand and gravel because old stream channels have been filled in. Included in mapping are gravel bars, which make up about 10 percent of the unit.

Typic Torrifluvents are droughty. Permeability is moderately rapid, and the available water capacity is low. The water table is generally more than 3 feet deep, but rises to 2 to 3 feet for short periods late in spring and early in summer when runoff is high from melting snow in the mountains. Runoff is slow. The erosion hazard is slight.

Typic Torrifluvents are used mainly for range. Some areas are used for wildlife. Some small areas are used for irrigated small grain and alfalfa. Natural vegetation is cottonwood and willows and an understory of grasses and sedges. Capability unit IVs–2 irrigated, VIIw–1 nonirrigated; not assigned to a range site.

Vastine Series

The Vastine series consists of poorly drained or somewhat poorly drained soils 20 to 40 inches deep over sand and gravel. These soils formed in alluvium on flood plains or bottom land. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly sedges, rushes, tufted hairgrass, and wild iris. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is black heavy loam about 10 inches thick. The subsoil is dark gray and dark yellowish brown clay loam about 24 inches thick. The substratum is mottled sand and gravel that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate or high. Reaction is mildly alkaline. The effective rooting depth is 20 to 40 inches. The water table is at a depth of 12 to 24 inches and is highest in spring and summer.

These soils are used for irrigated crops and for wildlife and range.

Representative profile of Vastine loam, 250 feet north and 75 feet west of the southeast corner sec. 25, T. 38 N., R. 8 E.

O1—1 inch to 0, undecomposed organic material consisting mainly of grass, leaf, and root remains.

A1—0 to 10 inches; dark gray (10YR 4/1) heavy loam, black (10YR 2/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles in lower part; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; mildly alkaline; clear smooth boundary.

B2g—10 to 34 inches; variegated colors ranging from gray (10YR 5/1) to yellowish brown (10YR 5/4) clay loam, dark gray (10YR 4/1) to dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

IICg—34 to 60 inches; gray (10YR 5/1) sand and gravel, dark gray (10YR 4/1) moist; common medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose; mildly alkaline.

The A1 horizon is 8 to 14 inches thick and is loam or light clay loam. The B2g horizon is 14 to 32 inches thick and is clay loam or loam. The O1 horizon is lacking in some pedons.

Va—Vastine loam. This nearly level soil occupies flood plains or low bottom land, mainly along Rock Creek in the southeastern part of the Area. Slopes are 0 to 1 percent. This soil is subject to flooding in spring when runoff is high from melting snow in the mountains. Some areas are protected by drainage ditches and canals. The water table is at a depth of about 12 to 24 inches. About 10 percent of this unit is included areas of Alamosa loam, 15 percent areas of Torsido clay loam, and 10 percent moderately saline areas.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated small grain and alfalfa, irrigated meadow, range, and wildlife. The soil is generally too wet for crops that need cultivation in summer. Meadows are cut for hay or used for grazing. Some areas are used for waterfowl nesting. Capability unit IIIw–1 irrigated, Vw–1 nonirrigated; Wet Meadow range site.

Villa Grove Series

The Villa Grove series consists of deep, well drained soils. Some areas are seeped from irrigation. These soils formed in alluvium on broad alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 7,800 feet. Natural vegetation is dominantly alkali sacaton, saltgrass, greasewood, and rabbitbrush. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark brown sandy clay loam about 8 inches thick. The subsoil is dark yellowish brown clay loam about 13 inches thick. The substratum is 16 inches of yellowish brown heavy loam and light sandy clay loam over yellowish brown gravelly sandy loam that extends to a depth of 60 inches or more.

Permeability is moderately slow. The available water capacity is mainly high, but in saline areas it is moderate. Reaction ranges from mildly alkaline to moderately alkaline. The effective rooting depth is more than 60 inches.

These soils are used for irrigated crops and for range.

Representative profile of Villa Grove sandy clay loam, 1,440 feet west and 75 feet south of the northeast corner sec. 33, T. 37 N., R. 8 E.

A1—0 to 8 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; mildly alkaline; clear smooth boundary.

B2t—8 to 15 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; thin continuous clay films on peds and in root channels; mildly alkaline; clear smooth boundary.

B3ca—15 to 21 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, firm; thin patchy clay films on peds and in root channels; visible secondary calcium carbonate occurring as soft masses and in thin seams; strongly calcareous; moderately alkaline; clear smooth boundary.

C1ca—21 to 37 inches; light yellowish brown (10YR 6/4) heavy loam and light sandy clay loam, yellowish brown (10YR 5/4) moist; massive; very hard, firm; visible secondary calcium carbonate occurring in soft masses and seams; strongly calcareous; moderately alkaline; clear smooth boundary.

C2—37 to 60 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; calcareous; moderately alkaline.

The A1 horizon is 6 to 9 inches thick and is sandy clay loam or loam. The B2t horizon is 6 to 18 inches thick and is dark yellowish brown to dark brown clay loam or sandy clay loam. Reaction in the A and B horizons ranges from mildly alkaline to strongly alkaline. Depth to visible lime ranges from 15 to 30 inches. A few areas have a sand and gravel substratum at a depth of 40 to 60 inches. Salinity ranges from low to high.

Vg—Villa Grove sandy clay loam. This nearly level soil occupies the lower end of broad alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series. Salinity is none or low. About 15 percent of this unit is included areas of Zinzer loam and about 5 percent areas of Acacio or San Arcacio soils.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used mainly for irrigated small grain, alfalfa, potatoes, and other vegetables. Some small areas are used as range. Capability unit IIIs–1 irrigated, VIIs–3 nonirrigated; Salt Flats range site.

Vh—Villa Grove sandy clay loam, saline. This nearly level soil occupies the lower end of broad alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but salinity is moderate to high and the soil is seeped from irrigation. The water table fluctuates between 24 and 60 inches. It is highest during irrigation and lowest in winter. About 15 percent of this unit is included areas of Zinzer loam, saline, and 5 percent areas of Acacio or San Arcacio soils.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated small grain, alfalfa, potatoes, and other vegetables. Capability unit IIIs–4 irrigated, VIw–2 nonirrigated; Salt Flats range site.

Zinzer Series

The Zinzer series consists of deep, well drained soils. Some areas are seeped from irrigation. These soils formed in alluvium on broad alluvial fans. Slopes are 0 to 1 percent. Elevation is 7,600 to 8,000 feet. Natural vegetation is dominantly alkali sacaton, saltgrass, greasewood, and rabbitbrush. The average annual precipitation is about 7 inches, the mean annual air temperature is about 41° F, and the frost-free season is 90 to 100 days.

In a representative profile the surface layer is dark brown loam about 12 inches thick. The underlying material is 30 inches of grayish brown and light brownish gray sandy clay loam over sand and gravel that extends to a depth of 60 inches or more.

Permeability is moderate. The available water capacity is moderate or high, and in saline areas it is moderate. Reaction is moderately alkaline. The effective rooting depth is 40 to 60 inches or more.

These soils are used for irrigated crops and for range.

Representative profile of Zinzer loam, 1,800 feet south and 1,500 feet east of the northwest corner sec. 21, T. 37 N., R. 8 E.

Ap—0 to 8 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

AC—8 to 12 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1ca—12 to 20 inches; white (10YR 8/2) sandy clay loam, light brownish gray (10YR 6/2) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable; much visible calcium carbonate occurring in finely divided form, in concretions, and in streaks; strongly calcareous; moderately alkaline; clear wavy boundary.

C2ca—20 to 42 inches; light gray (10YR 7/2) light sandy clay loam, grayish brown (10YR 5/2) moist; massive; hard, friable; visible calcium carbonate occurring in finely divided form and in concretions but less than in C1ca horizon; strongly calcareous; moderately alkaline; clear smooth boundary.

IIC3—42 to 60 inches; sand and gravel that is calcareous in the upper part.

The A horizon is 6 to 12 inches thick and is loam or sandy clay loam. Reaction ranges from moderately alkaline to strongly alkaline. Depth to the calcic horizon ranges from 10 to 30 inches. The content of calcium carbonate ranges from 15 to 35 percent. Depth to sand and gravel ranges from 40 to more than 60 inches. Salinity ranges from none to very high.

Zn—Zinzer loam. This nearly level soil occupies the lower end of broad alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is the one described as representative of the series. Salinity ranges from none to low. About 25 percent of this unit is included areas of Luhon loam and about 10 percent areas of San Arcacio, Villa Grove, and Acacio soils.

Runoff is slow. The soil blowing hazard is moderate.

This soil is used mostly for irrigated alfalfa, small grain, potatoes, and other vegetables. Some areas are used for range. Capability unit IIIs–1 irrigated, VIIs–3 nonirrigated; Salt Flats range site.

Zr—Zinzer loam, saline. This nearly level soil occupies the lower end of broad alluvial fans in the southeastern part of the Area. Slopes are 0 to 1 percent. The profile of this soil is similar to the one described as representative of the series, but salinity is moderate to very high and the soil is seeped from irrigation. The water table is 24 to 60 inches below the surface and is highest during irrigation and lowest in winter. About 25 percent of this unit is included areas

of a Luhon loam that is generally seeped and saline, 5 percent areas of San Arcacio and Villa Grove soils, and in places 20 percent soils that are not seeped and saline.

Runoff is slow. The erosion hazard is slight.

This soil is used for irrigated alfalfa, small grain, potatoes, and other vegetables and for range. Capability unit IIIs–4 irrigated, VIw–2 nonirrigated; Salt Flats range site.

Use and Management of the Soils

The following pages define general principles of management that apply to irrigated soils in Rio Grande County Area. They explain the capability classification and list predicted yields of principal irrigated crops under a high level of management. Also in this part of the survey is information on range, wildlife, recreation, and engineering.

Irrigation

About 125,000 acres is irrigated in the Rio Grande County Area. This acreage does not include the naturally wet or seeped areas that do not have a ditch system for irrigation. It does include the 20,000 acres of native meadow that is cut for hay or used for pasture. An additional 30,000 acres would be suitable for irrigation if water were available.

This section describes briefly the use and management of irrigated soils in the survey area. It also describes management by capability units and suggests efficient use of irrigation water for different kinds of soil.

Sources of irrigation water

Irrigation water in the Rio Grande County Area is diverted from the Rio Grande and various creeks. It is also obtained by pumping subsurface water.

The Rio Grande is the main source. Water is diverted from the river into canals that carry it to farms and ranches. The Rio Grande Canal, the Farmers Union Canal, and the Prairie Ditch carry water to farms and ranches north of the river and east of the town of Del Norte. These canals serve most of the Gunbarrel-Mosca-San Luis association, the Norte-Quamon-San Arcacio association, and the Dunul-Platoro-Graypoint association. The Monte Vista Canal and Empire Canal carry water to farms in the Zinzer-San Arcacio-Villa Grove association and the Hooper-Arena-San Luis association. Water diverted from creeks and other smaller canals serves the Torrifluvents-Torsido-Alamosa association.

Some ditch companies have storage reservoirs in the San Juan Mountains to the west of the survey area. Spring runoff is stored in these reservoirs to be used later in summer when streamflow is low. The depth and water content of snow is measured on the watershed during the winter. From this information, the streamflow in spring and summer and the amount of water available for irrigation can be predicted more accurately.

Irrigation pump wells provide much of the water for irrigating soils in the northeastern and southeastern parts of the survey area. Irrigation wells are an important source of water, particularly in the Gunbarrel-Mosca-San Luis association and the Norte-Quamon-San Arcacio association. Most farms use pump wells as a supplementary source of water *(7)*, but recently developed farms use pump wells as a primary source of water.

In the northeastern part of the survey area, the irrigation pump wells are 50 to 100 feet deep and produce 1,250 to 2,000 gallons per minute. In the southeastern part, most wells are 400 to 900 feet deep and produce about 800 to 1,200 gallons per minute. Some artesian wells used for irrigation in the eastern part of the Area are 600 to 2,200 feet deep. Most pump wells and artesian wells produce water of good quality.

Soil moisture as related to irrigation

The purpose of irrigation is to supply crops with adequate moisture for growth. Causes for low irrigation efficiency and loss of water are deep penetration below the root zone, runoff at the end of the field, seepage, and ditch losses.

Available moisture is the moisture a plant can draw from the soil to maintain good growth. Unless the soil is saline, this amount of moisture is generally about half the field capacity of the soil. After the available moisture has been drawn out, the plant begins to wilt. The amount of available moisture any soil can hold at field capacity depends on the soil texture, depth, and salt content. Silt loams, clay loams, and silty clay loams hold about 2.4 inches of available moisture per foot of soil; loams about 2.0 inches; clays and sandy clays about 1.8 inches; sandy loams about 1.4 inches; and loamy sands and fine sands about 0.8 inch per foot of soil *(13)*. Field capacity is the amount of moisture a soil can hold against the force of gravity, for example, the amount of soil moisture 2 or 3 days after an irrigation. Salinity decreases the amount of moisture available to plants. Drawing moisture from a saline soil is difficult.

Water is lost below the root zone if irrigation runs are too long or water is left too long on the same set. If runs are too long or if too little water is used for the length of run, the upper end often is wet below the root zone before the lower end is adequately irrigated. This is common in soils, such as Dunul, Graypoint, or Derrick soils, that have a shallow root zone over gravel and sand. Irrigating the soil below the root zone has very little value and often creates drainage problems.

If the size of the head of water is known, the amount of water applied can be calculated. One cubic foot of water per second, or 450 gallons per minute, covers an acre 1 inch deep in 1 hour. After all available moisture has been used, a crop with a 2-foot root zone in a clay loam or loam soil requires a 4-inch irrigation to refill the root zone to field capacity. The ability and ease of the soil to absorb water and the permeabiliy of the subsoil must also be considered. The rates of water intake and permeability depend on the texture of the soil. Permeability in soils of differing textures from the slowest rate to the most rapid is as follows: clay and silty clay, clay loam and silty clay loam, loam and silt

loam, fine sandy loam, sandy loam, loamy sand, and sand. The tilth of the surface layer and the structure of the subsoil also influence water intake rate and permeability.

To keep plants growing rapidly, irrigate when half the available moisture in the upper 6 to 12 inches is depleted, or when soil moisture is about one-fourth of field capacity. Irrigation trials show that plants draw about 40 percent of the moisture from the upper quarter of the root zone, 30 percent from the second quarter, 20 percent from the third quarter, and 10 percent from the bottom quarter. Because plants draw the greatest part of their moisture from the upper part of the soil, the moisture content of the upper 6 to 12 inches indicates the approximate time to irrigate. Deep-rooted crops and soils that do not have a uniform texture in the profile are exceptions to this general rule.

Methods of applying water

The soils of the Rio Grande County Area are suited to border irrigation, furrow irrigation, sprinkler irrigation, and subirrigation.

Border irrigation is suited to most soils. It is used on nearly level soils for close-growing crops. The borders are either small dikes or small ditches from which the water can be diverted at any desired point. The entire space between the borders is covered with water. The surface must be nearly level. Water stands in low spots and does not run over the high spots.

Furrow irrigation commonly is used for row crops, such as potatoes, lettuce, or cabbage. Water is diverted from a concrete or earth ditch and is carried through furrows between crop rows. This method is efficient, and water can be easily regulated and controlled.

In subirrigation, the water table is raised temporarily into the root zone. Specific soil conditions are essential. The surface must be nearly level, permeability must be moderately rapid to rapid in the substratum so that the water table can be raised or lowered in a short time, and there must be an impermeable layer in the lower part of the substratum to prevent deep percolation of water. Gunbarrel, Mosca, San Arcacio, Norte, and Quamon soils are suited to subirrigation. They are moderately rapidly to rapidly permeable in the gravel or sand substratum, are nearly level, and have a water table that usually can be regulated.

A small amount of water turned into each of several small ditches through a field can raise the water table. Check dams in the ditches at intervals allow the water to fill the ditch, go around the check dam, and down to the next ditch. In most subirrigated areas, the periodic check in a drainage ditch can be used to raise or lower the water level in the ditch. By raising the water level, adjacent fields can be more easily subirrigated. When the field has been sufficiently irrigated, the check is released and the water level is lowered, thus lowering the water table in the field. Fields in the subirrigated area are also designed so that they can be surface irrigated when the need arises.

Flood irrigation is used mainly on meadows or irrigated hayland. Alamosa, Vastine, Torsido, and Mishak soils and Typic Fluvaquents are suited to this method of irrigation. Water is turned out of a ditch at the upper end of a field and allowed to flow across the field, flooding the land that is not too high for the water to cover. Generally, some contour ditches are run through the field to carry water to the higher spots. Flood irrigation differs from border irrigation in that no borders control the water and as a result, more water is needed to irrigate a given area.

Sprinklers are used mainly where the soils are sandy and gravelly and the main source of water is from pump wells. They are used mainly on close-growing crops. Gunbarrel loamy sand, Mosca loamy sand, and the Norte, Dunul, and Quamon soils are suited to sprinklers. Water is distributed evenly, and a smaller amount can be applied than with other methods of surface irrigation. The soil does not have to be leveled as it does for border irrigation. Sprinkler irrigation has gained in popularity in the last few years. The center pivot type is most commonly used because it saves a considerable amount of labor, as compared with other types of irrigation.

Reclamation of saline and alkali soils

The salts and alkali in many of the soils of the Rio Grande County Area seriously reduce crop yields. Some soils contain so much alkali that only the most alkali-tolerant shrubs and grasses can survive. The alkali and saline conditions are caused by the high water table that underlies most of the soils in the eastern part of the survey area.

Saline and alkali soils can be reclaimed or improved by drainage, leaching, and good water management. Hooper and Mishak soils would be much more difficult to reclaim than Gunbarrel or Mosco soils because of differences in texture and permeabiliy. Experiments in the adjoining county have shown that some saline and alkali soils can be improved by drainage and leaching *(3)*. Soils that are high in sodium content often require chemical amendments of gypsum and sulphuric acid in order to leach the sodium out of the soil. Gypsum is applied to the surface in granular form and sulphuric acid is applied in liquid form into the surface layer.

If saline or alkali soils are to be reclaimed, good drainage should first be established. The soil should be leveled. Before the leaching process is started, the amendment should be added to the soil. The amount of the amendment depends on the severity of the alkali condition.

If drains are installed in moderately coarse textured soils, such as the Gunbarrel and Mosca soils, or soils shallow over gravel, such as Norte and Quamon soils, care should be taken not to drop the water table too low. The water table generally should not be lower than 4 or 4½ feet. If it is lower than this, an excessive amount of irrigation is required and much water is lost through deep percolation. Also crop yields can be reduced and subirrigation may not be practical.

Some experiments have shown that the amount of sodium has been reduced in the surface horizons by use of amendments and leaching, but sodium in the lower horizons has not been reduced. Leaching the surface horizons provides a favorable medium plant growth.

Good tillage practices and the use of green manure and legumes improve tilth of the soil and help in reclamation. Some crops that have a high degree of salt tolerance are barley and sugar beets. Those with a medium tolerance are cabbage, cauliflower, lettuce, peas, alfalfa, oats, and sweet clover (*9*).

Weed control

Annual weeds are a concern on most of the irrigated soils in the survey area. The most common are Russian-thistle, kochia, sunflower, common ragweed, and pigweed. These weeds can be controlled by cultivation and by spraying with chemicals. Most grain fields are sprayed to kill annual weeds. Weeds in ditchbanks and fence rows can be sprayed or burned to prevent them from seeding.

Noxious weeds grow mainly in the irrigated parts of the survey area, particularly on marginal soils or on soils that have been idle for several years. They grow along drainage ditches, road right-of-ways, and canals. The most common noxious weeds are Russian knapweed (*Centaurea repens*), povertyweed (*Iva axillaris*), Canada thistle (*Cirsium Arvense*), whitetop (*Cardaria draba*), and field bindweed (*Convolvulus arvensis*) (*4*). These weeds are hard to kill once they become established, but they can be controlled and seed production prevented by clean cultivation, by spraying with chemicals, or by soil sterilants.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The groupings do not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; do not take into consideration possible, but unlikely, major reclamation projects; and do 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, woodland, or engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, the subclass, and the unit. These levels are defined 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. (None in Rio Grande County Area.)

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

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.

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

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

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

CAPABILITY SUBCLASSES are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion; 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, or recreation.

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

Management by capability units

The capability units in the Rio Grande County Area are described on the pages that follow, and use and management is suggested for the soils in each unit.

Almost all the irrigated soils in the survey area are in capability class III or IV. Hooper loamy sand, how-

ever, is in class VI. Because the cold climate and short growing season are severe limitations to use of the soils for crops, no soils in the Area are in class I or II. In grouping the soils into irrigated capability units, it is assumed that sufficient water is available for irrigation and that the soils are irrigated. Nonirrigated soils are in class V through VIII. They are not suitable for cultivated crops because of the dry climate or other soil conditions.

To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT IIIe–1

This unit consists of deep, moderately permeable, well drained or moderately well drained loams. Slopes are 1 to 3 percent. The available water capacity is high. These soils are irrigated. The frost-free season is 90 to 115 days.

These soils are suited to irrigated crops and to most crops grown in the Area. They are also suited to less intensive uses, such as irrigated pasture. Smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa (fig. 12) are some of the most commonly grown plants for irrigated pasture.

The slope and the control of irrigation water are the main concerns of management. Irrigation water management, fertility maintenance, land leveling, and crop rotation protect the soil against deterioration and help to maintain production. Furrows, contour furrows, contour ditches, and sprinklers are suitable for irrigation. The length of runs should be short to control erosion. Managing the irrigation water is easier in areas that can be leveled. A cropping system that includes close-growing crops and legumes and only a limited number of row crops helps to maintain tilth and fertility.

CAPABILITY UNIT IIIe–2

The only soil in this unit is Mosca loamy sand. It is a deep, moderately rapidly permeable, well drained soil that has a high water table as a result of irrigation. The available water capacity is moderate. Slopes are 0 to 1 percent. The frost-free season is 90 to 100 days.

This soil is suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and vegetables. The soil is also suited to less intensive uses, such as irrigated pasture. Plants suitable for irrigated pasture are smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa.

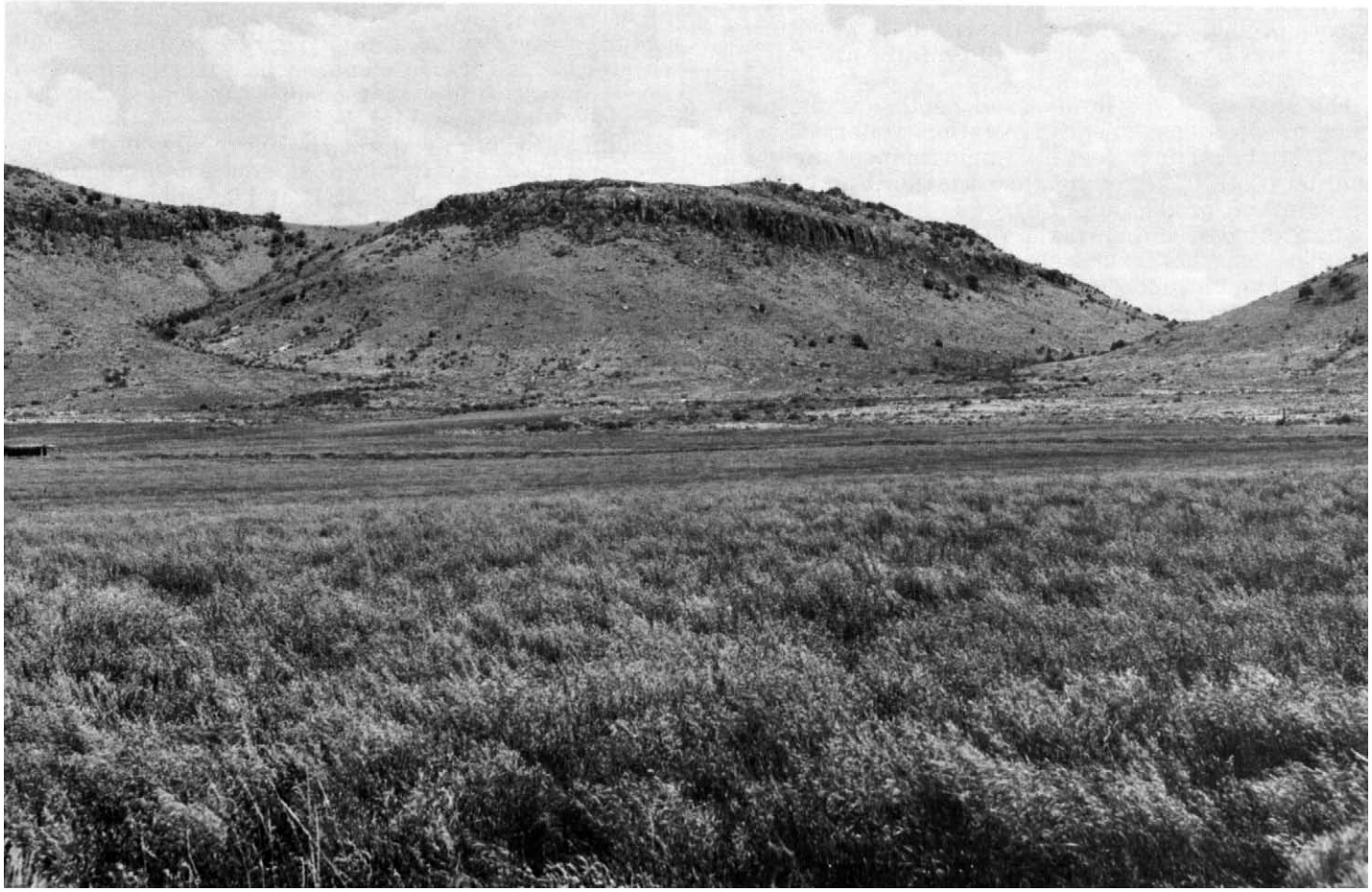

Figure 12.—**Irrigated brome about 30 inches high and alfalfa on Luhon loam, 1 to 3 percent slopes. This field is irrigated by small furrows from contour ditches.**

Soil blowing, a droughty surface layer, and sandy texture are the main concerns of management. Crop residue, minimum tillage, land leveling, irrigation water management, fertility maintenance, and crop rotation protect the soil against deterioration and help to maintain production. Soil blowing can be reduced by leaving stubble on the ground or leaving the surface in a rough condition during winter and early spring. Land leveling and planing make irrigation easier and water application more uniform. Borders, furrows, sprinklers, and subirrigation can be used in irrigating. Subirrigation and sprinklers are well suited. Center pivot sprinklers are most commonly used. Irrigations should be light and frequent. Under border and furrow irrigation, runs should be short to prevent water waste. A cropping system that includes close-growing crops and legumes helps to maintain tilth and fertility.

CAPABILITY UNIT IIIe–3

The only soil in this unit is Platoro loam, 1 to 3 percent slopes. It is a moderately slowly permeable, well drained soil that is 20 to 40 inches deep over sand and gravel. It has a moderate available water capacity. It is irrigated. The frost-free season is 90 to 105 days.

This soil is suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, and oats. The soil is also suited to less intensive uses, such as irrigated pasture. Smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa are suitable for irrigated pasture.

The slope and the limited soil depth are the main concerns of management. Irrigation water management, land leveling, fertility maintenance, and crop rotation protect the soil against deterioration and help to maintain production. Furrows, contour furrows, contour ditches, and sprinklers can be used in irrigating. The length of runs should be short to prevent erosion. Land leveling makes irrigation easier and promotes good water management. Care is needed in leveling to avoid cutting into the gravel. A cropping system that consists mostly of close-growing crops and legumes and a limited number of row crops helps to maintain tilth and fertility and to prevent erosion.

CAPABILITY UNIT IIIw–1

This unit consists of moderately rapidly permeable to moderately slowly permeable, poorly drained or somewhat poorly drained loams, sandy loams, and clay loams. All but Schrader soils are 20 to 40 inches deep over sand and gravel. Slopes are 0 to 3 percent. The available water capacity is moderate or high. These soils are irrigated. The frost-free season is 90 to 110 days.

These soils are suited to irrigated crops, such as barley, oats, and alfalfa. They are also suited to less intensive uses, such as irrigated meadow and irrigated pasture. Plants suitable for irrigated pasture are reed canarygrass, creeping meadow foxtail, timothy, tall fescue, alsike clover, and Ladino clover. Smooth brome and orchardgrass are suitable where drainage is improved.

The high water table, flooding, and unevenness of the surface are the main concerns of management. Some areas are subject to flooding during periods of high runoff. Drainage, land leveling, irrigation water management, and fertility maintenance protect the soil against deterioration and help to maintain production. Most of the soils in this unit are difficult to drain. Drainage, however, is generally necessary for cultivated crops. Outlets for drains are hard to find on the nearly level soils. Land leveling helps in the management of irrigation water. Furrows, borders, and flooding from contour ditches are suitable for irrigation. Length of runs can be longer on these soils than on sandy soils, but the amount of water applied should be controlled to prevent seepage and salt accumulation.

CAPABILITY UNIT IIIw–2

This unit consists of moderately permeable to moderately slowly permeable, poorly drained or somewhat poorly drained loams and clay loams. In many areas these soils are subject to flooding during periods of high runoff. They are 20 inches or more deep over sand and gravel. Slopes are 0 to 1 percent. Salinity ranges from low to high. The available water capacity is moderate to high. These soils are irrigated. The frost-free season is 90 to 105 days.

These soils are suited to irrigated crops, such as alfalfa, barley, and oats. They are also suited to less intensive uses, such as irrigated meadow and irrigated pasture. Plants suitable for irrigated pasture are tall wheatgrass, tall fescue, slender wheatgrass, and sweetclover. In less saline areas, reed canarygrass, timothy, and alsike clover are suitable.

Salinity, the high water table, unevenness of the surface, and flooding are the main concerns of management. Drainage, leaching salts, land leveling, irrigation water management, and fertility maintenance protect the soil against deterioration and help to maintain production. Drainage and leaching are needed, but drainage is difficult because the soil is low and outlets are hard to find. Land leveling promotes better water management and also helps in leaching salts. Borders, furrows, and flooding from contour ditches are suitable for irrigation.

CAPABILITY UNIT IIIs–1

This unit consists of deep, moderately permeable to moderately slowly permeable, well drained or moderately well drained loams, sandy clay loams, and sandy loams. Slopes are 0 to 1 percent. The available water capacity is high or moderate. These soils are irrigated. The frost-free season is 90 to 110 days.

These soils are suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and vegetables. The soils are also suited to less intensive uses, such as irrigated pasture. Smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa are some of the most commonly grown plants for irrigated pasture.

Land leveling, irrigation water management, fertility maintenance, and crop rotation protect the soil against deterioration and help to maintain production. Land leveling and frequent land planing make irrigation easier and more efficient and promote good water management. Borders and furrows are suitable

for irrigation. Irrigation runs can be longer on these soils than on sandy soils. A cropping system that includes high-residue crops, deep-rooted legumes in rotation, and applications of fertilizer helps to maintain tilth and fertility.

CAPABILITY UNIT IIIs–2

This unit consists of moderately permeable or moderately rapidly permeable, well drained or moderately well drained sandy loams and gravelly sandy loams that are 20 to 40 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is moderate. These soils have a seasonal water table at a depth of 36 to 60 inches. They are irrigated. The frost-free season is 90 to 100 days.

These soils are suited to irrigated crops and to all crops grown in the Area. They are especially suited to potatoes and vegetables. They are also suited to less intensive uses, such as irrigated pasture. Smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa are the commonly grown plants for irrigated pasture.

The limited depth over gravel and the hazard of soil blowing are the main concerns of management. Land leveling, irrigation water management, fertility maintenance, crop residue, and minimum tillage protect the soil against deterioration and help to maintain production. Land leveling and frequent planing make irrigation easier and more efficient and conserve water. Care is needed in leveling to avoid exposing gravel bars. Furrows, borders, sprinklers, and subirrigation can be used in irrigating. Subirrigation is used to a large extent. Light, frequent irrigations are needed. The hazard of soil blowing can be reduced by leaving stubble on the ground or leaving the surface rough during winter and early spring. The cropping system should include close-growing crops and legumes.

CAPABILITY UNIT IIIs–3

This unit consists of moderately permeable to moderately slowly permeable, well drained loams that are 20 to 40 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is moderate. These soils are irrigated. The frost-free season is 90 to 105 days.

These soils are suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and lettuce. The soils are also suited to less intensive uses, such as irrigated pasture. Smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa are some of the most commonly grown plants for irrigated pasture.

The limited depth over sand and gravel is the main concern of management. Land leveling, irrigation water management, fertility maintenance, and crop rotation protect the soil against deterioration and help to maintain production. Land leveling and frequent land planing make irrigation easier and more efficient and promote good water management. Deep cuts should be avoided in land leveling to avoid exposing gravel bars. Borders and furrows are suitable for irrigation. Irrigation runs can be longer on these soils than on sandy soils. The cropping system should include deep-rooted legumes and high-residue crops.

CAPABILITY UNIT IIIs–4

This unit consists of deep, moderately permeable to slowly permeable, well drained to poorly drained loams and sandy clay loams that are seeped from irrigation water. Slopes are 0 to 1 percent. These soils are moderately saline to very highly saline and have a high water table. They have a moderate to high available water capacity. The frost-free season is 90 to 100 days.

These soils are suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and lettuce. The soils are also suited to less intensive uses, such as irrigated meadow and irrigated pasture. Plants suitable for irrigated pasture are tall wheatgrass, tall fescue, slender wheatgrass, and sweetclover. In less saline areas, reed canarygrass and alsike clover are suitable.

Salinity, the high water table, and the control of irrigation water are the main concerns of management. Drainage, leaching salts, land leveling, irrigation water management, and fertility maintenance protect the soil against deterioration and help to improve production. Drainage is needed on most of the soils, and on others, existing drainage needs to be maintained. Leaching is needed. Most of the soils can be leached. Land leveling promotes uniform water application for leaching salts. It also promotes good water management. Borders and furrows are suitable for irrigation. Overirrigation increases the amount of salts in the soil and the height of the water table. A cropping system that includes deep-rooted legumes and high-residue crops helps to maintain tilth.

CAPABILITY UNIT IIIs–5

The only soil in this unit is San Arcacio sandy loam, saline. It is a moderately permeable soil that is seeped from irrigation water. It is 20 to 40 inches deep over sand and gravel. The available water capacity is moderate. This soil is moderately saline to highly saline and has a high water table. Slopes are 0 to 1 percent. The frost-free season is 90 to 100 days.

This soil is suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and lettuce. The soil is also suited to less intensive uses, such as irrigated pasture. Tall wheatgrass, tall fescue, slender wheatgrass, sweetclover, and alfalfa are suitable plants for irrigated pasture.

Salinity, the high water table, and the limited depth over sand and gravel are the main concerns of management. Drainage, leaching salts, land leveling, irrigation water management, and fertility maintenance protect the soil against deterioration and help to improve production. Drainage and leaching are needed. This soil can be easily drained because the substratum is sand and gravel. Land leveling promotes good water management and helps in leaching salts. Care is needed in leveling to avoid cutting into gravel bars. Furrows, borders, sprinklers, and subirrigation are suitable for irrigation. Subirrigation is well suited after the soil has been drained and leached. The cropping system should include high-residue crops and deep-rooted legumes.

CAPABILITY UNIT IIIs–6

This unit consists of deep, moderately permeable to slowly permeable, somewhat poorly drained or poorly drained loams and sandy loams. San Luis soils are 20

to 40 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is low to high. These soils are moderately saline to very highly saline, are highly alkali, and have a high water table. They are irrigated. The frost-free season is 90 to 100 days.

These soils are suited to irrigated crops. Alfalfa, barley, and oats are grown on some of the soils. Potatoes are grown to a minor extent. The soils are also used for irrigated meadow and irrigated pasture. Plants suitable for irrigated pasture are alkali sacaton, tall wheatgrass, tall fescue, and sweetclover.

Salinity, alkali, and the high water table are the main concerns of management. Drainage, leaching salts, land leveling, irrigation water management, and fertility maintenance protect the soil against deterioration and help to improve production. Drainage and leaching are needed. Amendments, such as gypsum or sulphuric acid, help to leach salts. Land leveling promotes uniform water application, helps to leach salts, and makes irrigation easier. Borders and furrows are suitable for irrigation. Irrigated meadows are generally flooded from contour ditches. A cropping system that consists mainly of legumes and high-residue crops helps to maintain tilth.

CAPABILITY UNIT IIIs–7

The only soil in this unit is San Luis sandy loam, drained. It is a moderately slowly permeable, somewhat poorly drained soil that is 20 to 40 inches deep over sand and gravel. Slopes are 0 to 1 percent. This soil has been partly leached of salts and alkali. It has a moderate available water capacity. It is irrigated. The frost-free season is 90 to 100 days.

This soil is suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and vegetables. The soil is also suited to less intensive uses, such as irrigated meadow and irrigated pasture. Plants suitable for irrigated pasture are smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa.

Maintaining drainage, controlling irrigation water, and preventing soil blowing are the main concerns of management. Land leveling, maintaining drainage, irrigation water management, fertility maintenance, crop rotation, and crop residue protect the soil against deterioration and help to maintain production. Drainage must be maintained to prevent salt and alkali from recurring. Land leveling and planing make irrigation easier and promote good water management. Furrows, borders, and sprinklers can be used in irrigating. The cropping system should include deep-rooted legumes and high-residue crops. Crop residue left on the surface in winter and early spring helps to prevent soil blowing.

CAPABILITY UNIT IVe–1

The only soil in this unit is Gunbarrel loamy sand. It is a deep, rapidly permeable, poorly drained soil. Slopes are 0 to 1 percent. The seasonal water table is at a depth of 2 to 3 feet. The available water capacity is low. This soil is drained and irrigated. The frost-free season is 90 to 100 days.

This soil is suited to irrigated crops. Alfalfa, potatoes, barley, oats, and vegetables are grown. The soil is also suited to less intensive uses, such as irrigated pasture. Smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa are suitable plants for irrigated pasture.

Soil blowing, droughtiness, and sandy textures are the main concerns of management. Crop residue, minimum tillage, land leveling, irrigation water management, drainage, fertility maintenance, and crop rotation protect the soil against deterioration and help to maintain production. Soil blowing can be reduced by leaving stubble on the ground or leaving the surface rough in winter and early in spring. Land leveling makes irrigation easier and water application more uniform. Controlled drainage is needed to regulate the water table. Borders, furrows, sprinklers, and subirrigation can be used in irrigating. Subirrigation and sprinklers are well suited. Center pivot sprinklers are most commonly used. Under border and furrow irrigation, runs should be short to prevent water waste. Irrigations should be light and frequent. A cropping system that includes close-growing crops and legumes helps to maintain tilth and fertility.

CAPABILITY UNIT IVe–2

This unit consists of deep, moderately permeable, well drained loams. Slopes are 0 to 6 percent, but most are 3 to 6 percent. The available water capacity is high. These soils are irrigated. The frost-free season is 80 to 115 days.

These soils are suited to irrigated crops. The crops grown are alfalfa, barley, and oats. The soils are also suited to less intensive uses, such as irrigated pasture. A small acreage is used for irrigated meadow. Plants suitable for irrigated pasture are smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa.

The slope and the control of irrigation water are the main concerns of management. Irrigation water management, land leveling, and fertility maintenance protect the soil against deterioration and help to maintain production. Furrows, contour furrows, and contour ditches are suitable for irrigation. The length of runs should be short to prevent erosion. A cropping system should consist mostly of close-growing crops and legumes. High-residue crops help to maintain tilth and prevent erosion.

CAPABILITY UNIT IVe–3

The only soil in this unit is Garita cobbly loam, 1 to 3 percent slopes. It is a deep, moderately permeable, well drained soil. It has a moderate or high available water capacity. It is irrigated. The frost-free season is 95 to 115 days.

This soil is suited to irrigated crops. The crops grown are alfalfa, barley, and oats. The soil is also suited to less intensive uses, such as irrigated pasture. Plants suitable for irrigated pasture are smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa.

The slope, the cobbles, and the control of irrigation water are the main concerns of management. Cobble removal, land leveling, irrigation water management,

and fertility maintenance protect the soil against deterioration and help to maintain production. Removing cobbles from the surface layer makes tillage easier and more feasible and saves wear on machinery. Land leveling makes irrigation easier and promotes more uniform water application. Deep cuts should be avoided in leveling to avoid exposing large, very cobbly areas or areas that have a high lime zone. Furrows, contour furrows, and sprinklers can be used in irrigating. A cropping system that includes close-growing crops and legumes helps to maintain fertility and tilth.

CAPABILITY UNIT IVw–1

This unit consists of moderately permeable to slowly permeable, poorly drained to somewhat poorly drained loams and clay loams that are 12 to 36 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is moderate, and the water table is high. These soils are irrigated. The frost-free season is 90 to 110 days.

These soils are suited to irrigated crops. The crops grown are alfalfa, barley, and oats. The soils are also suited to less intensive uses, such as irrigated meadow and irrigated pasture. Plants suitable for irrigated pasture are reed canarygrass, creeping meadow foxtail, timothy, tall fescue, alsike clover, and Ladino clover. Smooth brome and orchardgrass are suitable where drainage is improved.

The high water table, the depth over sand and gravel, and the unevenness of the surface are the main concerns of management. Drainage, land leveling, irrigation water management, and fertility maintenace protect the soil against deterioration and help to maintain production. The soils can normally be drained fairly easily because of the sand and gravel substratum. Land leveling makes irrigation easier and promotes good water management. Care is needed in leveling to avoid cutting into and exposing gravel bars. Borders, furrows, and flooding from contour ditches are suitable for irrigation. The cropping system should include legumes.

CAPABILITY UNIT IVs–1

This unit consists of rapidly permeable to moderately permeable, well drained to excessively drained gravelly or cobbly sandy loams and cobbly loams that are 6 to 40 inches deep over sand and gravel. Slopes are 0 to 3 percent. The available water capacity is low. These soils are irrigated. The frost-free season is 90 to 105 days.

These soils are suited to irrigated crops. The crops most commonly grown are alfalfa, potatoes, barley, and oats. The soils are better suited to less intensive uses, such as irrigated pasture. Crested wheat, intermediate wheat, pubescent wheat, Russian wildrye, smooth brome, sweetclover, and alfalfa are suitable plants for irrigated pasture.

The depth over sand and gravel, droughtiness, low rainfall, and cobbles and gravel are the main concerns of management. Cobble removal, land leveling, irrigation water management, and fertility maintenance protect the soil against deterioration and help to maintain production. Removing cobbles from the surface layer makes tillage easier and more feasible and saves wear on machinery. Land leveling makes irrigation easier and promotes better water management. Extreme care is needed in leveling to avoid exposing large areas of gravel bars. Sprinklers, borders, and furrows are suitable for irrigation. Center pivot sprinkler systems are well suited. A cropping system that consists mostly of close-growing crops and shallow-rooted legumes helps to maintain fertility.

CAPABILITY UNIT IVs–2

This unit consists of moderately slowly permeable to moderately rapidly permeable, excessively drained to somewhat poorly drained gravelly sandy loams, and loams that are 8 to 40 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is low or moderate. Typic Torrifluvents are subject to flooding during spring runoff. These soils are irrigated. The frost-free season is 90 to 105 days.

These soils are suited to irrigated crops. The crops grown are alfalfa, potatoes, barley, oats, and vegetables. The soils are also suited to less intensive uses, such as irrigated pasture. Some are used for irrigated meadow. Plants suitable for irrigated pasture are smooth brome, orchardgrass, intermediate wheatgrass, Russian wildrye, sweetclover, and alfalfa.

The depth over sand and gravel and the low available water capacity are the main concerns of management. Land leveling, irrigation water management, fertility maintenance, crop residue, and crop rotation protect the soil against deterioration and help to maintain production. Land leveling and frequent planing make irrigation easier and promote good water management. Care is needed in leveling to avoid cutting into and exposing large areas of gravel. Furrows, borders, and sprinklers are suitable for irrigation. In addition, subirrigation is suited to the Quamon soils. Light frequent irrigations are needed. Soil blowing can be reduced by leaving stubble on the surface or leaving the surface rough during winter and early spring. A cropping system that includes high-residue crops and legumes helps to maintain fertility and tilth.

CAPABILITY UNIT Vw–1

This unit consists of deep, moderately rapidly permeable to slowly permeable, poorly drained or somewhat poorly drained clay loams, loams, or sandy loams. All but Schrader soils are 20 to 60 inches deep over sand and gravel. Slopes are 0 to 3 percent. The available water capacity is moderate to high. The average annual precipitation is 7 to 8 inches. The frost-free season is 90 to 110 days.

These soils are suited to range, which is grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat.

The high water table and flooding are the main concerns of management. Proper stocking, fencing, and seeding selected areas protect the soil against deterioration and help to maintain production. Intermediate wheatgrass, tall fescue, sweetclover, and alsike clover are suitable plants. Reed canarygrass and creeping meadow foxtail also are suitable in wetter areas.

CAPABILITY UNIT VIe–1

This unit consists of deep, moderately permeable or moderately slowly permeable, well drained loams and cobbly loams. Slopes are 0 to 10 percent. The available

water capacity is high. The average annual precipitation is 12 to 15 inches. The frost-free season is 65 to 100 days.

These soils are suited to range, which is grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat. Deer and elk inhabit the areas.

Gully erosion is the main concern of management. Grass seeding and erosion control dams protect the soil against deterioration and help to maintain production. Stockwater development is needed in most areas and together with fencing promotes use of range and growth of desirable grasses and prevents runoff and erosion. Some areas need reseeding. Grasses suitable for reseeding are crested wheat, intermediate wheat, pubescent wheat, western wheat, and Russian wildrye. Erosion control dams and diversions can be built on small drainageways to control runoff and erosion.

CAPABILITY UNIT VIw–1

This unit consists of deep, moderately permeable to slowly permeable, poorly drained or somewhat poorly drained loams and clay loams. Alamosa soils and Typic Fluvaquents are 20 to 60 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is low to high. The soils are saline and alkali and in some areas are subject to flooding in spring. The average annual precipitation is 7 to 8 inches. The frost-free season is 90 to 105 days.

These soils are suited to range and pasture, which are grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat.

The high water table, salinity, and alkali are the main concerns of management. Proper stocking and grass seeding protect the soil against deterioration and help to maintain production. Plants suitable for seeding are alkali sacaton, tall fescue, tall wheatgrass, and sweetclover. Some irrigation is generally necessary to establish grass. The high water table is beneficial to grasses and legumes once established.

CAPABILITY UNIT VIw–2

This unit consists of deep, moderately permeable to moderately slowly permeable, somewhat poorly drained or well drained sandy loams, loams, and clay loams that are seeped from irrigation water. All but Villa Grove soils are 20 to 60 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is low to high. These soils are saline or affected by alkali and have a high water table. They receive an average of 7 inches of precipitation annually and have a frost-free season of 90 to 100 days.

These soils are suited to range and pasture, which are grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat.

The high water table, salinity, alkali, and low rainfall are the main concerns of management. Proper stocking, stockwater development, fencing, grass seeding, and brush control protect the soil against deterioration and help to maintain production. Stockwater development and fencing promote proper grazing and growth of desirable grasses. Artesian wells can be developed for stockwater. Plants suitable for seeding are alkali sacaton, tall fescue, tall wheatgrass, and sweetclover. Some irrigation is generally needed to establish grass. Brush control by spraying or railing is beneficial in many areas.

CAPABILITY UNIT VIw–3

The only soil in this unit is Gerrard loam. It is a moderately permeable, somewhat poorly drained or poorly drained soil that is only 12 to 20 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is moderate. The average annual precipitation is 9 inches. The frost-free season is 95 to 110 days.

This soil is suited to range and pasture, which are grazed by cattle and sheep. It is also suited to less intensive uses, such as wildlife habitat.

The high water table and the flood hazard are the main concerns of management. Proper stocking, grass seeding, and fencing protect the soil against deterioration and help to maintain production. Intermediate wheatgrass, tall fescue, sweetclover, and alsike clover are suitable for pasture. Reed canarygrass and creeping meadow foxtail are also suitable in some of the wetter areas. Drainage improves some areas. Fencing promotes proper use of range.

CAPABILITY UNIT VIw–4

The only soil in this unit, Arena loam, is deep, slowly permeable, and poorly drained. Slopes are 0 to 1 percent. The soil is highly or very highly saline and is highly alkali. It has a low available water capacity. It receives an average of 7 inches of precipitation annually and has a frost-free season of 90 to 100 days.

This soil is suited to range, which is grazed by cattle and sheep. It is also suited to less intensive uses, such as wildlife habitat.

The salts, the alkali, the high water table, and the low rainfall are the main concerns of management. Proper stocking, fencing, stockwater development, and brush control in selected areas protect the soil against deterioration and help to maintain production. Stockwater development and fencing promote proper use of the range and the growth of grasses. Some areas are suited to tall wheatgrass or tall fescue. Irrigation is essential to establish grass. Brush control by spraying and leaving dead brush standing is beneficial in areas where brush competes with the grass.

CAPABILITY UNIT VIs–1

The only soil in this unit is Hooper loamy sand. It is a deep, very slowly permeable, well drained soil that is 20 to 40 inches deep over sand and gravel. It is highly alkali. The available water capacity is low. This soil is irrigated. Slopes are 0 to 1 percent. The frost-free season is 90 to 100 days.

This soil is suited to irrigated meadow and irrigated pasture. It is also suited to less intensive uses, such as wildlife habitat. It is not suited to cultivated crops.

The alkali, the very slow permeability, and the low available water capacity are the main concerns of management. Irrigation water management, land smoothing, and pasture planting protect the soil against deterioration and help to maintain production. The only suitable irrigation is by flooding from contour

ditches or by border irrigation. Land smoothing promotes better water application. Tall wheatgrass is suitable for pasture.

CAPABILITY UNIT VIs–2

This unit consists of deep, moderately permeable, well drained or moderately well drained loams. Slopes are 0 to 3 percent. The available water capacity is high. The average annual precipitation is 11 inches. The frost-free season is 95 to 110 days.

These soils are suited to range, which is grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat. Deer and elk graze in some areas.

The limited rainfall is the main concern of management. Proper stocking, fencing, and grass seeding protect the soil against deterioration and help to maintain production. Grasses suitable for seeding are crested wheat, intermediate wheat, pubescent wheat, western wheat, Russian wildrye, and smooth brome. Fencing and stockwater development promote proper use of range and growth of desirable plants.

CAPABILITY UNIT VIIe–1

This unit consists of deep, moderately rapidly permeable or rapidly permeable, poorly drained and well drained loamy sands that are seeped from irrigation. Slopes are 0 to 1 percent. The available water capacity is low to moderate. The average annual precipitation is 7 inches. The frost-free season is 90 to 100 days.

These soils are suited to range, which is grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat.

Soil blowing, the limited available water capacity, and the resulting droughtiness are the main concerns of management. Proper stocking, fencing, brush control, and stockwater development protect the soil against deterioration and help to maintain production. Fencing and stockwater development promote proper use of range and growth of desirable grasses. Artesian wells can be developed. Brush control by spraying and leaving dead brush as cover to prevent soil blowing are beneficial in many areas. Because of the low rainfall and the droughtiness, establishing grass by seeding is difficult.

CAPABILITY UNIT VIIw–1

Only Typic Torrifluvents are in this unit. These soils are deep, moderately rapidly permeable stratified loams and sandy loams. They are excessively drained when the river is low. They are only 8 to 20 inches deep over sand and gravel. Slopes are 0 to 1 percent. The available water capacity is low. The average annual precipitation is 7 to 11 inches. The frost-free season is 85 to 100 days.

This unit is suited to range, which is grazed by cattle and sheep. It is also suited to less intensive uses, such as wildlife habitat. It provides cover and food for deer and elk.

The flood hazard, shallowness, and droughtiness are the main concerns of management. Proper stocking and fencing protect the soil against deterioration and help to maintain production. Flooding, low rainfall, and droughtiness make it difficult to establish grass by seeding.

CAPABILITY UNIT VIIs–1

This unit consists of shallow to deep, moderately permeable to slowly permeable, well drained or somewhat excessively drained loams, very stony loams, or extremely stony loams and Rock outcrop. Slopes are 3 to 25 percent. The available water capacity is low. The average annual precipitation is 12 to 16 inches. The frost-free season is 70 to 100 days.

These soils are suited to range, which is grazed by sheep and cattle. They are also suited to less intensive uses, such as woodland and wildlife habitat. Deer and elk range over part of the area. Wooded areas provide fence posts and firewood.

Stones, shallowness, droughtiness, and slope are the main concerns of management. Proper stocking, stockwater development, and fencing protect the soil against deterioration and help to maintain production. Stockwater development is needed on most of the soils and along with fencing promotes proper use of range and growth of desirable grasses. The stones and the slope make mechanical reseeding of grasses very difficult.

CAPABILITY UNIT VIIs–2

This unit consists of moderately permeable to moderately slowly permeable, well drained loams, sandy loams, or gravelly sandy loams that are 10 to 40 inches deep over sand and gravel. Slopes are 0 to 3 percent. The available water capacity is moderate. The average annual precipitation is 7 or 8 inches. The frost-free season is 90 to 105 days.

These soils are suited to range, which is grazed by sheep and cattle. They are also suited to less intensive uses, such as wildlife habitat.

Low rainfall and the limited soil depth are the main concerns of management. Proper stocking, fencing, and stockwater development protect the soil against deterioration and help to maintain production. Stockwater development and fencing promote proper use of range and growth of desirable grasses. Brush control by spraying or railing is beneficial in some areas. Because of the low rainfall, establishing grass by seeding is very difficult.

CAPABILITY UNIT VIIs–3

This unit consists of deep, moderately permeable or moderately slowly permeable, well drained loams, sandy clay loams, and sandy loams. Slopes are 0 to 6 percent. The available water capacity is high or moderate. The average annual precipitation is 7 to 9 inches. The frost-free season is 90 to 115 days.

These soils are suited to range, which is grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat.

The low rainfall, which limits production, is the main concern of management. Proper stocking, fencing, stockwater development, and brush control protect the soils against deterioration and help to maintain production. Fencing and stockwater development promote proper use of range and growth of desirable grasses. Brush control by spraying is beneficial on soils where

greasewood and rabbitbrush seriously compete with grasses. Leaving dead brush as cover helps to control soil blowing. Because of low rainfall, establishing grass by seeding is very difficult.

CAPABILITY UNIT VIIs–4

The only soil in this unit is Hooper clay loam. It is a very slowly permeable, well drained soil that is 20 to 40 inches deep over sand and gravel. It is highly alkali. The available water capacity is low. The average annual precipitation is 7 inches. Slopes are 0 to 1 percent. The frost-free season is 90 to 100 days.

This soil provides wildlife habitat, but is also suited to range, which provides limited grazing for sheep and cattle.

The alkali, the low rainfall, and the droughtiness are the main concerns of management. Proper stocking protects the soil against deterioration. Because of the alkali and low rainfall, seeding is impractical and grasses generally do not grow. Brush should not be cleared because it protects the soil against soil blowing.

CAPABILITY UNIT VIIs–5

The only soil in this unit is Hooper loamy sand. It is a deep, very slowly permeable, well drained soil that is 20 to 40 inches deep over sand and gravel. It is highly alkali. The available water capacity is low. The average annual precipitation is 7 inches. Slopes are 0 to 1 percent. The frost-free season is 90 to 100 days.

This soil is suited to range, which is grazed by cattle and sheep. It is also suited to less intensive uses, such as wildlife habitat.

The alkali, the low rainfall, and the droughtiness are the main concerns of management. Proper stocking, fencing, and stockwater development protect the soil against deterioration and help to maintain production. Fencing and stockwater development promote proper use of range and growth of desirable grasses. Brush control by spraying is beneficial in some places. Leaving dead brush as cover helps to control soil blowing. Because of the alkali, low rainfall, and droughtiness, establishing grass by seeding is very difficult.

CAPABILITY UNIT VIIs–6

The only soil in this unit is Seitz very stony loam, 20 to 65 percent slopes. It is a slowly permeable, well drained soil. It has a moderate available water capacity. The average annual precipitation is 15 to 20 inches. The frost-free season is 60 to 75 days.

This soil is suited to woodland. Engelman spruce, Douglas-fir, and aspen are dominant. The soil is also suited to less intensive uses, such as wildlife habitat. Deer and elk inhabit the woodland. The soil also provides limited grazing for cattle and sheep.

Stones and steep slopes are the main concerns of management. Proper stocking protects the soil against deterioration and helps to maintain production.

CAPABILITY UNIT VIIs–7

This unit consists of deep, moderately slowly permeable to rapidly permeable, somewhat poorly drained to excessively drained cobbly or gravelly sandy loams or loams that are 6 to 40 inches deep over sand and gravel. Slopes are 0 to 3 percent. The available water capacity is low or moderate. The average annual precipitation is 7 inches. The frost-free season is 90 to 105 days.

These soils are suited to range, which is grazed by cattle and sheep. They are also suited to less intensive uses, such as wildlife habitat.

The low rainfall and the droughtiness, both of which limit production, are the main concerns of management. Proper stocking, fencing, and stockwater development protect the soil against deterioration and help to maintain production. Fencing and stockwater development promote use of range and growth of desirable grasses. Because of low rainfall, establishing grass by seeding is very difficult.

CAPABILITY UNIT VIIs–8

This unit consists of shallow to deep, moderately permeable, well drained or somewhat excessively drained cobbly and very stony loams and sandy loams. Slopes are dominantly 1 to 25 percent, but range to as much as 50 percent. The available water capacity is low to high. The average annual precipitation is 8 to 9 inches. The frost-free season is 90 to 115 days.

These soils are suited to range, which is grazed by sheep and cattle. They are also suited to less intensive uses, such as wildlife habitat. Deer, elk, and antelope inhabit the areas.

Stoniness, shallowness, droughtiness, and the slope are the main concerns of management. Poor stocking, stockwater development, and fencing protect the soil against deterioration and help to maintain production. Stockwater development is needed and along with fencing promotes proper use of range and growth of desirable grasses. The stones and the slope make mechanical seeding of grass very difficult. Because of low rainfall, establishing grass by seeding is very difficult.

CAPABILITY UNIT VIIIw–1

This unit consists of Marsh, permanently wet areas near the river and along some major drainageways. These areas are covered with water most of the year and are generally too low to drain. The vegetation is cattails, sedges, and rushes.

Marsh is used by wildlife. It provides good nesting and cover for ducks. It also provides good duck hunting. It provides limited grazing around the edges during the driest part of the year.

CAPABILITY UNIT VIIIs–1

This unit consists of Rock outcrop, mostly bare rock and small pockets of shallow soils. Runoff is very rapid. A few trees and small patches of grass occur in the pockets of soil between the outcrops. Rock outcrop is best suited to wildlife habitat and recreation. It provides cover and some food for deer and elk.

Predicted Yields of Principal Irrigated Crops

Predicted yields of principal irrigated crops in the Rio Grande County Area are listed in table 2. Yield predictions are averages that can be expected under a high level management. They are based on statistics of the Colorado Crop and Livestock Reporting Service, on

TABLE 2.—*Predicted yields of principal irrigated crops*

[Dashes indicate that the soil is not suited to the particular crop or that the crop is not normally grown on the soil. Only arable, irrigated soils are listed]

Soil	Alfalfa	Potatoes	Barley	Oats	Lettuce	Native meadow hay
	Tons	*Cwt*	*Bu*	*Bu*	*Crates*	*Tons*
Acacio sandy loam	3.0	250	80	90	550	—
Acasco clay loam	2.0	—	65	75	—	1.5
Alamosa loam	2.5	—	70	75	—	1.7
Alamosa loam, saline	2.0	—	60	55	—	1.2
Arena loam	1.0	—	40	40	—	.7
Arena loam, drained	2.5	—	60	65	—	1.2
Derrick cobbly loam	1.75	225	55	60	—	—
Dunul cobbly sandy loam	1.75	225	50	55	350	—
Garita cobbly loam, 1 to 3 percent slopes	2.0	—	60	65	—	—
Gerrard loam	2.0	—	60	70	—	1.0
Graypoint gravelly sandy loam	2.0	225	50	55	500	—
Gunbarrel loamy sand	2.0	350	60	65	600	—
Hooper loamy sand	—	—	—	—	—	.7
Jodero loam	2.75	—	65	75	—	1.3
Laney loam	2.5	—	40	40	—	1.2
Luhon loam, 1 to 3 percent slopes	3.0	250	70	80	450	—
Luhon loam, 3 to 6 percent slopes	2.5	—	60	70	—	—
Mishak loam	—	—	—	—	—	1.2
Monte loam, 0 to 1 percent slopes	3.0	275	80	90	550	—
Monte loam, 1 to 3 percent slopes	2.75	—	70	80	450	—
Mosca loamy sand	2.5	275	60	70	600	—
Norte gravelly sandy loam	3.0	350	80	90	650	—
Norte-Dunul complex	2.0	275	60	65	450	—
Platoro loam, 0 to 1 percent slopes	3.5	250	80	85	500	—
Platoro loam, 1 to 3 percent slopes	2.75	225	70	75	—	—
Quamon gravelly sandy loam	2.5	325	65	70	550	—
San Arcacio sandy loam	3.0	300	80	90	550	—
San Arcacio sandy loam, saline	1.5	125	60	50	350	—
San Arcacio loam	3.5	250	80	90	500	—
San Luis sandy loam	1.25	125	50	45	—	.9
San Luis sandy loam, drained	2.5	250	70	75	450	1.4
San Luis-Quamon complex	2.0	225	55	60	—	1.1
Schrader sandy loam	2.0	—	60	65	—	1.4
Shawa loam, 0 to 1 percent slopes	3.5	250	80	90	550	1.6
Shawa loam, 1 to 3 percent slopes	3.0	—	75	85	450	1.6
Stunner loam, 1 to 3 percent slopes	3.0	250	70	80	400	—
Stunner loam, 3 to 6 percent slopes	2.5	—	60	70	—	—
Torsido clay loam	2.5	—	75	85	—	1.2
Typic Fluvaquents	2.0	—	70	75	—	1.4
Typic Torrifluvents	1.0	—	65	65	—	.6
Vastine loam	1.5	—	80	90	—	1.8
Villa Grove sandy clay loam	3.0	250	75	80	500	—
Villa Grove sandy clay loam, saline	1.5	125	50	50	350	—
Zinzer loam	3.5	275	80	90	550	—
Zinzer loam, saline	1.5	125	50	50	400	—

observations of the field party made during the survey, and on records kept by farmers, agricultural specialists from various government agencies, and members of the staff of Colorado State University. These figures can be used as a general guide to the yields that can be expected on a particular soil under a high level of management. Many factors that influence the actual yields must be considered in predicting the average yields. Climate, for example, is one of the major factors that varies from year to year and also from one part of the survey area to another.

A high level of management is one that includes most of the good conservation practices needed for the particular soil. Among these practices are improved water application by land leveling; rearrangment of ditch systems; irrigating according to soil moisture needs; shorter irrigation runs or other methods of applying irrigation water; maintaining fertility through the use of barnyard manure, green-manure crops, and fertilizer; draining and leaching seeped and saline areas; controlling weeds and insects; selecting good seed; timely tillage, planting, and harvest; and preventing erosion and soil blowing.

Range [2]

Open, nonforested land in the mountains and foothills mainly in the western part of the Rio Grande County Area is used as range. Extensive acreages occur on alluvial fans above the valley floor. Smaller acreages are along major streams in the valley, where the water table is high.

[2] By T. E. MULLINGS, range conservationist, Soil Conservation Service, Durango, Colo.

Most of the range provides spring and fall grazing for cattle and sheep. Some of it is grazed during the summer. The range supplements the winter hay feeding and the summer grazing in National Forest land or other high mountain ranges.

Range is an important resource in the survey area, even though production on much of it is limited by the dry climate. In addition to livestock forage, range provides food and cover for large numbers of game animals and other wildlife.

Range sites and range condition

This soil survey gives valuable information about the potential of the soils to produce native plants. To a large degree the kind of soil determines the combination of plants that are natural to an area and the yields that can be expected. Knowledge of the native plant potential helps an operator manage the range according to his particular needs. Soils that have similar potential for range are grouped into range sites.

A range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristically natural plant community (*4, 5*). It is the product of all environmental factors responsible for its development. In the absence of abnormal disturbance and physical site deterioration, it supports an original native plant community differing from that of other range sites in terms of kind or proportion of plants, total productivity, and other significant resource values.

Range condition is the present state of vegetation on a range site as related to the climax, or original, plant community for that site.

The range site indicates the potential, and range condition represents a starting point for management toward that potential or toward the objective selected by the decision maker. The range sites in this survey are described in the paragraphs that follow.

BASALT HILLS RANGE SITE

Soils of this range site have a very stony loam or very stony sandy loam surface layer and are moderately permeable. They have a low available water capacity. Slopes are 3 to 25 percent. Precipitation is about 9 inches annually, occurring mostly as rain in April through September. The peak period is in July and August following a normal dry period in June. The dry climate and the low available water capacity are dominating influences on the kind and amount of vegetation.

The vegetation is that of the grasslands of the high mountain parks and valleys. It is dominated by Indian ricegrass. The approximate potential plant community is 40 to 50 percent Indian ricegrass; 15 to 25 percent green rabbitbrush; 10 to 15 percent squirreltail, blue grama, and three-awn; and 5 to 10 percent fourwing saltbush, winterfat, four-o'clock, and other forbs.

If the range is in excellent condition, the total annual yield is about 700 pounds per acre in years of favorable moisture and about 300 pounds in unfavorable years. Of this total yield, about 70 percent is from plants that provide forage for cattle and about 75 percent from plants that provide forage for sheep.

When this site has been grazed heavily for long periods, Indian ricegrass, squirreltail, and four-wing saltbush decrease or disappear. They are replaced by blue grama, rabbitbrush, and fringed sage. Continued heavy grazing or further deterioration permits the invasion of the site by annual weeds in favorable years and a strong increase in rabbitbrush and pricklypear.

FOOTHILL LOAM RANGE SITE

Soils of this range site have a loam surface layer and are moderately permeable. They have a high or moderate available water capacity. Slopes are 3 to 15 percent. Precipitation is about 11 to 12 inches annually, occurring mostly as rain in July through September. The higher precipitation than at the lower elevations and the high or moderate capacity of the soils to store moisture are the dominating influences on the kind and amount of vegetation. Much of this site receives runoff from other areas. On the deteriorated parts of the range, most of this run-on water is carried off by deep gullies.

The vegetation is that of the pinyon-juniper zone. It is dominated by western wheatgrass, needleandthread, and other grasses. The approximate potential plant community is 35 to 45 percent western wheatgrass; 15 to 20 percent needleandthread; 10 to 15 percent sedges, littleseed ricegrass, and blue grama; 5 to 10 percent muttongrass, slender wheatgrass, and other grasses, fourwing saltbush, rubber rabbitbrush, and currant; and 2 to 5 percent lupine and other forbs.

If the range is in excellent condition, the total annual yield is about 1,600 pounds per acre in years of favorable moisture and about 800 pounds in unfavorable years. Of this total yield, about 90 percent is from plants that provide forage for cattle and sheep.

When this site has been grazed heavily for long periods, western wheatgrass, needleandthread, and ricegrass decrease or disappear. They are replaced by blue grama and rabbitbrush. Continued heavy grazing or further deterioration permits the invasion of the site by annual weeds and sleepygrass or a strong domination by rubber rabbitbrush. Gully control, control of rubber rabbitbrush, and range deferment are needed to restore maximum productivity on parts of this site.

LIMY BENCH RANGE SITE

Soils of this range site have a loam or cobbly loam surface layer and are moderately permeable. They have a moderate or high available water capacity. Slopes are 1 to 25 percent. Precipitation is about 8 or 9 inches annually, occurring mostly as rain in April through September. The peak period is in July and August following a dry period in June. A strong lime zone near the surface and low rainfall are dominating influences on the kind and amount of vegetation.

The vegetation is that of the grasslands of the high mountain parks and valleys. It is dominated by winterfat, Indian ricegrass, squirreltail, and blue grama. The approximate potential plant community is 40 to 50 percent winterfat; 30 to 40 percent squirreltail, blue grama, and Indian ricegrass; 10 to 15 percent fourwing saltbush and green rabbitbrush; and 5 to 10 percent three-awn and perennial forbs.

If the range is in excellent condition, the total annual yield is about 800 pounds per acre in years of favorable moisture and about 300 pounds in unfavorable years. Of this total yield, about 85 percent is from plants that provide forage for cattle and sheep.

When this site has been grazed heavily for long periods, Indian ricegrass and squirreltail decrease or disappear. They are replaced by rabbitbrush and snakeweed and in some areas by blue grama. Continued heavy grazing or further deterioration permits the invasion of the site by annual weeds in favorable years and allows rabbitbrush and snakeweed to become the main perennial plants.

LOAMY PARK RANGE SITE

Soils of this range site have a cobbly loam surface layer and are moderately slowly permeable. They have a high available water capacity. Slopes are 3 to 10 percent. Precipitation is about 15 inches annually, occurring mostly as snow in December through April and as rain in July and August. A good balance of summer and winter moisture, short cool summers, and the high available water capacity are dominating influences on the kind and amount of vegetation.

The vegetation is that of the mountain grasslands. It is dominated by Parry oatgrass, mountain muhly, and Arizona fescue. The approximate potential plant community is 30 to 40 percent mountain muhly and Arizona fescue; 25 to 35 percent Parry oatgrass; 15 to 20 percent native bromegrasses, western wheatgrass, needlegrass, and other grasses and sedges; 5 to 10 percent perennial forbs; and 2 to 5 percent low shrubs.

If the range is in excellent condition, the total annual yield is about 2,000 pounds per acre in years of favorable moisture and about 1,000 pounds in unfavorable years. Of this total yield, about 85 percent is from plants that provide forage for cattle and about 70 percent from plants that provide forage for sheep.

When this site has been grazed heavily for long periods, Parry oatgrass, mountain muhly, and Arizona fescue decrease or disappear. They are replaced by western wheatgrass, needlegrasses, and junegrass, which in turn decrease as they become the main forage plants under continued heavy grazing. Further deterioration permits the invasion of the site by annual weeds and rubber rabbitbrush. Fringed sage, pussytoes, lupine, slimstem muhly, and blue grama become major plants under such conditions.

MOUNTAIN OUTWASH RANGE SITE

Soils of this range site have a loam, gravelly sandy loam, cobbly sandy loam, or cobbly loam surface layer and are moderately slowly to rapidly permeable. The available water capacity is dominantly low to moderate, but ranges to high. Slopes are 0 to 3 percent. Precipitation is about 7 or 8 inches annually, occurring mostly as rain in April through September. The peak period is in July and August following a dry period in June. Good soil drainage and low rainfall are dominating influences on the kind and amount of vegetation.

The vegetation is that of the grasslands in high mountain parks and valleys. It is dominated by blue grama, squirreltail, Indian ricegrass, and western wheat. The approximate potential plant community is 30 to 40 percent squirreltail, Indian ricegrass, western wheatgrass, and needleandthread; 20 to 30 percent blue grama; 5 to 10 percent sand dropseed, three-awn, winterfat, fourwing saltbush, and green rabbitbrush; and 2 to 5 percent perennial forbs.

If the range is in excellent condition, the total annual yield is about 800 pounds per acre in years of favorable moisture and about 300 pounds in unfavorable years. Of this total yield, about 85 percent is from plants that provide forage for cattle and sheep.

When this site has been grazed heavily for long periods, squirreltail, Indian ricegrass, western wheatgrass, and needleandthread decrease or disappear. Blue grama and green rabbitbrush increase, and snakeweed and pricklypear invade. Continued heavy grazing or further deterioration permits the invasion of the site by ring muhly and, when conditions are favorable, annual weeds. Rabbitbrush, snakeweed, and pricklypear generally are dominant plants under such conditions.

ROCKY FOOTHILLS RANGE SITE

Soils of this range site have an extremely stony loam surface layer and are moderately permeable. They have a low available water capacity. Slopes are 5 to 25 percent. Precipitation is about 12 inches annually, occurring mostly as rain in July through September. Higher precipitation than at the lower elevations but a low capacity to store moisture are dominating influences on the kind and amount of vegetation.

Vegetation is that of the pinyon-juniper zone. It is dominated by western wheatgrass, needleandthread, Indian ricegrass, muttongrass, blue grama, and pinyon pine. Pinyon pine is abundant on a few north-facing slopes, but it grows in an irregular, widely spaced pattern throughout most of the site. The approximate potential plant community is 35 to 45 percent western wheatgrass, needleandthread, and Indian ricegrass; 10 to 15 percent mountainmahogany, currant, and gooseberry; 5 to 10 percent blue grama, muttongrass, squirreltail, mountain muhly, littleseed ricegrass, fringed sage, buckwheat, Douglas rabbitbrush, pinyon pine, and forbs.

If the range is in excellent condition, the total annual yield is about 900 pounds per acre during years of favorable moisture and about 400 pounds in unfavorable years. Of this yield, about 70 percent is from plants that provide forage for cattle and sheep.

When this site has been grazed heavily for long periods, western wheatgrass, needlegrasses, ricegrasses, muttongrass, and mountainmahogany decrease or disappear. They are replaced by blue grama, fringed sage, and low forms of rabbitbrush. Continued heavy grazing or further deterioration permits the invasion of the site by annual weeds and major increases in snakeweed, rubber rabbitbrush, and pricklypear.

SALT FLATS RANGE SITE

Soils of this range site have a loam, sandy clay loam, sandy loam, and loamy sand surface layer and are rapidly to very slowly permeable. They have a low to high available water capacity. Slopes are 0 to 1 percent. Precipitation is about 7 inches annually, occurring mostly

as rain in April through September. The peak period is in July and August following a normal dry period in June. The dry climate, the salts or the alkali, and a fluctuating water table are dominating influences on the kind and amount of vegetation.

The vegetation is that of the brushlands in the San Luis Valley. It is dominated by alkali sacaton, saltgrass, greasewood, and rubber rabbitbrush. The approximate potential plant community is 45 to 55 percent alkali sacaton and saltgrass; 15 to 20 percent greasewood (chico) and rubber rabbitbrush; 10 to 15 percent western wheatgrass, alkali cordgrass, blue grama, and wire rush; 5 to 10 percent forbs; and 2 to 5 percent fourwing saltbush.

If the range is in excellent condition, the total annual yield is about 1,200 pounds per acre in years of favorable moisture and about 600 pounds in unfavorable years. Of this total yield, about 70 percent is from plants that provide forage for cattle and sheep.

When this site has been grazed heavily for long periods, alkali sacaton, alkali cordgrass, western wheatgrass, and blue grama decrease or disappear. They are replaced by saltgrass, greasewood, and rabbitbrush. Continued heavy grazing or further deterioration permits greasewood and rabbitbrush to dominate the site and make up most of the yield.

Artesian wells can be developed on most of this site where needed to improve grazing distribution. Brush management is feasible where enough desirable grasses can take advantage of released moisture.

SALT MEADOW RANGE SITE

Soils of this range site have a loam to clay loam surface layer and are moderately to moderately slowly permeable. They have a moderate or high available water capacity. Slopes are 0 to 1 percent. Precipitation is about 7 inches annually, occurring mostly as rain in April through September. The peak period is in July and August following a dry period in June. The salinity and a high water table are dominating influences on the kind and amount of vegetation.

The vegetation is that of the meadowlands in the San Luis Valley. It is dominated by alkali sacaton and other salt-tolerant grasses. The approximate potential plant community is 45 to 55 percent alkali sacaton; 20 to 25 percent alkali cordgrass, western wheatgrass, and creeping wildrye; 15 to 20 percent saltgrass, wire rush, mat muhly, Nuttall alkali-grass, and sedges; 2 to 5 percent forbs; and 0 to 5 percent greasewood.

If the range is in excellent condition, the total annual yield is about 2,500 pounds per acre in years of favorable moisture and about 1,500 pounds in unfavorable years. Of this total yield, about 90 percent is from plants that provide forage for cattle and about 60 percent from plants that provide forage for sheep.

When this site has been grazed heavily for long periods, alkali sacaton, alkali cordgrass, wheatgrasses, and creeping wildrye decrease or disappear. They are replaced by saltgrass, wire rush, mat muhly, and alkali grass. Continued heavy grazing or further deterioration permits the invasion or a strong increase of foxtail barley, scratchgrass, and arrowgrass.

Artesian wells can be developed on much of this site where needed to improve grazing distribution.

SHALLOW LOAM RANGE SITE

Soils of this range site have a very stony loam surface layer and are slowly permeable. They have a low available water capacity. Slopes are 10 to 25 percent. Precipitation is about 16 inches annually, occurring mostly as snow in December through April and as rain in July and August. A good balance of summer and winter moisture, short cool summers, but a low capacity to store moisture are dominating influences on the kind and amount of vegetation.

The vegetation is that of the mountain grasslands. It is dominated by Parry oatgrass, mountain muhly, and Arizona fescue. The approximate potential plant community is 60 to 70 percent Parry oatgrass, mountain muhly, and Arizona fescue; 15 to 20 percent pine dropseed, junegrass, and other grasses; 10 to 15 percent cinquefoil, loco, lupine, herbaceous sage, and hairy goldaster; and 5 to 10 percent other forbs.

If the range is in excellent condition, the total annual yield is about 1,200 pounds per acre in years of favorable moisture and about 600 pounds in unfavorable years. Of this total yield, about 90 percent is from plants that provide forage for cattle and about 70 percent from plants that provide forage for sheep.

When this site has been grazed heavily for long periods, Parry oatgrass, mountain muhly, Arizona fescue, and pine dropseed decrease or disappear. They are replaced by squirreltail, blue grama, fringed sage, and various forbs. Continued heavy grazing or further deterioration permits the invasion of the site by annual weeds. Rabbitbrush, fringed sage, pussytoes, and pingue are generally major plants under such conditions.

WET MEADOW RANGE SITE

Soils of this range site have a loam, clay loam, or sandy loam surface layer and are slowly to moderately rapidly permeable. They have a moderate to high available water capacity. Slopes are 0 to 3 percent. Precipitation is about 7 to 9 inches annually, occurring mostly as rain in April through September. The peak period is in July and August following a dry period in June. A high water table and salt-free soils, or nearly so, are dominating influences on the kind and amount of vegetation.

The vegetation is that of the meadowlands in the San Luis Valley. It is dominated by tufted hairgrass, sedges, wheatgrasses, and reedgrasses. The approximate potential plant community is 40 to 50 percent tufted hairgrass and Nebraska sedge; 30 to 40 percent other sedges, bluejoint reedgrass, northern reedgrass, slender wheatgrass, western wheatgrass, and wire rush; and 5 to 10 percent alkali sacaton, iris, chicher-mallow, and other forbs.

If the range is in excellent condition, the total annual yield is about 3,000 pounds per acre in years of favorable moisture and about 2,000 pounds in unfavorable years. Of this total yield, about 90 percent is from plants that provide forage for cattle and sheep.

When this site has been grazed heavily for long periods, tufted hairgrass, Nebraska sedge, and slender wheatgrass decrease or disappear. They are replaced by short sedges, wire rush, mat muhly, and iris. Continued heavy grazing or further deterioration permits

the invasion of the site by annual weeds, foxtail barley, and rabbitfoot grass and a strong increase in wire rush and iris.

Wildlife [3]

The quality and quantity of the available wildlife habitat largely determine the kinds of wildlife that are present. The soil provides food, cover, and water where wildlife can find places to feed, breed, rear young, and escape enemies. While soils are the basis for habitat and for a diversity of habitat type, two additional factors that greatly influence wildlife populations in the Rio Grande County Area are land use or management and water. The kinds and numbers of wildlife on land used for potato production differ significantly from the wildlife on land used for barley or range.

The availability of water for irrigation has permitted land use changes that have greatly affected the kinds and numbers of wildlife. Irrigation has changed substantial acreages from range to field crops, for example, potatoes, barley, and hay. The introduction of grain, and to a lesser extent forage crops, has resulted in an excellent population of waterfowl in the survey area and a fair population of pheasants.

Tables 3 and 4 show the suitability of the various soils in the Rio Grande County Area to provide the habitat elements necessary for various kinds of wildlife.

Soils directly influence the kind and amount of vegetation and the amount of water available, and in this way influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are thickness of soil useful to crops, texture of the surface layer, available water capacity, wetness, surface stoniness or rockiness, flood hazard, slope, and permeability of the soil to air and water.

In table 3, nonirrigated soils are rated for producing seven elements of wildlife habitat and four groups or kinds of wildlife. Table 4 rates irrigated soils for producing four elements of wildlife habitat and two kinds of wildlife. The ratings indicate relative suitability for various elements and are expressed as follows.

A rating of *good* means that habitat is easily improved, maintained, or created. There are few or no soil limitations in management, and satisfactory results can be expected.

A rating of *fair* means that habitat can be improved, maintained, or created, but moderate soil limitations affect management or development. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

A rating of *poor* means that habitat can be improved, maintained, or created, but soil limitations are severe. Management can be difficult and expensive and require intensive effort. 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 habitats. 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 the characteristics of the soils and closely related natural factors of the environment. They do not take into account the present use of soils or the present distribution of wildlife and people. For this reason, selection of a site for development of a habitat requires inspection at the site.

Grain and seed crops are annual grain-producing plants, such as barley and oats.

Domestic grasses and legumes are domestic grasses and legumes that are established by planting and provide food and cover for wildlife. Grasses are tall wheatgrass, meadow foxtail, Russian wildrye, reed canarygrass, and timothy. Legumes commonly used are alfalfa, sweetclover, red clover, and alsike clover.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Examples of herbaceous plants typical of the area are Indian ricegrass, western wheatgrass, alkali sacaton, blue grama, saltgrass, foxtail barley, and alkali cordgrass.

Coniferous plants are cone-bearing trees and shrubs that provide cover and frequently furnish food in the form of browse, seeds or fruit-like cones. They commonly grow in their natural environment, but they can be planted and managed. Typical plants are spruce, fir, pinyon pine, and juniper. Aspen, cottonwood, and ornamental trees and shrubs are also included.

Shrubs produce buds, twigs, bark, or foliage used as food by wildlife. They also provide cover and shade for some wildlife species. These plants most commonly grow in their natural environment. Fourwing saltbush, rabbitbrush, sagebrush, and greasewood are typical.

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. Typical examples are smartweed, tufted hairgrass, spikerush and other rushes, sedges, cattails, and northern redgrass. Submerged and floating aquatics are not included in this category.

Shallow water areas are areas of surface water, an average depth of less than 5 feet, that are useful to wildlife. They may be natural wet areas or those created by dams or levees or by water-control devices in marshes or streams. Typical examples are waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

Table 3 rates the soils according to their suitability as habitat for the four kinds of wildlife in the survey area—openland, woodland, wetland, and rangeland. Only openland and wetland are considered in table 4. In both tables the ratings under the heading "Kinds of wildlife" are closely related to those under "Elements of wildlife habitat." For example, soils rated as *very poor* for shallow water developments are likewise *very poor* for wetland wildlife.

Openland wildlife are birds and mammals of cropland, pasture, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are the greater sandhill crane, pheasant, western meadowlark, mourning dove, killdeer, cottontail, jackrabbit, and yellow-bellied marmot.

[3] ELDIE W. MUSTARD, State biologist, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Suitability of nonirrigated soils for*

Soil series and map symbols	Elements of wildlife habitat				
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs
Acacio: Aa	Very poor	Very poor	Poor		Poor
Acasco: Ac	Very poor	Poor	Good		Good
Alamosa:					
Am	Very poor	Poor	Good	Fair	Good
Ao	Poor	Poor	Poor	Poor	Fair
Arena:					
Ar	Poor	Poor	Poor		Fair
As	Poor	Poor	Poor		Fair
Celeste: CrE	Very poor	Very poor	Fair	Fair	Good
Derrick: De	Very poor	Very poor	Poor	Very poor	Poor
Dunul: Dn	Very poor	Very poor	Poor		Poor
Embargo: EmE	Very poor	Very poor	Good	Good	Fair
Empedrado	Poor	Poor	Good	Good	Good
Mapped only with Tolman soils.					
Fulcher: FrC	Poor	Fair	Good	Good	Fair
Garita: GaB, GaE	Very poor	Very poor	Poor	Very poor	Poor
Gerrard: Ge	Poor	Poor	Good	Fair	Good
Graypoint: Gr	Very poor	Very poor	Poor		Poor
Gunbarrel: Gu	Very poor	Very poor	Poor		Fair
Hooper:					
Ho	Very poor	Very poor	Very poor		Poor
Hp	Very poor	Very poor	Very poor		Poor
Jodero: Jo	Poor	Poor	Good	Fair	Good
Laney: La	Very poor	Very poor	Very poor		Poor
Luhon: LuB, LuC	Very poor	Very poor	Fair	Poor	Fair
Mishak: Mh	Poor	Poor	Good		Fair
Monte: MoA, MoB	Very poor	Very poor	Poor		Poor
Mosca: Ms	Very poor	Very poor	Poor		Fair
Norte: No	Very poor	Very poor	Fair		Fair
Platoro: PaA, PaB	Very poor	Very poor	Fair	Poor	Fair
Quamon: Qa	Very poor	Very poor	Fair		Fair
San Arcacio:					
Sa, Sc	Very poor	Very poor	Fair		Poor
Sb	Poor	Poor	Poor		Good
San Luis: Sd, Se, Sf	Poor	Poor	Good		Good
Schrader: Sh	Very poor	Poor	Good	Good	Good
Seitz: SkF	Very poor	Very poor	Good	Good	Fair
Shawa:					
SmA	Fair	Fair	Good	Good	Good
SmB	Fair	Fair	Good	Good	Good
Stunner: SnB, SnC	Very poor	Very poor	Fair	Poor	Fair
Tolman: TeE	Very poor	Very poor	Fair	Fair	Good
Torsido: To	Very poor	Poor	Good		Fair
Travelers: TrE, TsE	Very poor	Very poor	Fair	Poor	Fair
Typic Fluvaquents: Tt.	Poor	Poor	Good	Fair	Good
Typic Torrifluvents: Tu.	Very poor	Very poor	Fair	Poor	Fair
Vastine: Va	Very poor	Poor	Good		Fair
Villa Grove:					
Vg	Very poor	Very poor	Fair		Fair
Vh	Poor	Poor	Good		Good
Zinzer:					
Zn	Very poor	Very poor	Fair		Fair
Zr	Poor	Poor	Good		Good

Woodland wildlife are birds and mammals of wooded areas, either hardwood or coniferous trees and shrubs, or a mixture of both. Examples are blue grouse, band-tailed pigeon, thrush, vireo, woodpeckers, snowshoe hare, bobcat, mule deer, elk, and black bear.

Wetland wildlife are birds and mammals of swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, beaver, and raccoon.

Rangeland wildlife are birds and mammals of natural rangeland. Examples are antelope, mule deer, chukar, scaled quail, grouse, meadowlark, and lark bunting.

Recreation

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 5 the soils of Rio Grande County Area are rated

elements of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued		Kinds of wildlife			
Wetland plants	Shallow water areas	Openland	Woodland	Wetland	Rangeland
Poor	Very poor	Very poor		Very poor	Poor.
Good	Good	Poor		Good	Good.
Good	Good	Poor	Fair	Good	Good.
Good	Good	Poor	Poor	Good	Poor.
Fair	Good	Poor		Fair	Poor.
Fair	Fair	Poor		Fair	Poor.
Very poor	Very poor	Poor	Fair	Very poor	Fair.
Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Poor	Fair	Very poor	Fair.
Very poor	Very poor	Poor	Fair	Very poor	Good.
Poor	Very poor	Fair	Good	Very poor	Fair.
Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
Good	Good	Fair	Fair	Good	Good.
Very poor	Very poor	Very poor		Very poor	Poor.
Good	Good	Very poor		Good	Poor.
Fair	Good	Very poor		Fair	Very poor.
Very poor	Good	Very poor		Poor	Very poor.
Poor	Very poor	Fair	Fair	Very poor	Good.
Fair	Fair	Very poor		Fair	Very poor.
Poor	Very poor	Poor	Poor	Very poor	Fair.
Fair	Good	Fair		Fair	Fair.
Poor	Very poor	Very poor		Very poor	Poor.
Good	Good	Very poor		Good	Poor.
Fair	Fair	Poor		Fair	Fair.
Poor	Very poor	Poor	Poor	Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Poor	Fair	Very poor		Poor	Poor.
Fair	Good	Poor		Fair	Fair.
Fair	Good	Fair		Fair	Good.
Good	Good	Poor	Good	Good	Good.
Very poor	Very poor	Poor	Fair	Very poor	Fair.
Good	Fair	Fair	Good	Fair	Good.
Good	Poor	Fair	Good	Fair	Good.
Poor	Very poor	Poor	Poor	Very poor	Fair.
Very poor	Very poor	Poor	Fair	Very poor	Fair.
Good	Fair	Poor	Good	Fair	Fair.
Very poor	Very poor	Poor	Poor	Very poor	Fair.
Good	Good	Fair	Fair	Good	Good.
Very poor	Very poor	Poor	Poor	Good	Fair.
Good	Good	Poor		Good	Fair.
Poor	Fair	Poor		Poor	Fair.
Fair	Good	Fair		Fair	Good.
Poor	Very poor	Poor		Very poor	Fair.
Fair	Good	Fair		Fair	Good.

according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails.

Limitations are expressed as slight, moderate, or severe. 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 soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense 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

TABLE 4.—*Suitability of irrigated soils for elements of wildlife habitat and kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat				Kinds of wildlife	
	Grain and seed crops	Domestic grasses and legumes	Wetland plants	Shallow water areas	Openland	Wetland
Acacio: Aa	Fair	Fair	Poor	Very poor	Fair	Very poor.
Acasco: Ac	Poor	Fair	Good	Good	Fair	Good.
Alamosa:						
Am	Fair	Fair	Good	Good	Fair	Good.
Ao	Fair	Fair	Good	Good	Fair	Good.
Arena:						
Ar	Fair	Fair	Fair	Good	Fair	Fair.
As	Fair	Fair	Fair	Fair	Fair	Fair.
Derrick: De	Poor	Poor	Poor	Very poor	Fair	Very poor.
Dunul: Dn	Poor	Poor	Poor	Very poor	Fair	Very poor.
Garita: GaB	Poor	Poor	Poor	Very poor	Fair	Very poor.
Gerrard: Ge	Poor	Fair	Good	Good	Fair	Good.
Graypoint: Gr	Poor	Poor	Poor	Very poor	Fair	Very poor.
Gunbarrel: Gu	Fair	Fair	Good	Good	Fair	Good.
Hooper:						
Ho	Very poor	Very poor	Very poor	Good	Very poor	Poor.
Hp	Poor	Poor	Fair	Good	Poor	Fair.
Jodero: Jo	Fair	Fair	Poor	Very poor	Good	Very poor.
Laney: La	Fair	Fair	Fair	Fair	Fair	Fair.
Luhon:						
LuB	Fair	Fair	Poor	Very poor	Fair	Very poor.
LuC	Poor	Fair	Poor	Very poor	Fair	Very poor.
Mishak: Mh	Fair	Fair	Poor	Fair	Good	Poor.
Monte: MoA, MoB	Fair	Fair	Poor	Very poor	Good	Very poor.
Mosca: Ms	Fair	Fair	Good	Good	Good	Good.
Norte: No	Fair	Fair	Poor	Poor	Good	Poor.
Platoro: PaA, PaB	Fair	Fair	Poor	Very poor	Good	Very poor.
Quamon: Qa	Poor	Poor	Very poor	Very poor	Fair	Very poor.
San Arcacio:						
Sa, Sc	Fair	Fair	Poor	Fair	Fair	Poor.
Sb	Fair	Fair	Fair	Good	Fair	Fair.
San Luis:						
Sd	Fair	Fair	Fair	Good	Good	Fair.
Se, Sf	Fair	Fair	Fair	Good	Good	Fair.
Schrader: Sh	Fair	Fair	Good	Good	Good	Good.
Shawa:						
SmA	Fair	Fair	Good	Fair	Good	Fair.
SmB	Fair	Fair	Good	Poor	Good	Fair.
Stunner:						
SnB	Fair	Fair	Poor	Very poor	Fair	Very poor.
SnC	Poor	Fair	Poor	Very poor	Fair	Very poor.
Torsido: To	Fair	Fair	Good	Fair	Good	Fair.
Typic Fluvaquents: Tt	Fair	Fair	Good	Good	Fair	Good.
Typic Torrifluvents: Tu	Poor	Poor	Very poor	Very poor	Poor	Very poor.
Vastine: Va	Fair	Fair	Good	Good	Good	Good.
Villa Grove:						
Vg	Fair	Fair	Good	Fair	Good	Fair.
Vh	Fair	Fair	Fair	Good	Good	Fair.
Zinzer:						
Zn	Fair	Fair	Good	Fair	Good	Fair.
Zr	Fair	Fair	Fair	Good	Good	Fair.

and limited vehicular traffic. The best soils have gentle slopes, good drainage, a surface free of rocks and coarse fragments, no flooding during periods of heavy use, and a surface that is firm after rain but not dusty when dry.

Picnic areas are attractive natural or landscaped tracts that are subject to heavy foot traffic. Most of the vehicular traffic is confined to access roads. The best soils are firm when wet but not dusty when dry, are free from 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 used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, no flooding during periods of heavy use, and 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 are used for local and cross country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded no more

TABLE 5.—*Recreational facilities*

Soil name	Degree and kind of soil limitations affecting—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Acacio sandy loam	Slight	Slight	Slight	Slight.
Acasco clay loam	Severe: somewhat poorly drained to poorly drained.	Moderate or severe: somewhat poorly drained or poorly drained.	Severe: somewhat poorly drained or poorly drained.	Moderate or severe: somewhat poorly drained or poorly drained.
Alamosa loam	Severe: somewhat poorly drained or poorly drained; flood hazard.	Moderate or severe: somewhat poorly drained or poorly drained; flood hazard.	Severe: somewhat poorly drained or poorly drained; flood hazard.	Moderate or severe: somewhat poorly drained or poorly drained.
Alamosa loam, saline	Severe: poorly drained or somewhat poorly drained.	Severe: poorly drained or somewhat poorly drained.	Severe: somewhat poorly drained or poorly drained.	Moderate: poorly drained or somewhat poorly drained.
Arena loam	Severe: poorly drained; slow permeability.	Severe: poorly drained.	Severe: poorly drained; slow permeability.	Severe: poorly drained.
Arena loam, drained	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Celeste-Rock outcrop complex, 5 to 25 percent slopes.	Severe: coarse fragments.	Severe: coarse fragments.	Severe: depth to bedrock; slope; coarse fragments.	Severe: stoniness.
Derrick cobbly loam	Moderate: cobbly	Moderate: cobbly	Severe: cobbly	Moderate: cobbly.
Dunul cobbly sandy loam	Severe: cobbly	Severe: cobbly	Severe: cobbly	Severe: cobbly.
Embargo very stony loam, 10 to 25 percent slopes.	Severe: stony	Severe: stony	Severe: stony; slope	Severe: stony.
Fulcher cobbly loam, 3 to 10 percent slopes.	Moderate: slope; moderately slow permeability.	Slight or moderate: slope.	Moderate or severe: slope; coarse fragments.	Slight.
Garita cobbly loam, 1 to 3 percent slopes.	Moderate: coarse fragments.	Moderate: coarse fragments.	Severe: coarse fragments.	Moderate: coarse fragments.
Garita cobbly loam, 3 to 25 percent slopes.	Moderate or severe: coarse fragments; slope.	Moderate or severe: coarse fragments; slope.	Severe: coarse fragments.	Moderate: coarse fragments; slope.
Gerrard loam	Severe: high water table.	Severe: high water table.	Severe: high water table.	Moderate or severe: high water table.
Gravel pits	(1)	(1)	(1)	(1).
Graypoint gravelly sandy loam	Slight or moderate: coarse fragments.	Slight or moderate: coarse fragments.	Moderate or severe: coarse fragments.	Slight or moderate: coarse fragments.
Gunbarrel loamy sand	Moderate: loamy sand.	Moderate: loamy sand.	Moderate: loamy sand.	Moderate: loamy sand.
Hooper loamy sand	Moderate: loamy sand.	Moderate: loamy sand.	Moderate: loamy sand.	Moderate: loamy sand.
Hooper clay loam	Moderate: clay loam; dusty.	Moderate: clay loam; dusty.	Moderate: dusty; clay loam.	Moderate: clay loam; dusty.
Jodero loam	Slight	Slight	Slight where slopes are 0 to 2 percent; moderate where 2 to 6 percent.	Slight.
Laney loam	Moderate: dusty	Moderate: dusty	Moderate: dusty	Slight or moderate: dusty.

See footnotes at end of table.

TABLE 5.—*Recreational facilities*—Continued

Soil name	Degree and kind of soil limitations affecting—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Luhon loam, 1 to 3 percent slopes	Slight	Slight	Moderate: slope; coarse fragments.	Slight.
Luhon loam, 3 to 6 percent slopes	Slight	Slight	Moderate: slope; coarse fragments.	Slight.
Marsh	(1)	(1)	(1)	(1)
Mishak loam	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Monte loam, 0 to 1 percent slopes	Slight	Slight	Moderate: dusty	Slight.
Monte loam, 1 to 3 percent slopes	Slight	Slight	Moderate: slope; dusty.	Slight.
Mosca loamy sand	Moderate: loamy sand.	Moderate: loamy sand.	Moderate: loamy sand.	Moderate: loamy sand.
Norte gravelly sandy loam	Slight or moderate: coarse fragments.	Slight or moderate: coarse fragments.	Moderate or severe: coarse fragments.	Slight.
Norte-Dunul complex	(2)	(2)	(2)	(2).
Platoro loam, 0 to 1 percent slopes	Moderate: moderately slow permeability.	Slight	Moderate: coarse fragments; moderately slow permeability.	Slight.
Platoro loam, 1 to 3 percent slopes	Moderate: moderately slow permeability.	Slight	Moderate: coarse fragments; slope; moderately slow permeability.	Slight.
Quamon gravelly sandy loam	Moderate: coarse fragments.	Moderate: coarse fragments.	Severe: coarse fragments.	Moderate: coarse fragments.
Rock outcrop	(1)	(1)	(1)	(1).
San Arcacio sandy loam	Slight	Slight	Slight	Slight.
San Arcacio sandy loam, saline	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
San Arcacio loam	Slight or moderate: dusty.	Slight or moderate: dusty.	Slight or moderate: dusty.	Slight.
San Luis sandy loam	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
San Luis sandy loam, drained	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Slight.
San Luis-Quamon complex	(2)	(2)	(2)	(2).
Schrader sandy loam	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Seitz very stony loam, 20 to 65 percent slopes.	Severe: slope; stoniness.	Severe: slope; stoniness.	Severe: slope; stoniness.	Moderate or severe: slope; stoniness.
Shawa loam, 0 to 1 percent slopes	Slight	Slight	Slight	Slight.
Shawa loam, 1 to 3 percent slopes	Slight	Slight	Slight or moderate: slope.	Slight.
Stunner loam, 1 to 3 percent slopes	Slight	Slight	Slight or moderate: slope.	Slight.

See footnotes at end of table.

TABLE 5.—*Recreational facilities*—Continued

Soil name	Degree and kind of soil limitations affecting—			
	Camp areas	Picnic areas	Playgrounds	Paths and trails
Stunner loam, 3 to 6 percent slopes	Slight	Slight	Moderate: slope	Slight.
Terrace escarpments	(1)	(1)	(1)	(1).
Tolman-Empedrado complex, 3 to 25 percent slopes.	Moderate or severe: slope; stoniness.	Moderate or severe: slope; stoniness.	Severe: slope; coarse fragments.	Slight or severe: slope; stoniness.
Torsido clay loam	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Travelers very stony sandy loam, 3 to 25 percent slopes.	Moderate or severe: slope; stoniness.	Moderate or severe: slope; stoniness.	Severe: slope; coarse fragments.	Moderate: slope; stoniness.
Travelers-Garita complex, 5 to 25 percent slopes.	(2)	(2)	(2)	(2).
Typic Fluvaquents	Severe: high water table.	Severe: high water table.	Severe: high water table.	Moderate or severe: high water table.
Typic Torrifluvents	Severe: subject to flooding.	Moderate or severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Vastine loam	Severe: high water table.	Severe: high water table.	Severe: high water table.	Severe: high water table.
Villa Grove sandy clay loam	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Slight.
Villa Grove sandy clay loam, saline	Severe: high water table.	Severe: high water table.	Severe: high water table.	Slight or moderate: high water table.
Zinzer loam	Slight	Slight	Slight	Slight.
Zinzer loam, saline	Severe: high water table.	Severe: high water table.	Severe: high water table.	Moderate or severe: high water table.

[1] Not suited for these purposes.
[2] See individual soils for limitation.

than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Engineering

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

[4] FLAVIO R. GONZALES, engineer, Soil Conservation Service, helped prepare this section.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 6, 7, and 8, which show, respectively, estimates of soil properties significant in engineering; engineering interpretations; and engineering test data.

TABLE 6.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit is made up of two or more kinds of soil. The soils in such mapping table carefully. The symbol > means

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction less than 3 inches
				Unified	AASHTO	
	Ft	*In*				
Acacio: Aa	(1)	0–4	Sandy loam	SM	A–4	0
		4–12	Clay loam	CL or SC	A–6	0
		12–30	Loam	SM or ML	A–4, A–6, or A–7	0
		30–60	Sandy clay loam	CL or SC	A–6	0
Acasco: Ac	2–3	0–14	Heavy clay loam	CL	A–7	0–15
		14–24	Gravelly heavy clay loam	CL	A–7	5–25
		24–60	Sand and gravel	SP or GP	A–1	10–30
Alamosa:						
Am	1–2	0–9	Loam	ML	A–4	0
		9–48	Clay loam, sandy clay loam	CL	A–6	0
		48–60	Sand and gravel	SM–SP	A–1 or A–3	0
Ao	2–3	0–9	Loam	ML	A–4	0
		9–48	Clay loam	CL	A–6	0
		48–60	Sand and gravel	SM–SP	A–1 or A–3	0
Arena:						
Ar	1.5–3	0–23	Loam and fine sandy loam	SM or ML	A–4	0
		23–46	Hardpan			
		46–60	Sandy loam	SM	A–2 or A–4	0
As	2.5–5	0–23	Loam	SM or ML	A–4	0
		23–46	Hardpan			
		46–60	Sandy loam	SM	A–2 or A–4	0
Celeste: CrE Rock outcrop part is too variable to rate.	(1)	0–14	Extremely stony loam	ML	A–4	50–75
		14	Rhyolite bedrock.			
Derrick: De	(1)	0–4	Cobbly loam	SM	A–4	30–40
		4–17	Very gravelly clay loam	CL, GC, or SC	A–6	30–50
		17–60	Very gravelly and cobbly sand	GP or SP	A–1	25–45
Dunul: Dn	4–5	0–10	Cobbly sandy loam	SC–SM or SM	A–1 or A–2	25–50
		10–60	Very gravelly sand	GP or SP	A–1	25–45
Embargo: EmE	(1)	0–12	Very stony loam	ML	A–7	50–70
		12–34	Very stony clay	CH, MH, or SM	A–7	40–70
		34	Rhyolite bedrock.			
Empedrado Mapped only with Tolman soil.	(1)	0–10	Loam	ML or CL	A–4 or A–6	0–10
		10–24	Light clay loam	SC, SM, ML, or CL	A–7	0–10
		24–40	Sandy loam	SM	A–2	0–10
Fulcher: FrC	(1)	0–11	Cobbly loam	ML or CL	A–4 or A–6	15–40
		11–42	Cobbly heavy clay loam	CL	A–7	15–30
		42–60	Cobbly sandy clay loam	SC	A–2 or A–6	30–50
Garita: GaB, GaE	(1)	0–9	Cobbly loam	GM or SM	A–4	20–70
		9–60	Cobbly loam	GM or SM	A–2 or A–4	30–65

See footnotes at end of table.

significant in engineering

units may have different properties and limitations, and for this reason it is necessary to follow the instructions in the first column of this more than; the symbol < means less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plastic index	Permeability	Available water capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Risk of corrosion to—		Hydrologic group
No. 4 (4.7 mm)	No. 10 (1.3 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Untreated steel pipe	Concrete	
				Pct		*In/hr*	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*				
95–100	90–100	55–75	35–50	-------	[2] NP	2.0–6.0	0.11–0.13	7.4–7.8	2–4	Low------	Moderate or high.	High-----	B.
95–100	95–100	80–95	45–75	30–40	10–25	0.6–2.0	0.15–0.20	7.4–7.8	2–8	Moderate.			
100	100	70–90	40–65	35–50	5–20	0.6–2.0	0.13–0.16	7.9–8.4	4–8	Low.			
100	100	80–90	35–55	30–40	15–25	0.6–2.0	0.14–0.16	7.9–8.4	2–8	Low.			
90–100	85–95	75–95	60–80	40–50	15–35	0.06–0.2	0.17–0.20	6.6–7.3	0–2	High-----	High-----	Low------	C.
85–95	70–85	65–85	50–70	40–50	15–35	0.06–0.2	0.16–0.20	6.6–7.3	0–2	High.			
35–70	30–70	15–50	0–5	-------	NP	>20.0	0.04–0.06	---------	0–2	Low.			
100	100	85–95	60–75	30–40	5–10	0.6–2.0	0.16–0.18	6.6–7.3	0–2	Moderate-	Moderate or high.	Moderate-	C.
100	100	90–100	70–80	35–40	15–25	0.2–0.6	0.19–0.21	7.4–8.4	0–2	Moderate.			
80–100	70–90	35–65	5–10	-------	NP	>20.0	0.04–0.06	---------	0–2	Low.			
100	100	85–95	60–75	30–40	5–10	0.6–2.0	0.12–0.14	7.4–8.4	8–16	Moderate-	High-----	Moderate-	C.
100	100	90–100	70–80	30–40	10–25	0.2–0.6	0.14–0.18	7.4–8.4	4–16	Moderate.			
80–100	70–90	35–65	5–10	-------	NP	>20.0	0.04–0.06	---------	4–8	Low.			
100	95–100	70–90	40–75	20–35	0–10	0.06–0.20	0.08–0.10	8.5–9.0	8–30	Low------	High-----	High-----	C.
100	100	60–70	30–40	-------	NP	0.06–0.20 2.0–6.0	0.11–0.13	8–5–9.0	4–16	Low.			
100	95–100	70–95	40–75	20–35	0–10	0.06–0.20	0.12–0.14	8.5–9.0	4–8	Low------	Moderate-	Moderate-	C.
100	100	60–70	30–40	-------	NP	0.06–0.20 2.0–6.0	0.11–0.13	8.5–9.0 8.5–9.0	4–8	Low.			
85–95	80–90	70–85	50–65	30–40	5–10	0.6–2.0	0.10–0.13	7.4–7.8	0–2	Low------	Moderate-	Low------	D.
65–80	60–75	50–70	35–50	30–40	5–10	2.0–6.0	0.10–0.13	6.6–7.3	0–2	Low------	Moderate-	Low------	B.
65–80	50–75	45–70	35–55	30–40	10–20	0.6–2.0	0.11–0.14	7.9–8.4	0–2	Low.			
25–70	30–60	10–30	0–5	-------	NP	>20.0	0.04–0.06	7.4–8.4	0–2	Low.			
60–70	50–70	30–50	15–30	10–25	0–10	6.0–20.0	0.07–0.09	7.9–8.4	0–2	Low------	Moderate-	Low------	A.
40–70	30–60	10–30	0–5	-------	NP	>20.0	0.04–0.06	7.9–8.4	0–2	Low.			
90–100	85–95	70–90	50–70	40–50	10–20	0.6–2.0	0.10–0.13	6.6–7.3	0–2	Moderate-	Moderate-	Low------	C.
75–90	55–85	50–85	40–80	50–60	15–30	0.06–0.2	0.08–0.10	6.6–7.8	0–2	High.			
95–100	95–100	80–95	55–75	30–40	5–15	0.6–2.0	0.16–0.18	6.6–7.3	0–2	Low------	Moderate-	Low------	B.
95–100	75–95	65–90	45–70	40–50	15–25	0.6–2.0	0.19–0.21	6.6–7.8	0–2	Moderate.			
95–100	90–100	55–70	20–35	20–30	0–5	2.0–6.0	0.11–0.13	7.9–8.4	0–2	Low.			
90–100	80–95	70–90	50–70	30–40	5–15	0.6–2.0	0.13–0.15	7.4–7.8	0–2	Moderate-	Moderate or high.	Low------	C.
90–100	85–95	75–95	60–75	40–50	20–25	0.2–0.6	0.17–0.19	7.4–8.4	0–2	High.			
75–85	50–75	40–70	20–40	25–35	10–20	0.6–2.0	0.10–0.12	7.9–8.4	0–2	Moderate.			
50–75	40–65	35–60	35–50	25–40	5–10	0.6–2.0	0.11–0.15	7.9–8.4	0–4	Low------	High-----	Low------	B.
35–75	30–60	25–60	20–45	25–40	5–10	0.6–2.0	0.09–0.12	7.9–8.4	0–4	Low.			

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction less than 3 inches
				Unified	AASHTO	
	Ft	*In*				
Gerrard: Ge	1–1.5	0–14	Loam	ML	A–4	0–5
		14–60	Very gravelly loamy sand	GM or SM	A–1	0–10
Gravel pits: Gp. Too variable to rate.						
Graypoint: Gr	(1)	0–6	Gravelly sandy loam	SM	A–2	0–10
		6–12	Gravelly sandy clay loam	SC	A–2 or A–4	0–10
		12–18	Gravelly sandy loam	GM or GM–GC	A–1 or A–2	0–10
		18–60	Gravel and sand	GP or GM–GP	A–1	10–15
Gunbarrel: Gu	2–3	0–30	Loamy sand	SM	A–2	0
		30–60	Sand and fine gravel	SM or SM–SP	A–1 or A–2	0
Hooper:						
Ho	4–5	0–5	Loamy sand	SM	A–2	0
		5–23	Clay loam	CL	A–6 or A–7	0
		23–30	Sandy clay loam	SC	A–6	0
		30–60	Sand	SM	A–2	0
Hp	4–5	0–23	Clay loam	CL	A–6 or A–7	0
		23–30	Sandy clay loam	SC	A–6	0
		30–60	Sand	SM	A–2	0
Jodero: Jo	(1)	0–24	Loam	ML	A–4	0
		24–70	Loam and fine sandy loam	ML or SM	A–4	0
Laney: La	(1)	0–11	Loam	CL	A–6	0
		11–50	Stratified sandy loam, loam, and clay loam.	SM or ML	A–4	0
		50–60	Gravelly sand	SM or SM–SP	A–1	0
Luhon: LuB, LuC	(1)	0–47	Loam	SM, SM–SC, ML, or CL–ML	A–4	0–15
		47–60	Gravelly sandy loam	SM	A–1 or A–2	0–15
Marsh: Ma. Too variable to rate.						
Mishak: Mh	1–2	0–12	Loam stratified with sandy clay loam.	CL	A–6	0
		12–30	Loam stratified with sandy clay loam and clay loam.	CL	A–6	0
		30–60	Sandy clay loam stratified with sandy loam, loam, and clay loam.	SC or CL	A–6	0
Monte: MoA, MoB	(1)	0–60	Loam	ML	A–4	0–5
Mosca: Ms	4–5	0–6	Loamy sand	SM	A–2	0
		6–38	Sandy loam, fine sandy loam	SM	A–2 or A–4	0
		38–60	Loamy sand and sandy loam	SM	A–2	0
*Norte: No, Nr For Dunul part of Nr, see Dunul series.	3–5	0–30	Gravelly sand loam	SM or SC–SM	A–1 or A–2	0–5
		30–60	Very gravelly loamy sand	SP, GP, or SP–SM	A–1	5–15

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plastic index	Permeability	Available water capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Risk of corrosion to—		Hydrologic group
No. 4 (4.7 mm)	No. 10 (1.3 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Untreated steel pipe	Concrete	
				Pct		*In/hr*	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*				
95-100	85-100	70-95	50-75	30-40	5-10	0.6-2.0	0.16-0.18	6.6-7.8	0-2	Moderate.	High	Low	C.
40-70	30-60	15-45	10-20		NP	6.0-20.0	0.05-0.07	6.6-7.3	0-2	Low.			
60-80	55-75	35-50	15-30	20-35	5-10	2.0-6.0	0.10-0.12	7.4-7.8	0-2	Low	Low	Low	B.
65-80	55-75	45-70	20-40	30-40	10-20	0.6-2.0	0.14-0.16	7.4-7.8	0-2	Moderate.			
40-50	20-40	10-30	5-15	20-30	0-10	6.0-20.0	0.07-0.09	7.9-8.4	0-2	Low.			
24-45	20-40	10-30	0-10		NP	>20.0	0.03-0.05	7.9-8.4	0-2	Low.			
90-100	90-100	50-75	15-30		NP	6.0-20.0	0.07-0.09	7.9-9.0	0-8	Low	Moderate or high.	Low	A.
75-90	65-80	40-60	5-15		NP	6.0-20.0	0.03-0.05	7.9-8.4	0-2	Low.			
100	95-100	50-75	15-30		NP	2.0-6.0	0.06-0.08	>9.0	0-4	Low	Moderate.	Low	D.
100	100	85-95	65-90	30-45	10-20	<0.06	0.04-0.06	>9.0	4-8	High.			
100	100	80-90	35-50	30-40	10-20	0.6-2.0	0.06-0.08	>9.0	2-4	Low.			
95-100	90-100	50-70	10-20		NP	6.0-20.0	0.03-0.05	>9.0	0-4	Low.			
100	100	85-95	65-90	30-45	10-20	<0.06	0.04-0.06	>9.0	4-8	High	Moderate.	Low	D.
100	100	80-90	35-50	30-40	10-20	0.6-2.0	0.06-0.08	>9.0	2-4	Low.			
95-100	90-100	50-70	10-20		NP	6.0-20.0	0.03-0.05	>9.0	0-4	Low.			
95-100	90-100	75-95	55-75	30-40	5-10	0.6-2.0	0.16-0.18	7.4-7.8	0-2	Low	High	Low	B.
95-100	90-100	75-90	45-65	20-35	0-10	0.6-2.0	0.14-0.17	7.9-8.4	0-2	Low.			
100	100	70-85	50-65	25-35	10-20	0.6-2.0	0.16-0.18	>9.0	4-16	Moderate.	High	Low	B.
95-100	95-100	65-80	40-60	20-35	0-10	0.6-2.0	0.10-0.12	8.5-9.0	4-8	Low to moderate.			
60-80	50-75	25-50	5-15		NP	6.0-20.0	0.04-0.06	8.5-9.0	4-8	Low.			
85-95	70-95	60-90	45-70	25-35	5-10	0.6-2.0	0.15-0.17	7.9-8.4	0-4	Low	High	Low	B.
70-85	55-70	35-50	15-30	20-30	0-5	0.6-2.0	0.07-0.09	7.9-8.4	0-4	Low.			
100	95-100	80-95	50-75	30-40	10-20	0.6-2.0	0.08-0.11	>9.0	8-30	Moderate.	High	Moderate.	C.
100	95-100	80-95	50-65	30-40	10-20	0.6-2.0	0.08-0.11	7.9-8.4	8-30	Moderate.			
100	95-100	80-95	35-60	30-40	10-20	0.6-2.0	0.13-0.15	7.9-8.4	8-16	Moderate.			
95-100	90-100	75-95	55-75	30-40	5-10	0.6-2.0	0.16-0.18	7.9-8.4	0-2	Low	Moderate.	Low	B.
95-100	90-100	50-75	10-30		NP	6.0-20.0	0.06-0.08	7.9-8.4	0-4	Low	High	Low	B.
100	95-100	60-75	25-40	0-15	0-5	2.0-6.0	0.11-0.13	8.5-9.0	2-8	Low.			
90-100	80-90	55-70	15-35		NP	6.0-20.0	0.07-0.09	>9.0	0-4	Low.			
60-90	55-85	35-60	15-30	10-30	0-10	2.0-6.0	0.09-0.11	7.9-8.4	0-2	Low	Moderate.	Low	A.
40-70	25-65	10-35	0-10		NP	>20.0	0.04-0.06	7.9-8.4	0-2	Low.			

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction less than 3 inches
				Unified	AASHTO	
	Ft	*In*				
Platoro: PaA, PaB	(1)	0–7	Loam	SC–SM, ML, SM	A–4	0–10
		7–18	Clay loam	CL	A–6	0–10
		18–26	Very gravelly loam	GM	A–1 or A–2	10–25
		26–60	Very gravelly sand	SP or GP	A–1	25–40
Quamon: Qa	3–5	0–16	Gravelly sandy loam	SM or SC–SM	A–1 or A–2	0–5
		16–60	Very gravelly sand	SP, GP, or SP–SM	A–1	5–15
Rock outcrop: Ro. Too variable to rate.						
San Arcacio:						
Sa	3–5	0–8	Sandy loam	SM	A–2 or A–4	0
		8–18	Sandy clay loam	SC	A–6	0
		18–25	Gravelly sandy loam	GM or SM	A–1	0–10
		25–60	Gravelly sand	GP or GM–GP	A–1	5–15
Sb	1.5–4	0–8	Sandy loam	SM	A–2 or A–4	0
		8–18	Sandy clay loam	SC	A–6	0
		18–25	Gravelly sandy loam	GM or SM	A–1	0–10
		25–60	Gravelly sand	GP or GM–GP	A–1	10–15
Sc	4–5	0–8	Loam	ML	A–4	0
		8–18	Sandy clay loam	SC	A–6	0
		18–25	Gravelly sandy loam	GM or SM	A–1	0–10
		25–60	Gravelly sand	GP or GM–GP	A–1	10–15
*San Luis:						
Sd	2–3	0–6	Sandy loam	SM	A–2 or A–4	0
		6–24	Clay loam or sandy clay loam	SC or CL	A–6	0
		24–60	Sand and gravel	SM or SM–SP	A–1	0
Se, Sf. For Quamon part of Sf, see Quamon series.	3–5	0–6	Sandy loam	SM	A–2 or A–4	0
		6–24	Clay loam or sandy clay loam	SC or CL	A–6	0
		24–60	Sand and gravel	SM or SM–SP	A–1	0
Schrader: Sh	1–2	0–7	Sandy loam	SM	A–2 or A–4	0
		7–60	Fine sandy loam and loam	SM or ML	A–4	0
Seitz: SkF	(1)	0–14	Very stony very fine sandy loam	ML or SM	A–4	45–75
		14–32	Very stony clay	MH or CH	A–7	45–75
		32–60	Very stony clay loam	CL	A–7	50–80
Shawa: SmA, SmB	(1)	0–60	Loam	ML	A–4	0
Stunner: SnB, SnC	(1)	0–7	Loam	ML	A–4	0–10
		7–25	Clay loam	CL	A–6	0–5
		25–60	Loam	ML or SM	A–4	0–10
Terrace escarpments: Ta. Too variable to rate.	(1)					

See footnotes at end of table.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plastic index	Permeability	Available water capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Risk of corrosion to—		Hydrologic group
No. 4 (4.7 mm)	No. 10 (1.3 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Untreated steel pipe	Concrete	
				Pct		*In/hr*	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*				
80–95	70–85	60–80	40–60	25–35	5–10	0.6–2.0	0.16–0.18	7.9–8.4	0–2	Low	High	Low	B.
85–95	80–90	70–85	50–65	30–40	10–20	0.2–0.6	0.19–0.21	7.9–8.4	0–2	Moderate.			
50–60	30–40	25–40	20–30	15–30	0–5	0.2–0.6	0.09–0.11	7.9–8.4	0–2	Low.			
40–70	30–60	10–30	0–5		NP	>20.0	0.03–0.05	7.9–8.4	0–2	Low.			
60–85	55–75	35–50	15–30	10–30	0–10	2.0–6.0	0.09–0.11	7.9–8.4	0–2	Low	Moderate	Low	A.
40–70	20–60	10–30	0–10		NP	>20.0	0.04–0.06	7.9–8.4	0–2	Low.			
90–95	85–95	50–65	25–40		NP	2.0–6.0	0.11–0.17	7.9–8.4	0–4	Low	High	Low	B.
90–95	85–95	70–85	35–50	30–40	10–20	0.6–2.0	0.14–0.16	7.9–8.4	0–4	Moderate.			
40–65	25–45	15–30	10–20		NP	2.0–6.0	0.07–0.09	7.9–8.4	0–4	Low.			
25–45	20–40	10–30	0–10		NP	>20.0	0.04–0.06	7.9–8.4	0–4	Low.			
90–95	85–95	50–65	25–40		NP	2.0–6.0	0.08–0.11	7.9–8.4	4–16	Low	High	Low	B.
90–95	85–95	70–85	35–50	30–40	10–20	0.6–2.0	0.11–0.14	7.9–8.4	4–16	Moderate.			
40–65	25–45	15–30	10–20		NP	2.0–6.0	0.07–0.09	7.9–8.4	4–8	Low.			
25–45	20–40	10–30	0–10		NP	>20.0	0.04–0.06	7.9–8.4	0–4	Low.			
100	100	85–95	60–75	30–40	5–10	0.6–2.0	0.16–0.18	7.9–8.4	0–4	Moderate	High	Low	B.
100	95–100	75–90	35–50	30–40	10–20	0.6–2.0	0.14–0.16	7.9–8.4	0–4	Moderate.			
40–65	25–45	15–30	10–20		NP	2.0–6.0	0.07–0.09	7.9–8.4	0–4	Low.			
25–45	20–40	10–30	0–10		NP	>20.0	0.07–0.06	7.9–8.4	0–4	Low.			
100	100	60–70	30–45	10–20	NP	2.0–6.0	0.08–0.10	8.5–9.0	4–30	Low	High	Moderate	B.
100	100	80–95	40–75	30–40	10–25	0.2–0.6	0.13–0.16	8.5–7.9	4–30	Moderate.			
75–90	65–80	35–50	5–15		NP	6.0–20.0	0.04–0.06	8.5–9.0	2–8	Low.			
100	100	60–70	30–45	10–20	NP	2.0–6.0	0.11–0.13	8.5–9.0	2–4	Low	Moderate	Moderate	B.
100	100	80–95	40–75	30–40	10–25	0.2–0.6	0.16–0.18	8.5–9.0	2–4	Moderate.			
75–90	65–80	35–50	5–15		NP	6.0–20.0	0.04–0.06	8.5–9.0	2–4	Low.			
100	100	60–70	30–40	10–20	NP	2.0–6.0	0.11–0.13	7.4–7.8	0–4	Low	Moderate	Low	B.
100	100	75–90	45–60		NP	2.0–6.0	0.14–0.17	6.6–7.3	0–4	Low.			
70–85	65–80	50–75	40–65	20–30	0–10	0.6–2.0	0.08–0.10	6.6–7.3	0–2	Low	Moderate	Moderate	B.
70–85	65–80	55–80	50–75	50–60	20–30	0.06–0.2	0.10–0.12	6.6–7.3	0–2	Moderate.			
70–85	65–80	60–80	50–65	40–50	15–25	0.2–0.6	0.12–0.14	6.6–7.3	0–2	Moderate.			
100	100	85–95	60–75	30–40	0–10	0.6–2.0	0.16–0.18	6.6–7.8	0–2	Low	Moderate	Low	B.
90–100	80–100	70–95	50–75	25–35	0–10	0.6–2.0	0.16–0.18	6.6–7.3	0–2	Low to moderate.	Moderate	Low	B.
90–100	85–100	75–100	60–80	30–40	10–20	0.6–2.0	0.19–0.21	7.4–8.4	0–4	Moderate.			
85–100	75–100	65–95	45–75	25–35	0–10	0.6–2.0	0.14–0.16	7.9–8.4	0–2	Low to moderate.			

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction less than 3 inches
				Unified	AASHTO	
	Ft	*In*				
*Tolman: TeE	(1)	0–12	Very stony loam and very cobbly clay loam.	CL or SC	A–6	50–75
For Empedrado part, see Empedrado series.		12	Rhyolite bedrock.			
Torsido: To	1–2	0–6	Clay loam	CL	A–6	0–5
		6–19	Clay loam	CL or SC	A–6	0–5
		19–30	Loam	ML, CL, SM, or SC	A–4 or A–6	0–10
		30–60	Very gravelly sand	GP or SP	A–1	25–40
*Travelers: TrE, TsE	(1)	0–16	Very stony loam	ML	A–4	35–75
For Garita part of TsE, see Garita series.		16	Basalt bedrock.			
Typic Fluvaquents: Tt	1–2	0–36	Loam and clay loam	CL	A–6	0
		36–60	Sand and gravel	SM or SP–SM	A–1 or A–3	0–10
Typic Torrifluvents: Tu	2–3	0–15	Gravelly sandy loam	SM	A–1 or A–2	10–35
		15–60	Gravel and sand	GP or SP	A–1	15–40
Vastine: Va	1–2	0–34	Clay loam and loam	CL or ML	A–4 or A–6	0
		34–60	Sand and gravel	SM or SM–SP	A–1, A–3, or A–2	0
Villa Grove:						
Vg	(1)	0–8	Sandy clay loam	SC	A–6	0
		8–37	Clay loam	CL	A–6	0
		37–60	Gravelly sandy loam	SM	A–2	0
Vh	2–5	0–8	Sandy clay loam	SC	A–6	0
		8–37	Clay loam	CL	A–6	0
		37–60	Gravelly sandy loam	SM	A–2	0
Zinzer:						
Zn	(1)	0–42	Loam and sandy clay loam	SC or CL	A–6	0
		42–60	Sand and gravel	SM or SM–SP	A–1 or A–3	0
Zr	2–5	0–42	Loam and sandy clay loam	SC or CL	A–6	0
		42–60	Sand and gravel	SM or SM–SP	A–1 or A–3	0

[1] No water table within depth of at least 5 feet.
[2] Nonplastic.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 6 and 7, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science that may not be familiar to engineers. The Glossary defines many terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system *(2)* used by the SCS engineers and others and the AASHTO system *(1)* adopted by the American Association of State Highway and Transportation Officials.

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plastic index	Permeability	Available water capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Risk of corrosion to—		Hydrologic group
No. 4 (4.7 mm)	No. 10 (1.3 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)								Untreated steel pipe	Concrete	
				Pct		*In/hr*	*In/in of soil*	*pH*	*Mmhos/cm at 25° C*				
75–85	60–75	50–70	40–60	30–40	10–20	0.6–2.0	0.11–0.13	6.6–7.3	0–2	Low	Moderate	Low	D.
90–100	85–100	70–95	50–75	30–40	10–20	0.6–2.0	0.16–0.18	6.6–7.3	0–2	Moderate	High	Low	C.
80–95	75–90	70–90	45–70	30–40	10–20	0.6–2.0	0.19–0.21	6.6–7.3	0–2	Moderate.			
75–90	70–85	60–80	40–65	30–40	5–15	0.6–2.0	0.14–0.16	6.6–7.3	0–2	Moderate.			
40–70	30–60	10–30	0–5	-------	NP	>20.0	0.03–0.05	6.6–7.3	0–2	Low.			
80–90	75–85	65–80	50–65	20–35	0–10	0.6–2.0	0.11–0.13	7.9–8.4	0–2	Low	Low	Low	D.
100	100	85–95	55–80	30–40	10–20	0.2–2.0	0.12–0.16	7.9–9.0	2–8	Moderate	High	Moderate	C.
80–100	70–90	35–65	5–10	-------	NP	>20.0	0.04–0.06	7.4–8.4	0–4	Low.			
75–90	65–75	35–50	20–30	-------	NP	2.0–6.0	0.07–0.09	7.4–8.4	0–2	Low	Low	Low	A.
30–80	25–75	15–50	0–5	-------	NP	>20.0	0.03–0.05	7.4–8.4	0–2	Low.			
100	100	85–95	60–75	30–40	5–20	0.6–2.0	0.16–0.21	7.4–7.8	0–4	Moderate	High	Moderate	C.
95–100	85–95	40–65	5–15	-------	NP	6.0–20.0	0.04–0.08	7.4–7.8	0–4	Low.			
100	100	80–90	35–50	30–40	10–20	0.6–2.0	0.14–0.16	7.4–7.8	0–4	Moderate	Moderate	Low	B.
100	100	80–95	60–80	30–40	15–25	0.2–0.6	0.17–0.19	7.4–8.4	0–4	Moderate.			
75–90	60–85	35–60	20–35	-------	NP	2.0–6.0	0.07–0.09	7.9–8.4	0–4	Low.			
100	100	80–90	35–50	30–40	10–20	0.6–2.0	0.11–0.13	7.9–9.0	4–16	Moderate	High	Low	C.
100	100	80–95	60–80	30–40	15–25	0.2–0.6	0.12–0.16	7.9–9.0	4–16	Moderate.			
75–90	60–85	35–60	20–35	-------	NP	2.0–6.0	0.07–0.09	7.9–8.4	0–4	Low.			
100	85–100	70–90	45–65	30–40	10–20	0.6–2.0	0.14–0.18	7.9–8.4	0–4	Low	Moderate	Low	B.
95–100	75–90	40–65	0–10	-------	NP	6.0–20.0	0.04–0.06	7.9–8.4	0–4	Low.			
100	85–100	70–90	45–65	30–40	10–20	0.6–2.0	0.12–0.14	7.9–9.0	4–30	Low	High	Low	C.
95–100	75–90	40–65	0–10	-------	NP	6.0–20.0	0.04–0.06	7.9–8.4	0–4	Low.			

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soil, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL–ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is classified in one of seven basic groups ranging from A1- through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils which have high bearing strength and are the best soils for subgrade or foundation. At the other extreme, in group A–7, are clay soils, which have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1-b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit is made up of two or more kinds of soil. The soils instructions in the first

Soil series and map symbols	Suitability as a source of—				Limitation for—	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites with basements
Acacio: Aa	Good	Unsuitable	Unsuitable	Fair to poor: mostly ML, and CL with PI [1] over 15; low strength.	Slight or moderate: moderate permeability.	Moderate: high gypsum content.
Acasco: Ac	Fair: clay loam.	Good below a depth of 2 feet.	Good below a depth of 2 feet.	Fair: frost action.	Severe: water table at a depth of 2 to 3 feet.	Moderate or severe: water table at a depth of 2 to 3 feet; frost action.
Alamosa: Am	Good	Fair below a depth of 4 feet; excess fines.	Fair below a depth of 4 feet; excess fines.	Fair to poor: ML and CL with PI over 15; low strength.	Severe: water table at a depth of 1 foot to 2 feet; moderately slow permeability.	Severe: water table at a depth of 1 foot to 2 feet; frost action.
Ao	Poor: salts	Fair below a depth of 4 feet; excess fines.	Fair below a depth of 4 feet; excess fines.	Fair to poor: ML and CL with PI over 15; low strength.	Severe: water table at a depth of 2 to 3 feet; moderately slow permeability.	Moderate or severe: water table at a depth of 2 to 3 feet; frost action.
Arena: Ar	Poor: salts	Poor or unsuitable: excess fines.	Unsuitable	Fair: frost action.	Severe: water table at a depth of 1½ to 3 feet; slow permeability.	Severe: water table at a depth of 1½ to 3 feet; frost action.
As	Poor: salts; hardpan.	Poor or unsuitable: excess fines.	Unsuitable	Fair: frost action.	Severe: water table at a depth of 2½ to 5 feet; slow permeability.	Moderate: water table at a depth of 2½ to 5 feet; frost action.
Celeste: CrE Rock outcrop part too variable to rate.	Poor: extremely stony.	Unsuitable	Unsuitable	Poor: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.
Derrick: De	Poor: cobbles and gravel.	Good	Good	Good	Slight	Slight
Dunul: Dn	Poor: cobbles and gravel.	Good	Good	Good	Slight	Slight

See footnote at end of table.

interpretations

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

Soil features affecting—					
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation
		Reservoir area	Embankments		
High gypsum content; frost hazard.	High gypsum content; subject to piping; slope is 0 to 1 percent.	High gypsum content; subject to piping.	High gypsum content; subject to piping; fair to good compaction characteristics.	Moderate permeability.	High available water capacity; slope is 0 to 1 percent.
High shrink-swell potential; water table at a depth of 2 to 3 feet; frost action.	Sand and gravel at a depth of 1⅔ to 3 feet; heavy clay loam; slow permeability.	Water table at a depth of 2 to 3 feet; slow permeability.	Low permeability of upper 2 feet when compacted; fair to good compaction characteristics.	Water table at a depth of 2 to 3 feet; sand and gravel at a depth of 1⅔ to 3 feet.	Slow permeability above sand and gravel at a depth of 1⅔ to 3 feet; water table at a depth of 2 to 3 feet.
Water table at a depth of 1 foot to 2 feet; frost action.	Slope is 0 to 1 percent; loam and clay loam; moderately slow permeability.	Water table at a depth of 1 foot to 2 feet; moderately slow permeability.	Fair to good compaction characteristics; low permeability when compacted.	Water table at a depth of 1 foot to 2 feet; moderately slow permeability.	Moderately slow permeability; water table at a depth of 1 foot to 2 feet; high available water capacity.
Water table at a depth of 2 to 3 feet; frost action.	Moderate or high salinity; slope is 0 to 1 percent; moderately slow permeability.	Water table at a depth of 2 to 3 feet; moderately slow permeability.	Fair to good compaction characteristics; low permeability when compacted.	Water table at a depth of 2 to 3 feet; moderately slow permeability; moderate or high salinity.	Drainage and leaching needed; water table at a depth of 2 to 3 feet; saline; moderately slow permeability.
Water table at a depth of 1½ to 3 feet; frost action.	High salinity; alkali soil; slope is 0 to 1 percent; slow permeability.	Water table at a depth of 1½ to 3 feet; slow permeability.	Fair to poor compaction characteristics; medium to low permeability when compacted.	Slow permeability; salinity; alkali soil.	Drainage and leaching needed; water table at a depth of 1½ to 3 feet; saline and alkali soil.
Water table at a depth of 2½ to 5 feet; frost action.	Slope is 0 to 1 percent; moderate salinity; slow permeability.	Water table at a depth of 2½ to 5 feet; slow permeability.	Fair to poor compaction characteristics; medium to low permeability when compacted.	Slow permeability; moderate salinity; alkali soil; existing drainage.	Existing drainage; slow permeability; moderate salinity.
Shallow to bedrock; steep slopes.	Shallow to bedrock; extremely stony; slope is 5 to 25 percent.	Shallow to bedrock; slope is 5 to 25 percent.	Shallow to bedrock; extremely stony.	Not needed	Bedrock at a depth ⅚ foot to 1⅔ feet; slope is 5 to 25 percent; extremely stony.
Good stability; nearly level.	Gravel and cobbles at a depth of ½ to ⅚ foot; very rapid permeability in gravelly material.	Shallow to gravel and cobbles; very rapid permeability in gravel and cobbles.	High permeability; shallow to gravel and cobbles.	Not needed; gravel and cobbles at a depth of ½ to ⅚ foot.	Gravel and cobbles at a depth of ⅚ foot to 1⅔ feet; moderate or low available water capacity; cobbly surface.
Good stability; nearly level.	Gravel and cobbles at a depth of ½ to ⅚ foot; very rapid permeability in gravelly material.	Shallow to gravel and cobbles; very rapid permeability in gravel and cobbles.	High permeability; shallow to gravel and cobbles.	Not needed; gravel and cobbles at a depth of ½ to ⅚ foot.	Gravel and cobbles at a depth of ⅚ foot to 1⅔ feet; low available water capacity; cobbly surface.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Limitation for—	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites with basements
Embargo: EmE	Poor: very stony.	Unsuitable	Unsuitable	Poor: high shrink-swell; very stony.	Severe: slow permeability; slope is 10 to 25 percent; very stony.	Severe: frost action; high shrink-swell.
Empedrado Mapped only with Tolman soil.	Good	Unsuitable	Unsuitable	Fair: ML, CL, SC, and SM; low strength.	Slight or moderate: slope is 3 to 15 percent.	Slight if slope is 3 to 8 percent; moderate if 8 to 15 percent.
Fulcher: FrC	Poor: cobbly	Unsuitable	Unsuitable	Poor: mostly CL with PI over 15; low strength.	Moderate: moderately slow permeability.	Severe: high shrink-swell.
Garita:						
GaB	Poor: cobbles and gravel.	Poor: GM or SM; excess fines.	Poor: GM or SM; excess fines.	Fair: 20 to 50 percent fines; low strength.	Slight	Slight
GaE	Poor: cobbles and gravel.	Poor: GM or SM; excess fines.	Poor: GM or SM; excess fines.	Fair: 20 to 50 percent fines; low strength; slope is 3 to 25 percent.	Slight if slope is 3 to 8 percent; moderate if 8 to 15 percent; severe if 15 to 25 percent.	Slight if slope is 3 to 8 percent; moderate if 8 to 15 percent; severe if 15 to 25 percent.
Gerrard: Ge	Good	Poor: GM or SM; excess fines.	Poor: GM or SM; excess fines.	Good	Severe: water table at a depth of 1 foot to 1½ feet.	Severe: water table at a depth of 1 foot to 1½ feet.
Gravel pits: Gp. Too variable to rate.						
Graypoint: Gr	Fair: gravelly	Good	Good	Good	Slight	Slight
Gunbarrel: Gu	Poor: loamy sand.	Fair or poor: SM or SM-SP; excess fines.	Unsuitable	Good	Severe: water table at a depth of 2 to 3 feet.	Moderate or severe: water table at a depth of 2 to 3 feet; frost action.

See footnote at end of table.

interpretations—Continued

Soil features affecting—					
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation
		Reservoir area	Embankments		
High shrink-swell; slope is 10 to 25 percent.	Stony; slope is 10 to 25 percent; slow permeability.	Slope is 10 to 25 percent; slow permeability.	Stony; poor compaction characteristics; low permeability; high shrink-swell.	Not needed; slope is 10 to 25 percent; slow permeability.	Slope is 10 to 25 percent; slow permeability; very stony soil; low available water capacity.
Good stability; slope is 3 to 15 percent.	Slope is 3 to 15 percent; moderate permeability.	Slope is 3 to 15 percent; moderate permeability.	Medium or low permeability when compacted; fair to good compaction characteristics.	Not needed	Slope is 3 to 15 percent; moderate available water capacity; moderate permeability.
High shrink-swell	Cobbly; slope is 3 to 10 percent; slow permeability.	Moderately slow permeability.	Cobbly; fair to good compaction characteristics; low permeability.	Not needed; moderately slow permeability; slope is 3 to 10 percent.	Slope is 3 to 10 percent; moderately slow permeability; cobbly surface.
Good stability	Cobbly; moderate permeability.	Moderate permeability.	Cobbly; fair to good compaction characteristics; medium to low permeability when compacted.	Not needed; moderate permeability.	Cobbly surface layer; moderate permeability; moderate or high available water capacity.
Good stability; slope is 3 to 25 percent.	Cobbly; slope is 3 to 25 percent.	Moderate permeability; slope is 3 to 25 percent.	Cobbly; fair to good compaction characteristics; medium to low permeability when compacted.	Not needed; slope is 3 to 25 percent.	Slope is 3 to 25 percent; cobbly; moderate permeability.
High water table; frost action.	Sand and gravel at a depth of 1 foot to 1⅔ feet; moderate permeability.	Water table at a depth of 1 foot to 1½ feet; moderate permeability at the surface; rapid permeability below a depth of 1 foot to 1⅔ feet.	Fair to good compaction characteristics; medium to low permeability when compacted.	Water table at a depth of 1 foot to 1½ feet; sand and gravel at a depth of 1 foot to 1⅔ feet.	Drainage needed; water table at a depth of 1 foot to 1½ feet; moderate available water capacity.
Good stability	Gravel and sand at a depth of ⅚ foot to 1⅔ feet; very rapid permeability in gravel and sand.	Gravel and sand at a depth of ⅚ foot to 1⅔ feet; very rapid permeability in gravel and sand.	Shallow to gravel and sand; fair to good compaction characteristics; medium to high permeability.	Not needed; sand and gravel at a depth of ⅚ foot to 1⅔ feet.	Sand and gravel at depth of ⅚ foot to 1⅔ feet; low available water capacity.
High water table; frost action.	Rapid permeability; slope is 0 to 1 percent.	Rapid permeability; water table at a depth of 2 to 3 feet.	Fair to good compaction characteristics; medium to high permeability when compacted.	Water table at a depth of 2 to 3 feet; rapid permeability.	Rapid permeability; water table at a depth of 2 to 3 feet; low available water capacity; high wind erosion hazard.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Limitation for—	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites with basements
Hooper: Ho	Poor: loamy sand; alkali.	Unsuitable to a depth of 2½ feet. Poor below a depth of 2½ feet; SM; excess fines.	Unsuitable	Poor to a depth of 2½ feet; good below that depth.	Moderate: water table at a depth of of 4 to 5 feet.	Severe: shrink-swell.
Hp	Poor: alkali	Unsuitable to a depth of 2½ feet. Poor below a depth of 2½ feet; SM; excess fines.	Unsuitable	Poor to a depth of 2½ feet; good below that depth; low strength.	Moderate: water table at a depth 4 to 5 feet.	Severe: shrink-swell.
Jodero: Jo	Good	Unsuitable	Unsuitable	Fair: ML or SM with over 45 percent fines; low strength.	Slight	Slight
Laney: La	Poor: salts and alkali.	Fair or poor below a depth of 4⅙ feet; SM or SM-SP; excess fines.	Fair or poor below a depth of 4⅙ feet; SM or SM-SP; excess fines.	Fair: mostly SM and ML; low strength.	Slight	Slight
Luhon: LuB, LuC	Good	Unsuitable	Unsuitable	Fair: mostly ML and SM with over 50 percent fines; low strength.	Slight	Slight
Marsh: Ma. Too variable to rate.						
Mishak: Mh	Poor: salts	Unsuitable	Unsuitable	Poor: frost action.	Severe: water table at a depth of 1 foot to 2 feet.	Severe: water table at a depth of 1 foot to 2 feet; frost action.
Monte: MoA, MoB	Good	Unsuitable	Unsuitable	Fair: ML; low strength.	Slight	Slight
Mosca: Ms	Poor: loamy sand.	Poor: SM; excess fines.	Unsuitable	Good	Moderate: water table at a depth of 4 to 5 feet.	Moderate: water table at a depth of 4 to 5 feet.

interpretations—Continued

Soil features affecting—					
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation
		Reservoir area	Embankments		
High shrink-swell; alkali; nearly level; frost action.	Very slow permeability in subsoil; alkali; sand and gravel at a depth of 1⅔ to 3½ feet.	Very slow permeability in subsoil; alkali; sand and gravel at a depth of 1⅔ to 3½ feet.	High shrink-swell; low permeability; fair to good compaction characteristics.	Very slow permeability; alkali.	Very slow permeability; alkali; low available water capacity.
High shrink-swell; alkali; nearly level; frost action.	Very slow permeability; alkali; difficult to establish vegetation; sand and gravel at a depth of 1⅔ to 3½ feet.	Very slow permeability; alkali; sand and gravel at a depth of 1⅔ to 3½ feet.	High shrink-swell; low permeability; fair or good compaction characteristics.	Very slow permeability; alkali.	Very slow permeability; alkali; low available water capacity; very slow intake rate.
Good stability	Slope is 0 to 6 percent; moderate permeability.	Moderate permeability; slope is 0 to 6 percent.	Fair or poor compaction characteristics; medium to low permeability when compacted.	Moderate permeability; slope is 0 to 6 percent.	Slope is 0 to 6 percent; high available water capacity; moderate permeability.
Nearly level; alkali	Moderate or high salinity; moderate permeability; slope is 0 to 1 percent.	Moderate permeability.	Fair or poor compaction characteristics; medium or low permeability when compacted.	Moderate or high salinity; moderate permeability.	Moderate or high salinity; moderate permeability; moderate available water capacity.
Good stability	Moderate permeability; slope is 1 to 6 percent.	Moderate permeability; slope is 1 to 6 percent.	Fair to poor compaction characteristics; medium to low permeability when compacted.	Moderate permeability.	Moderate permeability; high available water capacity.
High water table; frost action.	High salinity; alkali; moderate permeability; slope is 0 to 1 percent.	Water table at a depth of 1 foot to 2 feet; saline and alkali; moderate permeability.	Fair to good compaction characteristics; low permeability when compacted.	Water table at a depth of 1 foot to 2 feet; high salinity; moderate permeability.	Water table at a depth of 1 foot to 2 feet; high salinity; moderate permeability.
Nearly level to gently sloping; fair stability.	Moderate permeability; slope is 0 3 percent.	Moderate permeability; slope is 0 to 3 percent.	Fair to poor compaction characteristics; medium to low permeability when compacted.	Moderate permeability.	High available water capacity.
Nearly level; frost action.	Moderately rapid permeability; high soil blowing hazard; slope is 0 to 1 percent.	Moderately rapid permeability.	Fair to good compaction characteristics; medium to low permeability when compacted.	Water table at a depth of 4 to 5 feet; moderately rapid permeability; nearly level.	High soil blowing hazard; moderate available water capacity; moderately rapid permeability.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Limitation for—	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites with basements
*Norte: No, Nr. For Dunul part of Nr, see Dunul series.	Fair: gravelly	Poor above 2½ feet: excess fines. Good or fair below a depth of 2½ feet.	Poor above 2½ feet: excess fines. Good or fair below a depth of 2½ feet: excess fines.	Good	Moderate or severe: water table at a depth of 3 to 5 feet.	Moderate: frost action; water table at a depth of 0 to 5 feet.
Platoro: PaA, PaB	Good	Good below a depth of 1⅔ to 3⅓ feet.	Good below a depth of 1⅔ to 3⅓ feet.	Good	Slight	Slight
Quamon: Qa	Fair: gravelly	Good	Good	Good	Moderate or severe: water table at a depth of 3 to 5 feet.	Moderate: water table at a depth of 3 to 5 feet.
Rock outcrop: Ro. Too variable to rate.						
San Arcacio: Sa	Good	Good below a depth of 1⅔ to 3⅓ feet.	Good below a depth of 1⅔ to 3⅓ feet.	Good	Moderate or severe: water table at a depth of 3 to 5 feet.	Moderate: frost action; water table at a depth of 3 to 5 feet.
Sb	Fair to poor: salts.	Good below a depth of 1⅔ to 3⅓ feet.	Good below a depth of 1⅔ to 3⅓ feet.	Good	Severe: water table at a depth of 1½ to 4 feet.	Severe: water table at a depth of 1½ to 4 feet; frost action.
Sc	Good	Good below a depth of 1⅔ to 3⅓ feet.	Good below a depth of 1⅔ to 3⅓ feet.	Good	Moderate: water table at a depth of 4 to 5 feet.	Moderate: shrink-swell; frost action.
*San Luis: Sd	Poor: salts and alkali.	Fair or poor below a depth of 2 feet: SM or SM-SP; excess fines.	Unsuitable	Poor to a depth of 2 feet: low strength. Good below a depth of 2 feet.	Severe: water table at a depth of 2 to 3 feet.	Severe: water table at a depth of 2 to 3 feet; frost action.

See footnote at end of table.

interpretations—Continued

Soil features affecting—					
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation
		Reservoir area	Embankments		
Water table at a depth of 3 to 5 feet; frost action; good stability.	Moderately rapid permeability; gravel and sand at a depth of 2 to 3½ feet; slope is 0 to 1 percent.	Gravel and sand at a depth of 2 to 3½ feet; moderately rapid permeability above gravel; water table at a depth of 3 to 5 feet.	Sand and gravel at a depth of 2 to 3½ feet; fair to good compaction characteristics; medium to low permeability when compacted.	Water table at a depth of 3 to 5 feet; gravel and sand at a depth of 2 to 3½ feet; nearly level.	Gravelly sandy loam; gravel and sand at a depth of 2 to 3½ feet; low or moderate available water capacity.
Good stability	Gravel and sand at a depth of 1⅔ to 3⅓ feet; moderately slow permeability; slope is 0 to 3 percent.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; moderately slow permeability above gravel and sand.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; fair to good compaction characteristics; medium to low permeability when compacted.	Not needed; gravel and sand at a depth of 1⅔ to 3⅓ feet.	Gravel and sand at a depth of 1⅔ to 3⅓ feet; moderately slow permeability; moderate available water capacity.
Good stability; water table at a depth of 3 to 5 feet.	Gravel and sand at a depth of 1 foot to 2 feet; moderately rapid permeability above gravel and sand; slope is 0 to 1 percent.	Gravel and sand at a depth of 1 foot to 2 feet; moderately rapid permeability above gravel and sand.	Shallow over gravel and cobbles; good compaction characteristics; high permeability.	Gravel and sand at a depth of 1 foot to 2 feet; nearly level; water table at a depth of 3 to 5 feet.	Gravel and sand at a depth of 1 foot to 2 feet; moderately rapid permeability; moderate available water capacity.
Good stability; water table at a depth of 3 to 5 feet.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; moderate permeability; slope is 0 to 1 percent.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; water table at a depth of 3 to 5 feet; moderate permeability above gravel.	Medium to low permeability when compacted; 1⅔ to 3⅓ feet over sand and gravel.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; nearly level; water table at a depth of 3 to 5 feet.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; moderate permeability; moderate available water capacity.
Good stability; water table at a depth of 1½ to 4 feet; frost action.	Moderate to high salinity; sand and gravel at a depth of 1⅔ to 3⅓ feet; slope is 0 to 1 percent.	Water table at a depth of 1½ to 4 feet; sand and gravel at a depth of 1⅔ to 3⅓ feet; moderate permeability in subsoil.	Medium to low permeability when compacted; 1⅔ to 3⅓ over sand and gravel.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; moderate to high salinity.	Drainage and leaching needed; low available water capacity; moderate to high salinity.
Good stability; water table at a depth of 4 to 5 feet.	Moderate permeability; sand and gravel at a depth of 1⅔ to 3⅓ feet; slope is 0 to 1 percent.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; moderate permeability above sand and gravel.	Medium to low permeability when compacted; 1⅔ to 3⅓ feet over sand and gravel.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; water table at a depth of 4 to 5 feet; nearly level.	Sand and gravel at a depth of 1⅔ to 3⅓ feet; moderate permeability; moderate available water capacity.
Water table at a depth of 2 to 3 feet; frost action.	Moderate or high salinity; alkali; slope is 0 to 1 percent.	Water table at a depth of 2 to 3 feet; saline and alkali; moderately slow permeability.	Low permeability when compacted; fair to good compaction characteristics.	Water table at a depth of 2 to 3 feet; alkali and saline; moderately slow permeability.	Needs drainage and leaching; alkali; moderate or high salinity; low or moderate available water capacity.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Limitation for—	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites with basements
Se----- For Quamon part of Sf, see Quamon series.	Fair: clay loam texture.	Fair or poor below a depth of 2 feet: SM or SM-SP; excess fines.	Unsuitable-----	Poor to a depth of 2 feet: low strength. Good below a depth of 2 feet.	Moderate or severe: water table at a depth of 3 to 5 feet.	Moderate: shrink-swell; water table at a depth of 3 to 5 feet.
Schrader: Sh-----	Good-----	Unsuitable-----	Unsuitable-----	Fair: ML and SM with over 30 percent fines; low strength.	Severe: water table at a depth of 1 foot to 2 feet; floods.	Severe: water table at a depth of 1 foot to 2 feet; floods.
Seitz: SkF-----	Poor: very stony.	Unsuitable-----	Unsuitable-----	Poor: very stony.	Severe: slope is 20 to 65 percent; very stony; slow permeability.	Severe: slope is 20 to 65 percent; very stony.
Shawa: SmA, SmB-----	Good-----	Unsuitable-----	Unsuitable-----	Fair: ML; low strength.	Slight-----	Slight-----
Stunner: SnB, SnC-----	Good-----	Unsuitable-----	Unsuitable-----	Fair: ML, CL, and SM with over 45 percent fines; low strength.	Slight-----	Slight-----
Terrace escarpments: Ta. Too variable to estimate.						
*Tolman: TeE----- For Empedrado part, see Empedrado series.	Poor: very stony.	Unsuitable-----	Unsuitable-----	Poor: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.
Torsido: To-----	Fair or good: loam or clay loam.	Good below a depth of 2½ feet.	Good below a depth of 2½ feet.	Good below a depth of 2½ feet.	Severe: water table at a depth of 1 foot to 2 feet.	Severe: water table at a depth of 1 foot to 2 feet.
*Travelers: TrE, TsE----- For Garito part of TsE, see Garito series.	Poor: very stony.	Unsuitable-----	Unsuitable-----	Poor: shallow to bedrock.	Severe: shallow to bedrock.	Severe: shallow to bedrock.
Typic Fluvaquents: Tt----	Fair to good: salts; loam or clay loam.	Fair to poor below a depth of 3 feet: SM or SP-SM; excess fines.	Poor below a depth of 3 feet: 10 to 30 percent gravel.	Fair to poor: CL with PI 10 to 20; low strength.	Severe: water table at a depth of 1 foot to 2 feet; floods.	Severe: water table at a depth of 1 foot to 2 feet; floods.

See footnote at end of table.

interpretations—Continued

Soil features affecting—					
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation
		Reservoir area	Embankments		
Good stability; frost action.	Moderately slow permeability; slope is 0 to 1 percent.	Water table at a depth of 3 to 5 feet; moderately slow permeability.	Low permeability when compacted; fair to good compaction characteristics.	Not needed; water table at a depth of 3 to 5 feet; sand and gravel at a depth of 1⅔ to 3⅓ feet.	Existing drainage needs to be maintained; moderately slow permeability; moderate available water capacity.
Water table at a depth of 1 foot to 2 feet; frost action.	Moderately rapid permeability; slope is 0 to 1 percent; floods.	Water table at a depth of 1 foot to 2 feet; floods; moderately rapid permeability.	Fair compaction characteristics; medium to low permeability when compacted.	Water table at a depth of 1 foot to 2 feet; floods; nearly level.	Needs drainage; water table at a depth of 1 foot to 2 feet; moderately rapid permeability.
Very stony; slope is 20 to 65 percent.	Very stony; slope is 20 to 65 percent.	Very stony; slope is 20 to 65 percent.	Very stony; fair to poor compaction characteristics.	Not needed; slope is 20 to 65 percent.	Very stony; slope is 20 to 65 percent; slow permeability.
Nearly level to gently sloping; good stability.	Moderate permeability; slope is 0 to 3 percent.	Moderate permeability.	Fair to poor compaction characteristics; low to medium permeability when compacted.	Moderate permeability; nearly level to gently sloping.	Moderate permeability; high available water capacity; slope is 0 to 3 percent.
Good stability	Moderate permeability; slope is 1 to 6 percent.	Moderate permeability; slope is 1 to 6 percent.	Fair to good compaction characteristics; low permeability when compacted.	Not needed; moderate permeability; slope is 1 to 6 percent.	Moderate permeability; high available water capacity; slope is 1 to 6 percent.
Shallow to bedrock	Shallow to bedrock; very stony; slope is 10 to 25 percent.	Shallow to bedrock; very stony; slope is 10 to 25 percent.	Shallow to bedrock; very stony.	Not needed; bedrock at a depth of ⅚ foot to 1⅔ feet.	Bedrock at a depth of ⅚ foot to 1⅔ feet; very stony.
Water table at a depth of 1 foot to 2 feet; frost action.	Gravel and cobbles at a depth of 1⅔ to 3⅓ feet; moderate permeability; slope is 0 to 3 percent.	Water table at a depth of 1 foot to 2 feet; gravel and cobbles at a depth of 1⅔ to 3⅓ feet; moderate permeability in upper part.	Fair to good compaction characteristics; low permeability when compacted; gravel at a depth of 1⅔ to 3⅓ feet.	Water table at a depth of 1 foot to 2 feet; gravel and sand at a depth of 1⅔ to 3⅓ feet; slope is 0 to 3 percent.	Water table at a depth of 1 foot to 2 feet; gravel and sand at a depth of 1⅔ to 3⅓ feet; moderate permeability; moderate available water capacity.
Shallow to bedrock	Shallow to bedrock; very stony; slope is 3 to 25 percent.	Shallow to bedrock; very stony; slope is 3 to 25 percent.	Shallow to bedrock; very stony.	Not needed; bedrock at a depth of ⅚ foot to 1⅔ feet.	Bedrock at a depth of ⅚ foot to 1⅔ feet; slope is 3 to 25 percent; very stony; low available water capacity.
Water table at a depth of 1 foot to 2 feet; frost action.	Slope is 0 to 1 percent; floods.	Water table at a depth of 1 foot to 2 feet; floods.	Fair to good compaction characteristics; low permeability when compacted.	Water table at a depth of 1 foot to 2 feet; floods; nearly level.	Needs drainage; water table at a depth of 1 foot to 2 feet; floods; moderate to slow permeability.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Limitation for—	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites with basements
Typic Torrifluvents: Tu	Poor: gravelly.	Good	Good	Good	Severe: floods.	Severe: floods.
Vastine: Va	Fair or good: loam or clay loam.	Fair to poor below a depth of 2⅚ feet: SM or SM-SP; excess fines.	Unsuitable	Fair to a depth of 2⅚ feet: ML or CL; low strength. Good below a depth of 2⅚ feet.	Severe: water table at a depth of 1 foot to 2 feet.	Severe: water table at a depth of 1 foot to 2 feet; frost action.
Villa Grove: Vg	Fair: sandy clay loam.	Unsuitable	Unsuitable	Poor: CL; low strength.	Moderate or severe: moderately slow permeability.	Moderate: shrink-swell.
Vh	Fair or poor: salts.	Unsuitable	Unsuitable	Poor: CL; low strength.	Moderate or severe: water table at a depth of 2 to 5 feet.	Severe: frost action; water table at a depth of 2 to to 5 feet.
Zinzer: Zn	Good	Fair or poor below a depth of 3½ feet: SM or SM-SP; excess fines.	Unsuitable	Fair to a depth of 3½ feet: SC or CL; low strength. Good below a depth of 3½ feet.	Slight	Slight
Zr	Fair or poor: salts.	Fair or poor below a depth of 3½ feet: SM or SM-SP; excess fines.	Unsuitable	Fair to a depth of 3½ feet: SC or CL; low strength. Good below a depth of 3½ feet.	Moderate or severe: water table at a depth of 2 to 5 feet.	Severe: frost action; water table at a depth of 2 to 5 feet.

[1] Plasticity index.

range from 0 for the best material to 20 or more for the poorest *(8)*. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 8; the estimated classification for all soils mapped in the survey area, without group index numbers, is given in table 6.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 6. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Most soils in the Area are deep enough over bedrock that it generally does not affect their use. Rhyolite, andesite, and latite are at a depth of 10 to 20 inches in Celeste soils and at a depth of 20 to 40 inches in Embargo soils. Rhyolite or latite are at a depth of 10 to 20 inches in Tolman soils. Predominantly basalt is at a depth of 10 to 20 inches in Travelers soils.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in most years.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand,

interpretations—Continued

Soil features affecting—					
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation
		Reservoir area	Embankments		
Floods; good stability.	Rapid permeability; sand and gravel at a depth of ⅔ foot to 1⅔ feet; floods; slope is 0 to 1 percent.	Rapid permeability; floods.	Good compaction characteristics; high permeability.	Floods; sand and gravel at a depth of ⅔ foot to 1⅔ feet; nearly level.	Sand and gravel at a depth of ⅔ foot to 1⅔ feet; low available water capacity; floods.
Water table at a depth of 1 foot to 2 feet; frost action; floods.	Sand and gravel at a depth of 1⅔ to 3½ feet; moderate permeability; slope is 0 to 1 percent.	Water table at a depth of 1 foot to 2 feet; moderate permeability.	Fair to poor compaction characteristics; medium to low permeability when compacted.	Water table at a depth of 1 foot to 2 feet; sand and gravel at a depth of 1⅔ to 3½ feet; floods; nearly level.	Needs drainage; water table at a depth of 1 foot to 2 feet; floods; sand and gravel at a depth of 1⅔ to 3½ feet.
Nearly level	Moderately slow permeability; slope is 0 to 1 percent.	Moderately slow permeability.	Fair to good compaction characteristics; low permeability when compacted.	Moderately slow permeability.	High available water capacity; moderately slow permeability.
Water table at a depth of 2 to 5 feet; frost action.	Moderate or high salinity; moderately slow permeability; slope is 0 to 1 percent.	Moderately slow permeability; saline; water table at a depth of 2 to 5 feet.	Fair to good compaction characteristics; low permeability when compacted.	Water table at a depth of 2 to 5 feet; moderately slow permeability; moderate or high salinity.	Needs drainage and leaching; water table at a depth of 2 to 5 feet; saline; moderately slow permeability.
Nearly level	Moderate permeability; slope is 0 to 1 percent.	Moderate permeability.	Fair to good compaction characteristics; low permeability when compacted.	Moderate permeability.	Moderate or high available water capacity; moderate permeability.
Water table at a depth of 2 to 5 feet; frost action.	Moderate or high salinity; moderate permeability; slope is 0 to 1 percent.	Moderate permeability; saline; water table at a depth of 2 to 5 feet.	Fair to good compaction characteristics; low permeability when compacted.	Water table at a depth of 2 to 5 feet; moderate permeability; moderate or high salinity.	Needs drainage and leaching; water table at a depth of 2 to 5 feet; saline; moderate permeability.

silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil *(8)*. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic; and the liquid limit, from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 6, but in table 8 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of soil characteristics observed in the field, particularly structure, porosity, and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

TABLE 8.—*Engineering*

[Tests performed by Soil Mechanics Laboratory, Soil Conservation Service,

Soil name and location	Parent material	Laboratory sample number	Depth	Moisture density	
				Maximum dry density	Optimum moisture
			Inches		
Acacio sandy loam:					
NE1/4 sec. 13, T. 37 N., R. 8 E.	Loamy alluvium.	700128	0–5	121	12
		700129	5–10	112	16
		700130	16–40	101	25
Embargo very stony loam:					
SW1/4 sec. 3, T. 37 N., R. 6 E.	Clayey residual material from rhyolite.	700116	0–7	96	23
		700117	7–18	95	22
Empedrado loam:					
SE1/4 sec. 1, T. 39 N., R. 4 E.	Loamy residual material from rhyolite.	700123	6–13	104	19
		700124	19–40	112	18
Luhon loam:					
Near center of sec. 36, T. 40 N., R. 5 E.	Loamy alluvium.	700111	0–9	112	16
		700112	9–20	105	19
Norte gravelly sandy loam:					
1,240 feet north and 580 feet west of southeast corner sec. 5, T. 40 N., R. 8 E.	Gravelly alluvium.	700125	0–9	118	13
		700126	11–15	120	13
		700127	22	----------	----------
Platoro loam:					
800 feet west and 50 feet south of northeast corner of sec. 2, T. 37 N., R. 7 E.	Loamy alluvium over gravelly alluvium.	700113	0–5	117	13
		700114	9–17	105	19
		700115	27–40	----------	----------
Seitz very stony loam:					
Near center of sec. 30, T. 37 N., R. 7. E.	Clayey and stony slope-wash material.	700118	1.5–14	103	18
		700119	14–28	94	24
Torsido clay loam:					
600 feet south and 225 feet east of N1/4 corner, sec. 23, T. 37 N., R. 7 E.	Loamy alluvium over gravelly alluvium.	700120	0–5	103	19
		700121	5–14	105	20
		700122	14–22	109	17

[1] Mechanical analysis according to AASHTO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crops.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soils. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25°C. Salinity affects the suitability of a soil for crop production, its stability when used as contruction material, and the risk of corrosion to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content; that is, the extent to which the soil shrinks when dry or swells when wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Risk of corrosion, as used in table 6, pertains to potential soil-induced chemical action that dissolves or

test data

Portland, Oreg. Dashes indicate that no determination was made]

Mechanical analysis [1]													Liquid limit	Plasticity index	Classification	
Percentage passing sieve—									Percentage smaller than—							
3 in.	2 in.	1½ in.	1 in.	¾ in.	⅜ in.	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	Unified
		100	99	99	97	93	89	73	38	33	21	13	9		[2] NP	A-4(0)	SM
					100	99	98	85	49	45	38	30	25	33	13	A-6(4)	SC
					100	99	99	71	38					44	17	A-7-6(3)	SM or SC
		100	99	99	98	97	95	78	61	52	32	16	10	44	12	A-7-5(7)	ML
100	98	96	95	93	88	77	57	47	40	37	29	21	17	52	21	A-7-5(4)	SM
					100	96	88	62	48	44	35	28	22	47	20	A-7-6(6)	SC or SM
					100	96	92	65	28	25	18	13		38	13	A-2-6(0)	SC or SM
				100	98	95	92	80	51	41	21	12	9	28	7	A-4(3)	CL–ML
		100	99	98	96	92	84	71	49	40	22	13	9	33	7	A-4(3)	SM
		100	96	95	89	86	81	55	24	21	15	10	8	25	6	A-2-4(0)	SC–SM
		100	98	96	90	86	82	53	21	18	12	8	6		NP	A-2-4(0)	SM
		100	94	91	78	70	61	29	6	6	5	5			NP	A-1-6(0)	SP–SM
		100	98	96	91	88	76	61	41	35	23	14	10	27	6	A-4(1)	SC–SM
100	98	96	94	93	89	87	82	71	51	47	36	29		36	14	A-6(2)	CL
100	95	91	83	79	70	65	53	13	3						NP	A-1-6(0)	SP
100	97	95	89	86	79	73	67	61	56	49	35	17	12	25	2	A-4(4)	ML
100	96	93	88	85	79	74	67	57	52	48	39	29	25	53	25	A-7-6(10)	CH
						100	99	89	61	55	40	37	27	35	13	A-6(6)	CL
100	97	96	93	91	89	88	87	78	51	48	38	75	26	39	18	A-6(5)	CL
		100	96	93	85	81	78	67	41	36	26	17	13	32	10	A-4(1)	SC

in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[2] Nonplastic.

weakens uncoated steel or concrete. The rate of corrosion on uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. The rate of corrosion on concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one horizon. A rating of *low* indicates a low probablity of soil-induced corrosion damage. A rating of *high* indicates a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Hydrologic groupings are soil groups that are used in watershed planning to estimate runoff from rainfall. Soil properties are considered that influence the rate of infiltration obtained for a bare soil after prolonged wetting. Examples of these properties are depth to a seasonal high water table, water intake rate, permeability after prolonged wetting, and depth to a very slowly permeable layer. The influence of present ground cover is not considered in making the individual hydrologic soil groupings but is considered along with other factors in the total hydrologic evaluation of a watershed. The soils have been classified into four groups, A through D.

Group A soils have low runoff potential. They have

a high, or rapid, infiltration rate even though thoroughly wetted, and consist chiefly of deep, well drained to excessively drained, coarse textured soils. They have a high rate of water transmission.

Group B soils have a moderately low runoff potential. They have a moderate infiltration rate when thoroughly wetted and consist chiefly of moderately deep or deep, moderately well drained or well drained, moderately fine textured to moderately coarse textured soils that have moderately slow to moderately rapid permeability. They have a moderate rate of water transmission.

Group C soils have a moderately high runoff potential. They have a slow infiltration rate when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils that are moderately fine textured or fine textured, have a slow infiltration rate because of salts or alkali, or have a moderately high water table. They have a slow rate of water transmission.

Group D soils have a high runoff potential. They have a very slow infiltration rate when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanently high water table, a claypan or clay layer at or near the surface, very slow infiltration because of salts or alkali, and shallow soils over nearly impervious material. They have a very slow rate of water transmission.

Engineering interpretations

The interpretations in table 7 are based on the estimated engineering properties of soils shown in table 6, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Rio Grande County Area. In table 7, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 7 lists those soil features not be overlooked in planning, installation, and maintenance.

Soil limitations are expressed as slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or in other words, limitations are minor and are easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* indicates soil properties so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required. For some uses, the rating of severe is divided to obtain ratings of severe and very severe. *Very severe* indicates one or more soil properties so unfavorable for a particular use that overcoming the limitations is difficult and costly and commonly not practical for the rated use.

Soil suitability is expressed as *good, fair, poor,* and *unsuitable.* These terms have meanings approximately parallel with the terms slight, moderate, severe, and very severe.

Following are explanations of some of the columns in table 7.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as in preparing a seedbed; the natural fertility of the material, or its response to plants when fertilizer is applied; and the absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability. Also considered in the ratings is damage that will result in the area from which the topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide information on probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and the relative ease of excavating the material at borrow areas.

Septic tank filter fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects layout and construction and increases the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Homesites with basements, as rated in table 7, are sites for dwellings that are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Highway location pertains to superhighways similar to those of the interstate system and not to local roads and streets. In estimating the soil features that affect selection of highway location, evaluation is for the profile of an undisturbed soil that has not been drained but has had its organic surface layer removed, if one occurs. Some of the features considered are the height of the water table; the hazard of flooding; the stability of the soil material, particularly under heavy loads of pressure; depth to and kind of bedrock; degree of frost hazard; and slope.

Dikes and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for dikes or

diversions are uniformity and steepness of slope; depth to bedrock or other unfavorable material; stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Reservoirs hold water behind a dam or embankment. Soils suitable as pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones and organic material in a soil are among features that are unfavorable.

Agricultural drainage is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope, stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of the soil below the surface layer and in a fragipan or other layer that restricts movement of water; amount of water held available to plants; need for drainage; and depth to the water table or bedrock.

Soil test data

Table 8 contains engineering test data for some of the major soil series in Rio Grande County Area. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as explained for table 6.

Formation and Classification of the Soils

This section describes some of the characteristics of the soils of the Rio Grande County Area and tells how they are related to the factors of soil formation. It also explains the system of soil classification and classifies the soils in the survey area according to that system.

Factors of Soil Formation

Soil is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials containing living matter and supporting or capable of supporting plants. Soils differ in appearance, composition, productivity, and management requirements in different localities or even within short distances in the same locality.

The interaction of five main factors cause soils to differ. These are the physical and chemical composition of the parent material; the climate under which the parent material accumulated and existed since accumulation; the kinds of plants and organisms living in the soil; the relief, or lay of the land, and its effect on runoff; and the length of time the soil forming processes have acted. Generally, a long period is required for the formation of distinct soil horizons.

The relative importance of each factor differs from place to place but the interaction of all the factors determines the kind of soil that forms in any given place. In the following pages, the factors of soil formation are defined as related to their effects on the soils of the survey area.

Parent material

Parent material is the material in which soil forms. It can be material that has weathered in place or that has been transported by wind or water. In many soils there is no distinct difference between the soil material in the lower part of the profile and the parent material. Parent material affects soil formation in many ways. It largely determines the texture, structure, consistency, color, and sometimes arrangement of the horizons. It affects the rate of soil formation according to its resistance to weathering. For example, sandy and gravelly parent material weathers slowly, therefore soils formed in such material are generally sandy and have weak horizon differentiation. Medium textured parent material generally weathers more readily and the soils formed are more likely to be loamy and have stronger horizon differentiation. Parent material also affects the inherent fertility and the erodibility of the soil. The soils of the Rio Grande County Area formed in three major kinds of parent material: alluvium, slope-wash, and volcanic rocks of Tertiary age.

Soils formed in alluvium are the most extensive in the survey area. There is a wide range in the composition of the alluvium, depending largely on the rocks from which it weathered, the distance from its source, and the topography. Acasco, Alamosa, Gerrard, Schrader, Shawa, and Vastine soils formed in moderately fine textured to moderately coarse textured alluvium deposited by the Rio Grande, Rock Creek, Pinos Creek, and other major creeks. Some of these soils are underlain within a depth of 40 inches by coarse textured material. The parent material deposited by these streams was derived from areas having large amounts of volcanic rocks, mainly quartz latite, andesite, rhyolite, and basalt (*11, 13*). Most of this material was transported a long distance.

Acacio, Laney, Luhon, Mishak, Monte, Stunner, Villa Grove, and Zinzer soils formed in medium textured calcareous alluvium. This parent material originated

mostly from the weathering of volcanic rocks, mainly quartz latite and rhyolite. Most of this material was transported a comparatively short distance. The gypsum occurring in some of these soils was derived from sulfides and sulfates in the volcanic rocks.

Parent material for many of the soils consists of thick beds of gravelly, cobbly, and sandy alluvium that in places has a thin mantle of medium textured material. In some places the medium textured material is embedded with gravel and cobbles. Derrick, Dunul, Garita, Graypoint, Norte, Quamon, Platoro, and San Arcacio soils formed in this type of parent material. This material covers most of the alluvial fans and terraces and extends onto the valley floor. The material was derived from a large variety of volcanic rocks and deposited mostly during the Pleistocene and Holocene epochs (*6*, *14*).

Gunbarrel and Mosca soils formed in moderately coarse textured or coarse textured alluvium on the Rio Grande fan and flood plain in the eastern part of the survey area. This parent material weathered from volcanic rocks and was deposited during the Pleistocene.

Hooper, Arena, and San Luis soils formed in the fine textured to medium textured alluvium that overlies sandy alluvium. This material, deposited on old flood plains during the Pleistocene, was derived from the weathering of volcanic rocks that contain large amounts of sodium.

Fulcher and Jodero soils formed in alluvium weathered from nearby sources. Fulcher soils formed in fine textured material, and Jodero soils in medium textured material. This is material weathered mainly from quartz latite and rhyolite rocks and transported only a short distance.

Seitz soils formed in fine textured stony slope-wash material weathered from volcanic rock, mainly rhyolite, andesite, and latite. This material was moved a short distance downslope by water and gravity.

Celeste, Embargo, Empedrado, Tolman, and Travelers soils formed in material mostly weathered in place from Tertiary volcanic rocks consisting of rhyolite, andesite, quartz latite, and basalt. The weathered material is medium textured to fine textured and contains large amounts of stones. Some areas contain large amounts of lime.

Climate

Climate influences the physical and chemical weathering of parent material and affects the rate of biological activity. Soil temperature and moisture are the main factors, but wind velocity and humidity have a significant influence. Generally, soil-forming processes are more active when temperatures are warm and moisture is adequate but not excessive. The high water table in part of the survey area affects the soil climate and creates climates that are not normal for the survey area.

The climate of the Rio Grande County Area is of two general types. The cold, dry mountain valley has cool summers and cold winters. The lower part of the valley is cooler and drier, and the upper part near the foothills is slightly warmer. At Monte Vista, in the lower part of the valley at an elevation of about 7,650 feet, the average annual temperature is about 41° F, the average summer temperature is about 61°, and the average annual precipitation is about 7 inches. At Del Norte, at the edge of the foothills at an elevation of 7,900 feet, the average annual temperature is about 43°, the average summer temperature is about 62°, and average annual precipitation is about 8.5 inches.

The mountainous part of the Area is colder and receives more moisture. The average annual temperature is about 35°, the average summer temperature is about 40° to 50°, and average annual precipitation is about 15 to 20 inches. Average snowfall in the valley is about 35 inches, and in the mountains is as much as 100 inches.

Water moving downward through the soil leaches calcium carbonate and other soluble salts out of the surface horizon and deposits them in the B or C horizon. Clay particles are moved from the upper to the lower horizons. The low amount of precipitation in this survey area is reflected in the low degree of soil horizon differentiation in Monte, Norte, Laney, and Gunbarrel soils and by the thin sola in Acacio, Villa Grove, Stunner, and Platoro soils. Most soils that are not sandy are calcareous at or near the surface. This fact indicates that leaching has been slow. Sandy soils, such as Gunbarrel and Norte soils, through which water readily moves, have carbonates leached to a greater depth.

Soil moisture influences the amount and type of vegetation and, subsequently, the amount of organic matter returned to the soil. In areas where soil moisture is limited, particularly in the valley proper and in the low foothills, vegetation is sparse. Consequently, the soils are relatively low in content of organic matter because yearly amounts of vegetation returned to the soil are small. In the mountains and higher foothills, precipitation results in more vegetation and more organic matter in the soils.

In areas where the water table is close to the surface part of each year, the normal downward movement of water through the soil is restricted and salts carried in solution by ground water is precipitated within the soil or on the surface. Horizons that have a high accumulation of salt are not unusual in soils of such areas. In these areas vegetation is normally abundant unless retarded by salt or alkali.

Plant and animal life

Vegetation, micro-organisms, earthworms, and other plant and animal life influence soil formation. The kind of plant cover and micro-organisms at any location is controlled mainly by soil temperature, moisture, and the physical and chemical character of the parent material. In the Rio Grande County Area, moisture is the greatest limiting factor on well drained soils. In the mountainous part of the Area, moisture and temperature are limiting factors on plant growth and biological activity.

Most well drained soils in the valley and low foothills formed under a cover of shrubs and short grasses. The vegetation is sparse and little plant material is returned to the soil. The content of organic matter averages about 0.5 to 1.5 percent in the upper 12 inches of the soil. In poorly drained areas, moisture supplies are greater, and there is a dense cover of sedges, rushes, and water-tolerant grasses. These wet soils have higher

organic matter content and it extends to a greater depth than in well drained soils.

In the mountains and in parts of the foothills, the soils formed under various kinds of vegetation. Some soils formed under a moderate to thick stand of spruce and fir trees, others under mid and tall grasses, and some under a cover of pinyon and juniper trees.

The most important function of soil micro-organisms is the breakdown of organic plant residue. In the Rio Grande County Area, these processes proceed rapidly in well drained soils as long as soil temperature is favorable and moisture supplies are adequate. Consequently, well drained soils are characterized by a low organic matter content, highly stable forms of residual organic compounds, and distribution patterns where organic matter is concentrated in the upper few inches of the profile. The maximum amount of organic matter coincides with the greatest concentration of plant roots.

In sites where the water table keeps the soil moist, microbial activity proceeds uniformly throughout warm seasons. In these areas vegetation is more luxuriant and greater amounts of plant residue are returned to the soil. Consequently, there is a greater accumulation of decomposed organic material and it is distributed to a greater depth. Such soils are darker colored than the soils on well drained sites.

In some very poorly drained areas where the soil is wet most of the time, microbial activity is mostly anaerobic. Under such conditions decomposition is often incomplete, and undecomposed organic matts accumulate on the surface.

Nonirrigated soils are too dry for earthworm activity. Rodents and other small animals influence soil formation by burrowing and mixing soil horizons and bringing parent material to the surface.

Man affects soil formation in many ways. On irrigated soils he has changed the climate by adding water. The crops grown often produce large amounts of organic matter that is returned to the soil. In addition, crops are fertilized.

Topography

Topography modifies the effects of climate and vegetation, mainly by controlling the amount of runoff and the degree of drainage. Many soils of the Rio Grande County Area formed on nearly level topography that restricted subsurface drainage. These soils occur on flood plains, mainly along the major drainageways and on broad alluvial fans in the eastern part of the survey area. Topography affects drainage, which in turn affects plant growth and microbial activity. Alamosa, Gerrard, Acasco, Schrader, Gunbarrel, and Norte soils formed under restricted drainage. Lack of good drainage affects some of the processes of soil formation. For example, the alternate oxidation and reduction in Vastine soils results in strong mottles.

Some nearly level soils are well drained, and most sloping soils are well drained or somewhat excessively drained. Runoff is considerable and the resulting effective precipitation is less than the total amount that falls. Some nearly level soils receive additional runoff from higher areas. On some soils where runoff is rapid, erosion removes the soil as rapidly as it forms.

Time

Time or age refers to the length of time the processes of soil formation have been active. Soils that have been in place for a long time normally have more distinct genetic horizons.

The older soils in the survey area normally have a B horizon of clay accumulation and a horizon of calcium carbonate accumulation. Older soils, such as Villa Grove and Stunner soils, normally have an A, B2t, Cca horizon sequence.

Younger soils, such as Celeste soils, are generally in material that has not been in place very long and have only an A, C, or R horizon.

Processes of Soil Formation

Interaction of the soil forming factors in the Rio Grande County Area has resulted in the accumulaation of organic matter, mainly in the A horizon; leaching of calcium carbonate from the upper horizons; translocation of silicate clay from the A horizon to the B horizon; accumulation of soluble salts; and oxidation and reduction of iron minerals.

Accumulation of organic matter in the upper part of the profile has been important in most soils of the survey area. Luhon, Stunner, Travelers, and Zinzer soils have a strong calcium carbonate zone. Evidence of clay movement is shown in Embargo, Fulcher, Platoro, Graypoint, and Stunner soils. In such soils as Platoro and Stunner soils, the horizon of clay accumulation is only about 1 foot below the surface. In other soils, such as Fulcher soils, it extends to a depth of about 3 feet. Accumulation of soluble salts is typical in soils that have poor drainage, for example, Mishak, San Luis, and Arena soils.

Oxidation and reduction are processes that are active in soils that have restricted drainage. Vastine and Alamosa soils have a high water table most of the year. Reduction of iron is the result of a lack of oxygen, and the soil becomes mottled and gleyed. In some soils, the water table drops during part of the year and the soils undergo a period of oxidation. In part of these soils, the water table drops only enough to allow the upper part of the profile to dry out while the lower part remains wet.

Classification of Soils

Soil classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to management. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison of large areas such as countries and continents.

TABLE 9.—*Classification of soil series*

Series	Current classification [1]		
	Family	Subgroup	Order
Acacio	Fine-loamy, mixed, frigid	Typic Haplargids	Aridisols.
Acasco	Clayey over sandy or sandy-skeletal, montmorillonitic, frigid.	Typic Haplaquolls	Mollisols.
Alamosa	Fine-loamy, mixed, frigid	Typic Argiaquolls	Mollisols.
Arena	Fine-loamy, mixed, frigid	Aquentic Durorthids	Aridisols.
Celeste	Loamy-skeletal, mixed	Lithic Haploborolls	Mollisols.
Derrick	Loamy-skeletal, mixed, frigid	Typic Haplargids	Aridisols.
Dunul	Sandy-skeletal, mixed, frigid	Typic Torriorthents	Entisols.
Embargo	Clayey-skeletal, montmorillonitic	Argid Cryoborolls	Mollisols.
Empedrado	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Fulcher	Fine, montmorillonitic	Argic Pachic Cryoborolls	Mollisols.
Garita	Loamy-skeletal, mixed, frigid	Typic Calciorthids	Aridisols.
Gerrard	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Typic Haplaquolls	Mollisols.
Graypoint	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Typic Haplargids	Aridisols.
Gunbarrel	Mixed, frigid	Typic Psammaquents	Entisols.
Hooper	Clayey over sandy or sandy-skeletal, montmorillonitic, frigid.	Typic Natrargids	Aridisols.
Jodero	Fine-loamy, mixed	Cumulic Haploborolls	Mollisols.
Laney	Fine-loamy, mixed (calcareous), frigid	Typic Torrifluvents	Entisols.
Luhon	Fine-loamy, mixed	Borollic Calciorthids	Aridisols.
Mishak	Fine-loamy, mixed (calcareous), frigid	Typic Halaquepts	Inceptisols.
Monte	Fine-loamy, mixed (calcareous), frigid	Typic Torriorthents	Entisols.
Mosca	Coarse-loamy, mixed, frigid	Typic Natrargids	Aridisols.
Norte	Loamy-skeletal, mixed (calcareous), frigid	Typic Ustorthents	Entisols.
Platoro	Fine-loamy over sandy or sandy-skeletal, mixed.	Borollic Haplargids	Aridisols.
Quamon	Sandy-skeletal, mixed, frigid	Typic Ustorthents	Entisols.
San Arcacio	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Typic Haplargids	Aridisols.
San Luis	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Aquic Natrargids	Aridisols.
Schrader	Coarse-loamy, mixed, frigid	Cumulic Haplaquolls	Mollisols.
Seitz	Clayey-skeletal, montmorillonitic	Typic Cryoboralfs	Alfisols.
Shawa	Fine-loamy, mixed	Pachic Haploborolls	Mollisols.
Stunner	Fine-loamy, mixed	Borollic Haplargids	Aridisols.
Tolman	Loamy-skeletal, mixed	Lithic Argiborolls	Mollisols.
Torsido	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Typic Argiaquolls	Mollisols.
Travelers	Loamy-skeletal, mixed	Borollic Lithic Camborthids	Aridisols.
Vastine	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Typic Haplaquolls	Mollisols.
Villa Grove	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
Zinzer	Fine-loamy, mixed	Aridic Calciborolls	Mollisols.

[1] Literature Cited (*10*).

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the differentiae used as a basis for classification are soil properties that can be observed in the field, or that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or those that affect soil genesis. In table 9, the soil series of the Rio Grande County Area are classified according to the current system. The categories of this system are defined briefly in the following paragraphs.

ORDER. Ten soil orders are recognized. The differentiae are based on the kind and degree of the dominant sets of soil-forming processes. Each order is identified by a word of three or four syllables ending in *sol*. An example is Mollisols.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or on properties selected to reflect what seemed to be the most important variables within the order. Each suborder is identified by a word of two syllables. The last syllable indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisols).

GREAT GROUP. Each suborder is divided into great

groups on the basis of uniformity in kind, arrangement, and degree of expression of pedogenic horizons, moisture, and temperature and in base status. Each great group is identified by a word of three or four syllables; a prefix is added to the name of the suborder. An example is Haplaquoll (*Hapl*, meaning minimum horizon differentiation, plus *aquoll*, the suborder of Mollisols that have an aquic moisture regime).

SUBGROUPS. Each great group is divided into three kinds of subgroups. The central (typic) concept of the great groups (not necessarily the most extensive subgroup); the intergrades, or transitional forms to other orders, suborders, or great groups; and extragrade subgroups, which have some properties representative of the great groups, but do not indicate transitions to any other known kind of soil. Each subgroup is identified by the name of the great group preceded by one or more adjectives. The adjective Typic is used for the subgroup that is thought to typify the great group. An example is Typic Haplaquoll.

FAMILY. Soil families are established within a subgroup that have similar physical and chemical properties and nearly the same responses to management. Among the properties considered in horizons of major biological activity below plow depth, are particle-size distribution, mineralogy, temperature, thickness of the soil penetrable by roots, consistence, moisture, slope, and permanent cracks. A family name is the subgroup name preceded by a series of adjectives. The adjectives are the class names for particle-size distribution, mineralogy, and temperature, for example, that are used as family differentiae (see table 9). An example is Typic Haplaquolls clayey over sandy or sandy-skeletal, montmorillonitic, frigid.

SERIES. The series consists of a group of soils that formed in a particular kind of parent material and, except for texture of the surface layer, have horizons similar in differentiating characteristics and in arrangement in the profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition. The series name can be a place name in an area where the soil was first defined. An example is the Acasco series.

Soil Temperature

All soils of the Rio Grande County Area have frigid or cryic soil temperature regimes. They have a mean annual temperature of less than 47° F. and a difference of 9° or more between the mean summer and the mean winter temperatures. Cryic soils also have a colder summer temperature than frigid soils. The limit depends on whether or not the soil is saturated during the summer and whether or not it has an organic surface layer.

Table 10 lists average soil temperatures of six soil series in March through November for the period 1967 to 1971. The soils were frozen during the winter months. The temperature of the frozen soil was 25° to 30°. These measured temperatures were used as a guide in estimating temperatures of similar soils.

General Nature of the Area

The San Luis Valley was Spanish territory that became part of Mexico, and subsequently part of the United States during the Mexican War. During the early 1860's, small Spanish settlements were established along the Rio Grande, west of Monte Vista. Stockmen from the East also settled along the river to utilize the grass that grew well on the wet bottom land. A few ranches in the vicinity of Del Norte became supply points for mining camps to the west in the San Juan Mountains. In the 1870's, ranches were established along Rock Creek south of Monte Vista.

Settlement increased sharply after the Civil War. Del Norte, founded in 1871, was the county seat when Rio Grande County was formed in 1874. The town of Monte Vista was founded in 1881 when the railroad was extended west of Alamosa. The population of the county was at its peak about the time of World War I. It has declined slowly since then. The population in 1970 was 10,494.

TABLE 10.—*Soil temperatures of six soils*

[Temperature measured at a depth of 20 inches about the 15th of the month during the period 1967–71. Data presented are averages]

Month	Soil					
	Fulcher	Jodero	Luhon	Mishak	Monte	Seitz
March	30	34	35	33	36	30
April	36	43	45	36	43	32
May	42	51	53	48	50	34
June	51	56	59	53	58	39
July	56	62	65	59	65	47
August	58	63	65	60	66	49
September	53	58	60	58	61	47
October	46	51	51	47	49	42
November	37	41	43	40	41	36
Average annual	41	46	46	43	46	37
Average summer	55	60	63	57	63	45

Cattle and sheep ranching increased rapidly during the 1870's. Cattle ran the entire valley all year until roundup time. After heavy losses during a few severe winters, stock were fed hay close to headquarters in winter and spring and moved to the high mountain ranges in summer. During this early period large bands of sheep, as well as cattle, ranged in the Area.

In order to serve the ranching in the valley and the mining activity in the San Juan Mountains, the Rio Grande Western Railroad was extended to the valley in 1878 and along the Rio Grande to Creede a few years later. Still later a branch line, built mainly to ship potatoes out of the survey area, was extended north to the town of Center.

The first irrigation was in the low area along the river and creeks where it was easy to run small ditches from the river and creeks. The first ditch of any size was constructed about 4 miles east of Del Norte in 1866.

The first large canal, the Rio Grande Canal constructed in 1881, served the area north of the river. The second was the Monte Vista Canal south of the river, and subsequently the Empire, Farmers Union, and Prairie Canals.

Farming increased rapidly following construction of the canals. During the early years, wheat was the main crop. A few years of continuous wheat production, however, resulted in alkalinity, reduced yields, and a weed problem. Farmers soon turned to a wider variety of crops, mainly alfalfa and field peas. Potatoes were grown shortly after irrigation was started, and the acreage increased rapidly.

Farming has been the main incentive to development of the county. There was, however, a great deal of mining exploration in the mountains to the west and several mines were developed. The trade centers for much of this mining activity were towns within the Area.

On the pages that follow is information about the geology, physiography, and climate of the survey area and additional facts about the farming.

Geology and Physiography [5]

The Rio Grande survey area is along the west-central part of the San Luis Valley. Most of it is within the valley. Some is in the San Juan Mountains. The valley is bordered by foothills that grade into the mountains within a few miles. The western part of the survey area is within and adjacent to the valley of the Rio Grande, where it drains eastward from South Fork to Del Norte. The valley is a narrow flood plain near the river bordered by a series of stream terraces. Alluvial fans slope down to the terraces from the mountains and, in some places, extend onto the terraces. Several drainageways enter the river valley in this part of the survey area. Some are perennial streams, and some are intermittent.

Where the Rio Grande leaves the San Juan Mountains at Del Norte, the area opens abruptly into the broad San Luis Valley, a broad structural depression surrounded by mountains. Parts of several counties are within this valley.

[5] ALEX D. ELKIN, geologist, Soil Conservation Service, Denver, Colo., helped prepare this section.

The part of the survey area north of the river and east of Del Norte makes up part of the broad Rio Grande alluvial fan and gradually merges with the valley bottom and old flood plain. The gradient is nearly level to gently sloping. There are no defined drainageways across this fan (*15*).

The southeastern part of the survey area consists of parts of the large alluvial fans deposited by Rock Creek, Cat Creek, Alamosa Creek, and other small creeks. The fan slopes eastward from the foothills, gradually merging with the valley bottom and old flood plain. The gradient is gentle. Drainageways are not well defined in many places.

The southwestern part is the high mountainous area. The elevation is as much as 11,000 feet on Greenie Mountain. The lowest elevation, where the Rio Grande leaves the Area, is about 7,600 feet.

Geologic formations within the survey area are volcanic rock of the Tertiary period and unconsolidated surficial deposits of the Quaternary period (*11*).

The Tertiary volcanic rock crops out in the foothills and mountains. It is mainly tuff, breccia, pumice, and flow rock of the Miocene and Pliocene epochs. The composition ranges from rhyolitic to basaltic, but rock of latitic or andesitic composition is dominant. The volcanic rock slopes eastward toward the San Luis Valley at angles ranging from 6 to 15 degrees (*6*).

The surficial deposit of the Pleistocene epoch is mainly gravelly alluvium, which covers terraces and high-level erosion surfaces. Colluvial slopewash deposits of Pleistocene and Holocene epochs occur in the mountains. Alluvial deposits of Holocene epoch occur along all of the larger stream valleys.

Bedrock exposures are Tertiary volcanic rock of the Miocene and Pliocene epochs, deposited during at least six main periods of eruption. Considerable erosion of older volcanic material occurred locally between eruptions, and contacts between rock units of different ages are often irregular.

The volcanic rock includes those of flow origin as well as a variety of rock of pyroclastic origin, such as welded tuff, tuff agglomerate, and tuff breccia, all of which range from very soft to very hard. The flow rock is generally very hard. The material derived from the weathering of the volcanic rock is dominantly sandy, but ranges from clay to large boulders.

The six main units of volcanic rock in the survey area are the Conejos, Treasure Mountain, Sheep Mountain, Alboroto, Piedra, and Hinsdale Formations. In chemical composition, most are in the high to intermediate range of silica content and the low to intermediate range in percentage of calcium, magnesium, and iron minerals. The Conejos and Sheep Mountain rocks are generally dark colored and are mainly quartz latite, a rock that is intermediate in silica content but tends to be closer in composition to the high silica rocks than to the low silica rocks. The Treasure Mountain, Alboroto, and Piedra rocks are rhyolitic and high in silica. The Hinsdale rock is mostly latitic to basaltic and has a higher percentage of calcium than the quartz latites.

The Conejos quartz latite is largely tuff and tuff breccia. In the area west of Del Norte, the lowest exposed horizon in the Conejos is a few hundred feet of

light-colored, fine-textured, well-bedded tuff, which crops out on the gentle slopes just south of the Rio Grande and west of Pinos Creek. Overlying this tuff is a great body of tuff breccia, which attains a thickness of more than 1,000 feet. Much of it is poorly bedded and sorted. The fragments are mainly subangular to angular, rarely rounded, and for the most part are less than 1 foot in diameter.

Volcanic rock of probable Sheep Mountain age occurs only in a relatively small area in the vicinity of Del Norte. It has been included in the Sheep Mountain Quartz Latite because of general similarity to the Sheep Mountain rock occurring north of the survey area. The quartz latite flows forming Observatory Hill, just south of Del Norte, overlie the Conejos rocks very irregularly. The main flow is a purple-drab to dull-gray, banded, platy rock with alternate, highly vesicular bands.

The volcanic rock of the Treasure Mountain, Alboroto, and Piedra Rhyolite Formations generally is closely associated. The principal types are rhyolitic tuffs and welded tuffs formed from great explosive ash flows originating largely from the Creede caldera.

The tuff is soft rock made up mostly of small fragments of glass, pumice, and the broken walls of gas cavities and carrying a few crystals of feldspar and biotite. It is generally pale pinkish, light gray, or cream colored. In many places it is associated and interbedded with gravel and sand. This fact shows some distribution by water.

Welded tuff representing all stages of duration makes up a large part of these formations. It is the result of the cohesion of glass fragments in ash-flow material under certain temperature conditions prevailing at the time of deposition and subsequent cooling. The welded tuff is moderately hard to very hard, ranges from light brown to lavendar, and contains conspicuous phenocrysts of feldspar, biotite, and quartz. In many places it forms massive cliffs along stream valleys or resistant cappings of mesas. In places it has a thin basal zone of obsidian or vitrophyre. The harder varieties of welded tuff have often been mistakenly identified as flow rock. Probably only a few of the rhyolitic rocks of this survey area are of the lava flow type.

The Hinsdale Formation, of Pliocene epoch, is mainly lava flow deposited on a flat erosion surface over Miocene volcanic material. The Hinsdale rock is mainly in the Greenie Mountain area south of Rock Creek. A few small remnants occur southwest of Sevenmile Plaza. The rock at the lower elevations in these areas has been classified as basalt. The lava capping Greenie Mountain is latite.

The Quaternary, the latest and current period of geologic time, includes the Pleistocene and Holocene epochs. The Pleistocene epoch is marked by evidence of repeated worldwide glacial advances in the higher latitudes, fluctuations of sea level, and the appearance and migration of many existing species of plants and animals. The Holocene epoch is roughly the lapse of time since the retreat of the last Pleistocene ice sheet.

Deposits of the Quaternary period consist mainly of unconsolidated material weathered from Tertiary volcanic rock and transported and redeposited by water. These deposits consist of varying proportions of clay, silt, sand, gravel, cobbles, and boulders.

The oldest Quaternary deposit in the survey area is sandy and gravelly alluvial material, which mantles surfaces of the low, gently sloping terraces along both sides of the Rio Grande west of Del Norte and the mesas or fans along the mountain front south of Del Norte. In these areas at least two main sets of gravel-covered terraces can be observed at different heights above the modern stream flood plain. From a point about 4 miles east of South Fork and extending eastward toward the San Luis Valley, the two terrace levels converge rapidly and decline somewhat abruptly until in places they merge into the modern alluvium.

Upstream toward the west along Rock Creek and Raton Creek, the higher mesa surface rises much more steeply than the channels of the streams. In sections 29 and 32, T. 38 N., R. 7 E., the surface of the gravel mantle is less than 100 feet above the bed of Rock Creek, whereas 3.5 miles farther west it is more than 400 feet above the same stream.

In some places west of Monte Vista, the lower set of mesas or terraces blends into the younger alluvium of the flood plain. In places they are bounded on the east by escarpments 20 to 40 feet high, which descend abruptly from the mesa level to the flood plain. Westward, the mesa surface rises more rapidly than the stream gradient, so that at the mountainward margins it is 150 to 200 feet above the adjacent streambed.

The two sets of sloping mesas or terraces mantled with gravel indicate upward tilting of the mountains and downward tilting of the San Luis Valley during the Quaternary period. The gravelly alluvium mantling the two sets of mesas or terraces probably can be correlated with the two main intervals of Pleistocene glaciation in the San Juan Mountains that preceded the latest interval of Pleistocene glaciation.

Along the flood plains of the larger streams and on the Rio Grande alluvial fan, there are extensive alluvial deposits of latest Pleistocene (late Wisconsin) and Holocene epochs. A low glacial outwash terrace of probable late Wisconsin age is a prominent feature on both sides of the valley of the Rio Grande in the vicinty of South Fork. Eastward its surface declines regularly with a steeper gradient than that of the flood-plain alluvium. The terrace blends into the Recent alluvium of the flood plain in a few miles.

Some soils in the mountains have had reddish windblown silt and clay deposited on them from a source 200 or 300 miles to the southwest. In the eastern part of the survey area, some soils have been influenced by sandy material reworked by wind, especially at the surface.

Climate [6]

The Rio Grande County Area is in a high, dry mountain valley. The climate is characterized by cold winters, cool summers, low precipitation, strong winds in spring, and much sunshine. Temperature and precipitation are shown in tables 11 and 12 for the survey area.

[6] Tables prepared with the assistance of J. W. BERRY, climatologist for Colo., National Weather Service, U.S. Department of Commerce.

TABLE 11.—*Temperature and precipitation*

[Data on snow cover from Monte Vista. Other data from Del Norte, elevation 7,880 feet]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Average number of days with snow cover of 0.1 inch or more	Average depth of snow on days with snow cover of 0.1 inch or more
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*		*Inches*
January	36	6	48	−9	0.46	0.1	1.1	15	4
February	40	11	54	−6	.29	.1	.6	10	3
March	49	19	61	2	.50	.1	1.2	4	3
April	58	27	70	18	.77	.1	1.6	1	3
May	67	35	77	26	.87	.1	2.4	[1]	1
June	76	42	84	35	.59	.2	1.5	0	----------
July	80	47	86	42	1.19	.4	2.4	0	----------
August	78	46	83	40	1.57	.5	2.8	0	----------
September	73	39	81	32	.88	.1	1.7	[1]	1
October	63	30	73	21	.82	.1	2.5	[1]	1
November	48	18	60	2	.37	.1	1.1	1	4
December	38	9	51	−5	.34	.1	.9	8	5
Year	59	27	[2] 87	[3] −14	8.65	5.2	13.3	39	4

[1] Less than 0.5 day. [2] Average annual maximum. [3] Average annual minimum.

TABLE 12.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Del Norte, elevation 7,880 feet]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 25	May 8	May 17	June 3	June 18
2 years in 10 later than	April 19	May 2	May 11	May 28	June 12
5 years in 10 later than	April 8	April 21	April 30	May 17	June 1
Fall:					
1 year in 10 earlier than	October 20	October 11	October 2	September 23	September 9
2 years in 10 earlier than	October 25	October 16	October 7	September 27	September 14
5 years in 10 earlier than	November 3	October 25	October 16	October 7	September 23

Rainfall is lowest in the eastern part of the Area, averaging about 7 inches at Monte Vista. It increases to the west, averaging about 8.5 inches at Del Norte and about 12 inches at South Fork. The mountains in the southwestern part of the Area receive about 15 to 20 inches of precipitation. About 80 percent of the annual precipitation occurs from April to October. July and August receive the highest amount. June, the month when crops need moisture to germinate and start growing, is the driest month. Most of the rain falls as light showers from thunderstorms that form over the mountains and move into the valley during the afternoon. Most of these showers are light and benefit growing crops only slightly. Hail frequently falls in some areas during thunderstorms, causing extensive damage to crops.

At Del Norte in 40 years of record, the highest annual precipitation was 16.42 inches and the lowest was 4.75 inches. During this period 8 years had more than 11.0 inches of precipitation and 11 years less than 7.0 inches. At Monte Vista in 23 years of record, the highest annual precipitation was 13.06 inches and the lowest was 3.75 inches. During this period 2 years had more than 11.0 inches of precipitation and 8 years less than 6.0 inches.

Summer is characterized by maximum temperature

in the middle 80's and a minimum in the low 40's. The highest temperature recorded at Del Norte was 91° F, and the lowest −26°. The average summer temperature is about 62°, and the average annual temperature is about 43°. At Monte Vista the highest temperature recorded was 94°, and the lowest −37°. The average summer temperature is about 61°, and the average annual temperature 41°.

The length of the growing season varies considerably from year to year. It also varies between Monte Vista, in the central part of the major irrigated area, and Del Norte, on the edge of the foothills. Table 12 shows probabilities of last freezing temperature in spring and first in fall at Del Norte. The average length of the growing season is about 95 days at Monte Vista and about 110 days at Del Norte. This season is long enough for two cuttings of alfalfa, and it is generally sufficient time for potatoes, barley, oats, peas, lettuce, cauliflower, and cabbage. The last 32° or lower temperature in spring is generally between May 25 and June 15 at Del Norte and between June 2 and June 18 at Monte Vista. The first 32° or lower temperature in the fall is generally between September 9 and October 3 at Del Norte and between September 2 and Sptember 22 at Monte Vista.

Frost can occur in every month. It penetrates to a depth of 2 to 3 feet every year. The soil is generally frozen from mid-November to mid-March, but thaws by April.

Strong winds occur in spring and early in summer, causing much blowing dust before crops start to grow. Winds are mostly from the southwest. The wind does not normally blow strongly during fall and winter, unless it precedes a storm front. Spring and summer winds do the most damage by drying out the soil and making more frequent irrigation necessary.

Snowfall averages about 35 inches per year in the valley, but is more in the mountains. It is generally light between November and April. During winter, snow normally stays on the ground for several weeks at a time.

Farming

The Rio Grande County Area is mainly an agricultural community. The principal industry is irrigated farming and cattle and sheep raising. There are at present about 488 operating farms and ranches in the Area. Most farms are 160 to 320 acres in size. Most ranches are more than 640 acres.

The main crops and the approximate acreage are alfalfa and irrigated pasture, 31,000 acres; potatoes, 23,000 acres; barley, 30,000 acres; oats, 6,000 acres; and meadow hay, 20,000 acres. Other crops, such as lettuce, cabbage, cauliflower, peas, and spring wheat, grown to a lesser extent, amount to about a total of 5,000 acres.

Ranchers raise cattle and sheep, and many do some irrigated farming. Many farmers also have livestock—cattle, sheep, and hogs. The number of livestock on farms and ranches varies from year to year. Cattle generally number 13,000 to 28,000; sheep 55,000 to 100,000; and hogs 5,000 to 10,000.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil materials, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Depth, soil. To bedrock or to materials that restrict root development of common plants. Deep: more than 40 inches; moderately deep: 20 to 40 inches; shallow: 10 to 20 inches.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basins.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Parent material. Disintegrated and partly weathered rock from from which soil has formed.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposted by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of incresing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflowers) wilt so much that they do not recover when placed in a dark, humid atmosphere.

GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Capability unit Irrigated	Page	Capability unit Nonirrigated	Page	Range site	Page
Aa	Acacio sandy loam	8	IIIs-1	38	VIIs-3	43	Salt Flats	47
Ac	Acasco clay loam	8	IVw-1	41	Vw-1	41	Wet Meadow	48
Am	Alamosa loam	9	IIIw-1	38	Vw-1	41	Wet Meadow	48
Ao	Alamosa loam, saline	9	IIIw-2	38	VIw-1	42	Salt Meadow	48
Ar	Arena loam	10	IIIs-6	39	VIw-4	42	Salt Flats	47
As	Arena loam, drained	10	IIIs-4	39	VIw-1	42	Salt Flats	47
CrE	Celeste-Rock outcrop complex, 5 to 25 percent slopes	10	------	--	VIIs-1	43	----------	--
	Celeste extremely stony loam part	--	------	--	------	--	Rocky Foothills	47
	Rock outcrop part	--	------	--	------	--	(1/)	--
De	Derrick cobbly loam	11	IVs-1	41	VIIs-7	44	Mountain Outwash	47
Dn	Dunul cobbly sandy loam	11	IVs-1	41	VIIs-7	44	Mountain Outwash	47
EmE	Embargo very stony loam, 10 to 25 percent slopes	12	------	--	VIIs-1	43	Shallow Loam	48
FrC	Fulcher cobbly loam, 3 to 10 percent slopes	13	------	--	VIe-1	41	Loamy Park	47
GaB	Garita cobbly loam, 1 to 3 percent slopes	13	IVe-3	40	VIIs-8	44	Limy Bench	46
GaE	Garita cobbly loam, 3 to 25 percent slopes	13	------	--	VIIs-8	44	Limy Bench	46
Ge	Gerrard loam	14	IVw-1	41	VIw-3	42	Wet Meadow	48
Gp	Gravel pits	14	------	--	------	--	(1/)	--
Gr	Graypoint gravelly sandy loam	15	IVs-2	41	VIIs-2	43	Mountain Outwash	47
Gu	Gunbarrel loamy sand	15	IVe-1	40	VIIe-1	43	Salt Flats	47
Ho	Hooper loamy sand	16	VIs-1	42	VIIs-5	44	Salt Flats	47
Hp	Hooper clay loam	16	------	--	VIIs-4	44	(1/)	--
Jo	Jodero loam	17	IVe-2	40	VIe-1	41	Foothill Loam	46
La	Laney loam	18	IIIs-4	39	VIIs-3	43	Salt Flats	47
LuB	Luhon loam, 1 to 3 percent slopes	19	IIIe-1	37	VIIs-3	43	Limy Bench	46
LuC	Luhon loam, 3 to 6 percent slopes	19	IVe-2	40	VIIs-3	43	Limy Bench	46
Ma	Marsh	19	------	--	VIIIw-1	44	(1/)	--
Mh	Mishak loam	20	IIIs-6	39	VIw-1	42	Salt Meadow	48
MoA	Monte loam, 0 to 1 percent slopes	21	IIIs-1	38	VIIs-3	43	Mountain Outwash	47
MoB	Monte loam, 1 to 3 percent slopes	21	IIIe-1	37	VIIs-3	43	Mountain Outwash	47
Ms	Mosca loamy sand	23	IIIe-2	37	VIIe-1	43	Salt Flats	47
No	Norte gravelly sandy loam	23	IIIs-2	39	VIIs-7	44	Mountain Outwash	47
Nr	Norte-Dunul complex	23	IVs-1	41	VIIs-7	44	Mountain Outwash	47
PaA	Platoro loam, 0 to 1 percent slopes	24	IIIs-3	39	VIIs-2	43	Mountain Outwash	47
PaB	Platoro loam, 1 to 3 percent slopes	24	IIIe-3	38	VIIs-2	43	Mountain Outwash	47
Qa	Quamon gravelly sandy loam	24	IVs-2	41	VIIs-7	44	Mountain Outwash	47
Ro	Rock outcrop	25	------	--	VIIIs-1	44	(1/)	--
Sa	San Arcacio sandy loam	26	IIIs-2	39	VIIs-2	43	Salt Flats	47
Sb	San Arcacio sandy loam, saline	26	IIIs-5	39	VIw-2	42	Salt Flats	47
Sc	San Arcacio loam	26	IIIs-3	39	VIIs-2	43	Salt Flats	47
Sd	San Luis sandy loam	27	IIIs-6	39	VIw-2	42	Salt Flats	47
Se	San Luis sandy loam, drained	27	IIIs-7	40	VIw-2	42	Salt Flats	47
Sf	San Luis-Quamon complex	27	IVs-2	41	VIIs-7	44	----------	--
	San Luis sandy loam, drained part	--	------	--	------	--	Salt Flats	47
	Quamon gravelly sandy loam part	--	------	--	------	--	Mountain Outwash	47
Sh	Schrader sandy loam	27	IIIw-1	38	Vw-1	41	Wet Meadow	48
SkF	Seitz very stony loam, 20 to 65 percent slopes	28	------	--	VIIs-6	44	(1/)	--
SmA	Shawa loam, 0 to 1 percent slopes	28	IIIs-1	38	VIs-2	43	Foothill Loam	46
SmB	Shawa loam, 1 to 3 percent slopes	29	IIIe-1	37	VIs-2	43	Foothill Loam	46
SnB	Stunner loam, 1 to 3 percent slopes	29	IIIe-1	37	VIIs-3	43	Limy Bench	46
SnC	Stunner loam, 3 to 6 percent slopes	29	IVe-2	40	VIIs-3	43	Limy Bench	46
Ta	Terrace escarpments	29	------	--	VIIs-8	44	(1/)	--
TeE	Tolman-Empedrado complex, 3 to 25 percent slopes	30	------	--	VIIs-1	43	----------	--
	Tolman very stony loam part	--	------	--	------	--	(1/)	--
	Empedrado loam part	--	------	--	------	--	Foothill Loam	46

Map symbol	Mapping unit	Page	Capability unit Irrigated	Page	Capability unit Nonirrigated	Page	Range site	Page
To	Torsido clay loam	30	IIIw-1	38	Vw-1	41	Wet Meadow	48
TrE	Travelers very stony sandy loam, 3 to 25 percent slopes	31	------	--	VIIs-8	44	Basalt Hills	46
TsE	Travelers-Garita complex, 5 to 25 percent slopes	31	------	--	VIIs-8	44	----------	--
	Travelers very stony loam part	--	------	--	------	--	Basalt Hills	46
	Garita cobbly loam part	--	------	--	------	--	Limy Bench	46
Tt	Typic Fluvaquents	31	IIIw-2	38	VIw-1	42	Salt Meadow	48
Tu	Typic Torrifluvents	32	IVs-2	41	VIIw-1	43	(1/)	--
Va	Vastine loam	32	IIIw-1	38	Vw-1	41	Wet Meadow	48
Vg	Villa Grove sandy clay loam	33	IIIs-1	38	VIIs-3	43	Salt Flats	47
Vh	Villa Grove sandy clay loam, saline	33	IIIs-4	39	VIw-2	42	Salt Flats	47
Zn	Zinzer loam	33	IIIs-1	38	VIIs-3	43	Salt Flats	47
Zr	Zinzer loam, saline	33	IIIs-4	39	VIw-2	42	Salt Flats	47

1/ Not in a range site.

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