United States Department of Agriculture

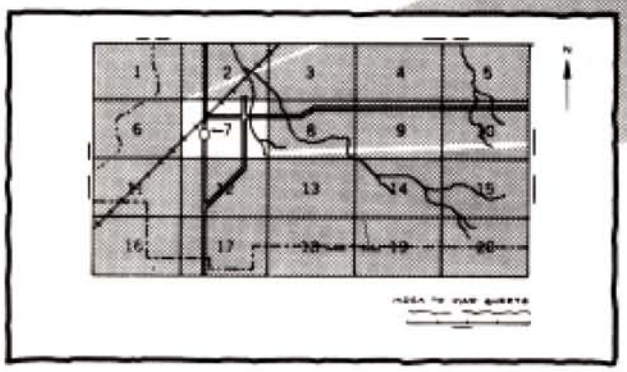
Soil Conservation Service

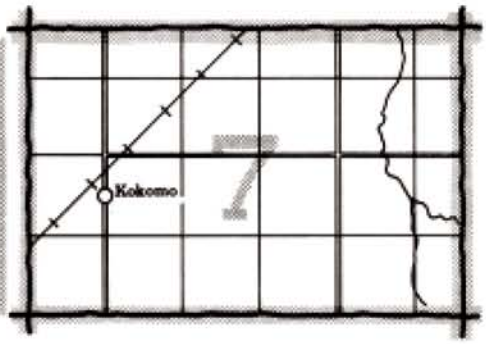
In cooperation with United States Department of the Interior, Bureau of Indian Affairs, and Colorado Agricultural Experiment Station

Soil Survey of La Plata County Area, Colorado

HOW TO USE

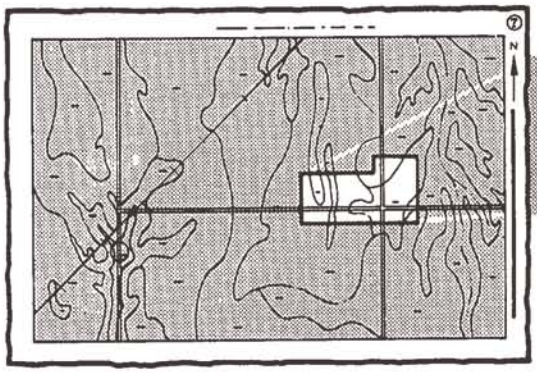
1. Locate your area of interest on the "Index to Map Sheets"

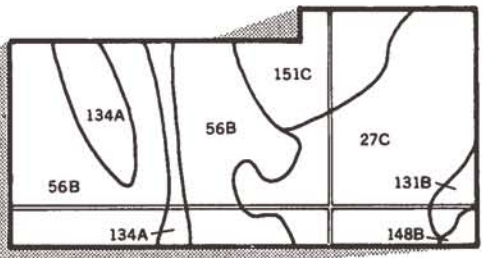




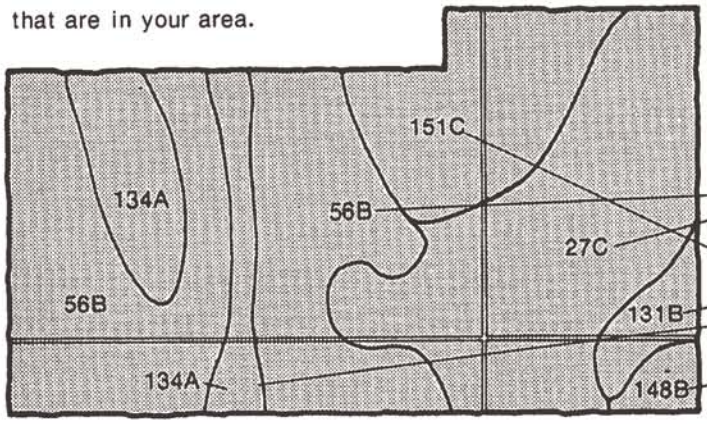
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.

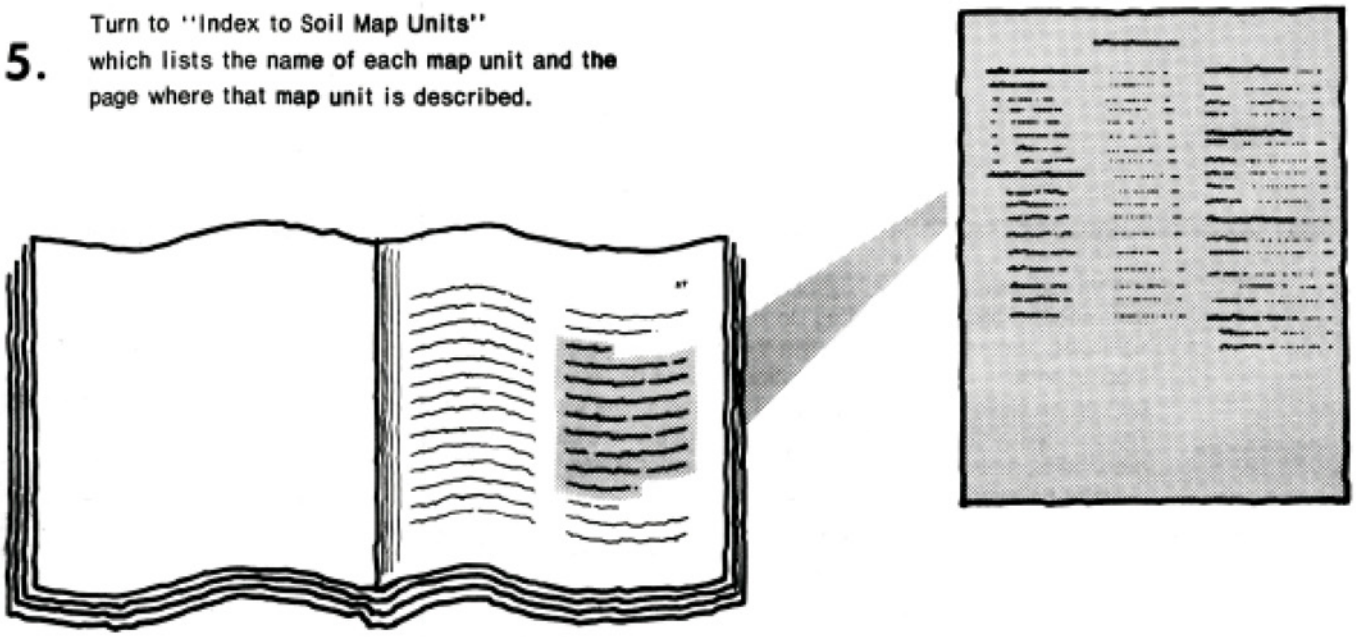


Symbols

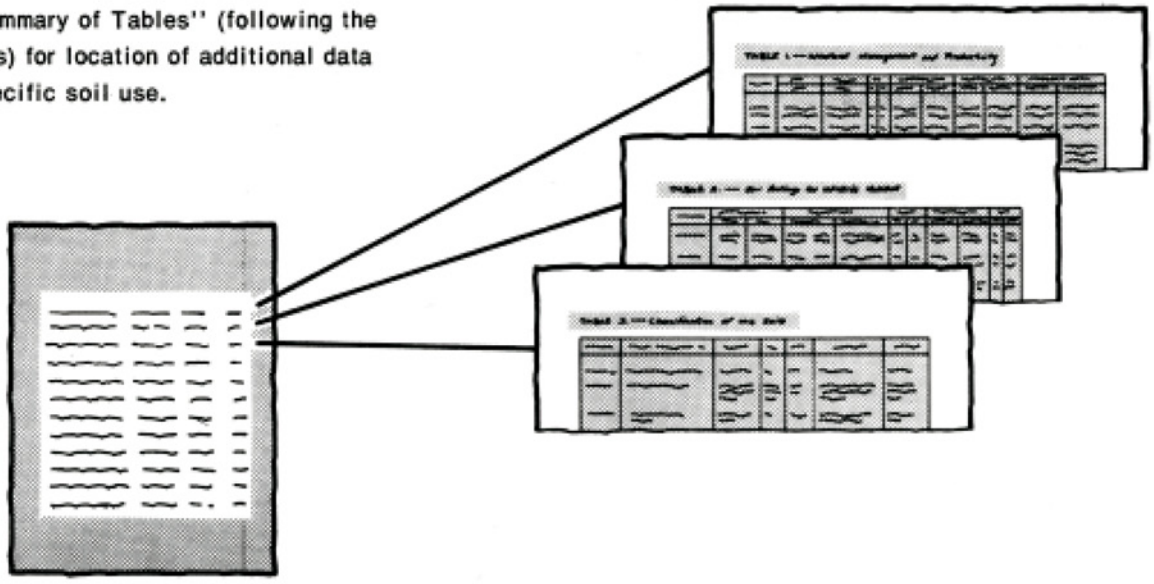
- 27C
- 56B
- 131B
- 134A
- 148B
- 151C

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. 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, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981. This survey was made cooperatively by the Soil Conservation Service, the Bureau of Indian Affairs, and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the La Plata and Pine River Soil Conservation Districts. Financial assistance was provided by these districts.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Irrigated pasture and hay on Falfa clay loam early in spring. Snow-capped La Plata Mountains in the background.

Contents

Soil Series

Index to Map Units

Summary of Tables

Foreword

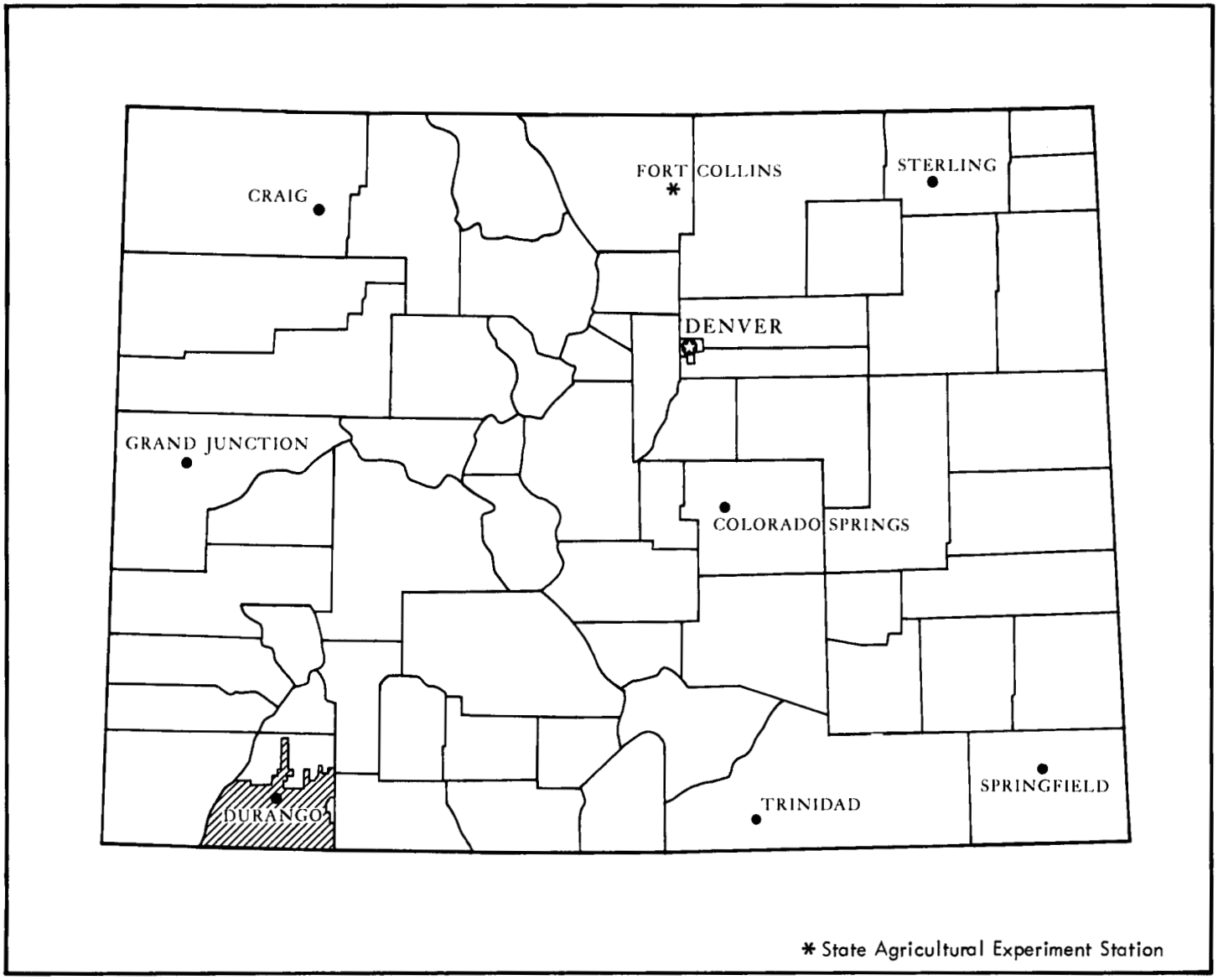
This soil survey contains information that can be used in land-planning programs in the La Plata County Area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Sheldon G. Boone
State Conservationist
Soil Conservation Service



Location of La Plata County Area in Colorado.

Soil Survey of
La Plata County Area, Colorado

By James P. Pannell, Soil Conservation Service

Fieldwork by James P. Pannell, Bernard A. Benton, Barbara W. Cencich, Paul A. Deutsch, Jan L. Fritch, and Mark C. Neeley, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with
United States Department of the Interior, Bureau of Indian Affairs;
Colorado Agricultural Experiment Station;
La Plata Soil Conservation District; and
Pine River Soil Conservation District

LA PLATA COUNTY AREA is in the southwestern part of Colorado. It has a total area of about 823,240 acres. Durango, the county seat, is located approximately in the center of the area. The population of Durango is about 11,646, and the population of the survey area is about 27,101.

The southern part of the survey area consists of mesas, foothills, and valleys, and the northern part consists of high mountains and valleys. The Animas, Florida, La Plata, and Los Pinos Rivers run through the area and join the San Juan River in New Mexico.

The climate in the survey area is mild, and it is semi-arid to subhumid. The summers are dry, and the winters are characterized by heavy snow. The average annual temperature at Durango is about 47 degrees F, the average annual precipitation is about 18 inches, and the growing season is about 100 days.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent survey areas. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey area.

General Nature of the Survey Area

This section gives general information concerning the survey area. It discusses history and development; physiography, relief, and drainage; climate; natural resources; farming and ranching; industry and transportation; and school facilities.

History and Development

La Plata County was established in 1874 from parts of Costilla, Conejos, and Lake Counties. The first known explorer to this area was Coronado in 1541. The Baker expeditions of gold seekers in 1859-61 essentially opened the way for development of the county. In 1881 the Denver & Rio Grande Railroad came to the town of Durango, which became the new county seat.

Mining played an important part in the early settlement of La Plata County. Rich strikes of gold, silver, lead, and copper were made. Several coal mines were also in operation early in the development of the county. Some mining is still being done today.

In about 1875, cattle ranches became prominent along the Florida River. In the 1880's, large cattle herds and sheep grazed the open range. Farming also became more prominent during this time. In 1905 the San Juan National Forest was established. Grazing permits were given to the cattlemen and sheepmen to use the forest land. This system is still used today.

Many of the valleys and mesas are irrigated by water from high mountains through various irrigation ditches and laterals built in the late 1800's and early 1900's by companies formed by area farmers. Sprinkler irrigation is also used in parts of the survey area. Field crops grown are alfalfa hay, small grain, and some corn for silage and dry beans.

Recreation and tourism play an important part in the economy of the survey area.

Physiography, Relief, and Drainage

The survey area consists of mountains, foothills, mesas, and valleys. Part of the area is in the Southern Rocky Mountain physiographic province, and part makes up the San Juan Basin in the Navajo section of the Colorado Plateaus province.

The northern part of the area is in the San Juan and La Plata Mountains. During Tertiary and Quaternary time, these mountains were formed by an uplift that was accompanied or followed by periods of high volcanic activity. This part of the area consists of mountains and narrow valleys. Many of the valleys are as much as 2,500 feet lower than the adjacent mountaintops. The mountains range in elevation from about 7,000 to 10,400 feet. The mountainsides are sloping to steep.

The southern part of the area consists of mesas, foothills, and valleys. The mesas are mostly gently sloping or sloping and have been dissected by narrow valleys. The valleys have steep canyonsides and rock ledges along the edge of the mesas. The mesa tops are about 100 to 300 feet higher than the narrow valley bottoms.

The foothills make up transitional areas between the mountains and the mesas and areas within broad upland valleys. The foothills are gently sloping to steep and consist mostly of shale and sandstone. These areas are characterized by high relief, stepped topography, hilltops, narrow upland valleys, steep canyonsides, and rock ledges. Elevation ranges from about 6,300 to 7,500 feet.

Four river valleys cross the survey area, generally in a north-south direction. They are nearly level to gently sloping. Most of the valleys are terraced above the valley bottom. Elevation of the valleys ranges from about 6,000 to 8,000 feet.

A large upland valley in the southeastern part of the survey area, which includes Tiffany and Oxford, is gently sloping to sloping. It includes many small areas of foothills. This area is characterized by low relief, and the difference in elevation between the drainage bottoms and ridge summits is seldom more than 100 feet.

The survey area is drained by the La Plata, Animas, Florida, and Los Pinos Rivers and their tributaries. They all flow to the south and join the San Juan River in New Mexico. The hazard of flooding along the Florida and Los Pinos Rivers has been greatly reduced by the construction of Vallecito Dam and Lemon Dam; however, flooding is still a threat to urban areas, farmland, and irrigation and transportation systems along the Animas and La Plata Rivers.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

In this survey area, summers are warm in most valleys and much cooler in the mountains. Winters are cold in the mountains. Winters in the valleys are colder than the lower slopes of adjacent mountains because of cold air drainage. Precipitation occurs in the mountains throughout the year, and a deep snowpack accumulates during winter. Snowmelt usually supplies much more water than can be used for agriculture in the area. In the valleys precipitation in summer falls as rain showers and in winter the ground is covered with snow much of the time. Some thunderstorms occur.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Durango, Ignacio, and Vallecito Dam for the period 1951-78. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature at Durango, Ignacio, and Vallecito Dam is 28, 26, and 24 degrees F, respectively. The average daily minimum temperature is 13 degrees at Durango, 10 degrees at Ignacio, and 8 degrees at Vallecito Dam. The lowest temperature, -35 degrees, occurred at Vallecito Dam on January 12, 1963. In summer the average temperature is 65 degrees at Durango and Ignacio and 62 degrees at Vallecito Dam. The average daily maximum temperature is about 83 degrees. The highest recorded temperature, 102 degrees, occurred at Ignacio on July 8, 1966.

Growing degree days, shown in table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees). The normal monthly accumulation is used to schedule single or successive planting of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 18 inches at Durango, 14 inches at Ignacio, and 25 inches at Vallecito Dam. Of this, 50 percent usually falls in April through September, which includes the growing season for most crops. The heaviest 1-day rainfall during the period of record was 3.65 inches at Durango on October 19, 1972.

Thunderstorms occur on about 45 days each year, and most occur in summer.

The average seasonal snowfall is 67 inches at Durango, 38 inches at Ignacio, and 131 inches at Vallecito Dam. The greatest snow depth during the period of record was 35 inches at Durango and Vallecito Dam, and 22 inches at Ignacio.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is at least 90 percent in summer and 70 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 10 miles per hour, in spring.

Natural Resources

Natural resources in the survey area include natural gas, coal, lead, zinc, silver, gold, sand, gravel, soil, and water. Natural gas has been important to the economy of the area since about 1951. Natural gas fields occupy extensive areas in the central and southern parts of the survey area, which is in the San Juan structural basin.

Coalbeds underlie a large part of the central and southern parts of the survey area. Most of it is bituminous or subbituminous coal at a depth of 150 to 3,000 feet. In several narrow bands or small areas along canyonsides, coalbeds are at a depth of less than 150 feet. Interest has increased rapidly in coal exploration and mining in recent years.

Lead, zinc, silver, and gold are also mined. The mines are in the La Plata mining district, part of which is in the survey area in the vicinity of Mayday.

Sand and gravel occur throughout the survey area in the river valleys and on gravelly terrace edges. The sand and gravel are used for construction of roads and buildings.

Soil and water are important natural resources. Crops, range plants, woodland products, and food and cover for wildlife are produced on the soils in the survey area. Water originating in the area is used for irrigation, for domestic, industrial, and recreation purposes, and for wildlife. The water comes from melting snow and streams in the mountains, and much of it is stored in Vallecito and Lemon Reservoirs and Electra Lake for use in summer.

Farming and Ranching

Farming in the survey area consists of nonirrigated farming, mainly in the southwestern part of the area, and irrigated farming, mainly in the southeastern and central parts. Ranching consists of cattle and sheep operations.

Nonirrigated crops are mainly winter wheat and dry beans. Small amounts of barley, oats, and alfalfa are also grown. A few fields in the county are summer fallowed. A common cropping system on nonirrigated land is 2 years of dry beans followed by 1 year of winter wheat. Normally, sufficient precipitation falls in winter and spring for production of the crops.

The main irrigated crops grown in the area are alfalfa hay and other hay crops. Small amounts of irrigated corn for silage, oats, and barley are also grown. In 1980 about 22,000 acres of alfalfa hay was produced, about 12,500 acres of other hay crops, and about 6,000 acres of other irrigated crops.

Gravity-pressurized irrigation systems can be used in some areas. These systems include sprinkler and gated pipe methods. Irrigated crop production is limited by the relatively short growing season and the cool summer nights.

Ranches are throughout most of the survey area. Many ranchers have grazing permits for the San Juan National Forest or for land administered by the Bureau of Land Management, and sheep graze this land during summer. Then the sheep are moved to pasture at lower elevations during fall, winter, and spring. Most of the ranchers in the area grow alfalfa hay or grass hay, or a mixture of both, to supplement feed during winter. Some irrigated hayfields are also used for pasture. Most ranches are cow-calf operations, but there are a few feedlot operations in the area.

Industry and Transportation

Industry in the survey area includes tourist and recreational enterprises, production and processing of timber, mining and natural gas production, farming, and ranching. Tourist and recreational enterprises are probably the largest sources of income for the area. The high peaks, wooded mountains, river, and creeks attract sightseers, hikers, and campers. The big game animals in the area and the lakes, reservoirs, and streams draw many people for hunting and fishing. One major ski area and four small ones attract many people for winter sports. A narrow-gauge railroad provides daily scenic excursions from Durango up the Animas River Valley to Silverton in summer and fall.

Timber is produced in the survey area. Much of it is processed at local sawmills, which provide employment for many people and benefit the economy of the area. Mining and natural gas production are also important to the economy. Farming and ranching thrive in the area.

Two highways serve the survey area—U.S. Highway 160 crosses it in an east-west direction, and U.S. Highway 550 crosses it in a north-south direction. Both run through Durango. All livestock, coal, and timber products produced in the area are shipped over these highways. The area is served by the La Plata County Airport.

School Facilities

Primary and secondary schools are in the towns of Durango, Bayfield, and Ignacio. In addition, primary

schools are also in the more populated rural areas. Fort Lewis College, a 4-year liberal arts school, is located in Durango.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge gradually onto one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While the soil survey was in progress, samples of some of the soils in the area were collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses and under different levels of management. Some interpretations were modified to fit local conditions, and some new interpretations were developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils or miscellaneous areas can be identified on the map. Likewise, areas that are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general map units in this survey have been grouped into general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

Map Unit Descriptions

Warm soils on mesas, foothills, and breaks and in upland valleys

This group consists of seven map units. It makes up about 62 percent of the survey area.

1. Witt-Lazear-Pulpit

Shallow to deep, well drained, gently sloping to steep, medium textured soils; on mesas, uplands, and breaks

This map unit is in the west-central and southwestern parts of the survey area, in the vicinity of the Red Mesa and Kline. It is in gently sloping to sloping areas on uplands and mesas and in sloping to steep areas on breaks and edges of mesas. Slope is 1 to 65 percent. The native vegetation is pinyon, juniper, sagebrush, and grasses. Elevation is 6,000 to 7,800 feet. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 45 to 50 degrees F. The frost-free season is 110 to 130 days.

This unit makes up about 17 percent of the survey area. It is about 50 percent Witt soils, 20 percent Lazear soils, and 10 percent Pulpit soils. The remaining 20 percent is components of minor extent.

Witt soils are on mesas and uplands. These soils are deep and well drained. They formed in silty calcareous loess derived dominantly from red-bed sandstone. The surface layer is loam, the subsoil is silty clay loam, and the substratum is loam.

Lazear soils are on breaks, mesa tops, and edges of mesas. These soils are shallow and well drained. They formed in residuum derived dominantly from sandstone. The surface layer is stony loam, and the underlying material is loam. Sandstone is at a depth of 10 to 20 inches.

Pulpit soils are on mesas. These soils are moderately deep and well drained. They formed in loess derived dominantly from red-bed sandstone. The surface layer is loam, the subsoil is silty clay loam, and the substratum is loam. Sandstone is at a depth of 20 to 40 inches.

Of minor extent in this unit are deep, moderately well drained Umbarg soils on alluvial fans and upland valley bottoms; deep, well drained Vosburg soils in upland swales and on foot slopes; Simpatico soils in upland swales; and Vernal soils on terraces. Also included are Rock outcrop, Ustic Torriorthents, and Ustollic Haplargids on breaks, mesa edges, and hillsides.

This unit is used for nonirrigated crops, irrigated crops, livestock grazing, and wildlife habitat.

The main nonirrigated crops are wheat and beans. The major management concerns on nonirrigated cropland are conserving moisture and controlling water erosion. Much of this unit has good potential for use as irrigated cropland, but an adequate water supply is not available. In areas that are irrigated, the principle crops are alfalfa, barley, and oats. The major management concerns on irrigated cropland are controlling water erosion, maintaining fertility, and properly managing irrigation water.

2. Arboles-Bayfield-Zyme

Shallow and deep, well drained, nearly level to moderately steep, moderately fine textured soils; on foothills and in upland valleys

This map unit is in the eastern and southeastern parts of the survey area, in the vicinity of Ignacio and Tiffany.

It is in gently sloping to sloping areas in upland valleys and on valley sides and in sloping to moderately steep areas on hills and ridges. Slope is 1 to 25 percent. The native vegetation is pinyon, juniper, shrubs, and grasses. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 13 to 18 inches, and the average annual air temperature is 46 to 50 degrees F. The frost-free season is 110 to 130 days.

This unit makes up about 13 percent of the survey area. It is about 35 percent Arboles soils, 30 percent Bayfield and similar soils, and about 20 percent Zyme soils. The remaining 15 percent is soils of minor extent.

Arboles soils are in upland valleys and on valley sides. These soils are deep and well drained. They formed in alluvium derived dominantly from shale. The surface layer and subsoil are clay, and the substratum is clay loam.

Bayfield and similar soils are in broad upland valleys. These soils are deep and well drained. They formed in alluvium derived dominantly from shale. The surface layer is silty clay loam. The underlying layer is silty clay over silty clay loam. The similar soils are in the Sili series.

Zyme soils are on hills and ridges. These soils are shallow and well drained. They formed in residuum derived from shale. The surface layer and underlying material are clay loam. Shale is at a depth of 6 to 20 inches.

Of minor extent in this unit are the moderately deep, well drained Bodot soils on shale hills.

This unit is used for irrigated field crops, irrigated pasture, and rangeland.

The main irrigated crops grown are alfalfa, small grain, and pasture. The main management concerns are controlling water erosion, properly managing irrigation water, and maintaining the organic matter content and fertility of the soil.

3. Falfa-Ustic Torriorthents

Deep, well drained and somewhat excessively drained, gently sloping to steep, moderately fine textured and moderately coarse textured soils; on mesas and breaks

This map unit is in the central part of the survey area and includes Florida Mesa. It is in gently sloping to sloping areas on mesas and moderately steep to steep areas on mesa edges. Slope is 1 to 65 percent. The native vegetation is pinyon, juniper, shrubs, and grasses. Elevation is 6,500 to 7,000 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 45 to 50 degrees F. The frost-free season is 100 to 130 days.

This unit makes up about 5 percent of the survey area. It is about 80 percent Falfa soils and 10 percent Ustic Torriorthents. The remaining 10 percent is soils of minor extent.

Falfa soils are on mesas. These soils are deep and well drained. They formed in loess derived dominantly from red-bed sandstone. The surface layer is clay loam, the subsoil is clay, and the substratum is clay loam.

Ustic Torriorthents are on mesa edges and breaks. They are deep and are well drained and somewhat excessively drained. They formed in gravelly and cobbly alluvium. The surface layer is gravelly loam, cobbly loam, or fine sandy loam. The underlying material is mixed alluvium that is very gravelly or cobbly.

Of minor extent in this unit are deep, well drained Simpatico soils in swales on mesa tops and Ustollic Haplargids on mesa edges and hillsides.

This unit is used for irrigated crops, nonirrigated crops, rangeland, and wildlife habitat.

The principle irrigated crops grown are alfalfa, pasture, small grain, and corn for silage. The major management concerns on irrigated cropland are preventing water erosion, maintaining organic matter content and fertility, and properly managing irrigation water. Wheat is the principle nonirrigated crop grown. The major management concerns on nonirrigated cropland are conserving moisture and preventing water erosion. In areas used as rangeland, proper grazing use and planned grazing systems are important to maintain the quality and quantity of desirable rangeland plants. Management for wildlife includes providing protection from overgrazing by livestock, maintaining wooded areas, maintaining cover and nesting areas in and around the areas of irrigated cropland, and providing protection from fire.

4. Dulce-Travessilla-Rock outcrop

Shallow, well drained, sloping to steep, moderately coarse textured soils, and Rock outcrop; on foothills and ridges

This unit is in the southern part of the survey area, bordering the state line. It is in sloping to steep areas on foothills and ridges and is characterized by escarpments of Rock outcrop and many canyons. Slope is 6 to 50 percent. Native vegetation is pinyon, juniper, shrubs, and grasses. Elevation is 6,000 to 7,00 feet. The average annual precipitation is 13 to 16 inches, and the average annual air temperature is 45 to 50 degrees F. The frost-free season is 115 to 140 days.

This unit makes up about 7 percent of the survey area. It is about 30 percent Dulce and similar soils, 25 percent Travessilla and similar soils, and 20 percent Rock outcrop. The remaining 25 percent is soils of minor extent.

Dulce and similar soils are on foothills and ridges. These soils are shallow and well drained. They formed in residuum derived from sandstone. The surface layer and underlying material are sandy loam. Soft sandstone is at a depth of 10 to 20 inches. The similar soils are in the Zyme series.

Travessilla and similar soils are on foothills and ridges. These soils are shallow and well drained. They formed in

residuum derived from sandstone. The surface layer and underlying material are sandy loam. Hard sandstone is at a depth of 6 to 20 inches.

Rock outcrop is on cliffs, ridges, breaks, and ledges. It consists of exposures of sandstone. The similar soils are in the Lazear series.

Of minor extent in this unit are deep, well drained Buckle, Yenlo, and Florita soils in upland valleys and deep, well drained Mikim soils on alluvial fans and in foothill valleys.

This unit is used mainly as rangeland and wildlife habitat.

Low precipitation and shallow soils depth limit the kind and amount of forage plants produced.

5. Zyme-Rock outcrop-Ustic Torriorthents

Shallow and deep, well drained and somewhat excessively drained, gently sloping to steep, moderately fine textured and moderately coarse textured soils, and Rock outcrop; on foothills, ridges, terrace escarpments, and breaks

This map unit is in the central and southern parts of the survey area and includes parts of Mesa Mountain, Basin Mountain, and Black Ridge. It is in gently sloping to steep areas on hills and ridges and in moderately steep to steep areas on terrace edges. Slope is 3 to 65 percent. The native vegetation is pinyon, juniper, shrubs, and grasses. Elevation is 6,000 to 7,500 feet. The average annual precipitation is 14 to 17 inches, and the average annual air temperature is 45 to 50 degrees F. The frost-free season is 110 to 130 days.

This unit makes up about 15 percent of the survey area. It is about 50 percent Zyme and similar soils, 20 percent Rock outcrop, and 15 percent Ustic Torriorthents and similar soils. The remaining 15 percent is components of minor extent. The similar soils are in the Picante and Lazear series.

Zyme soils are on hills and ridges. These soils are shallow and well drained. They formed in residuum derived from shale. The surface layer and underlying material are clay loam. Shale is at a depth of 6 to 20 inches.

Rock outcrop is on cliffs, ridges, breaks, and ledges. It consists of exposures of sandstone.

Ustic Torriorthents and similar soils are on terrace edges, mesa edges, and hillsides. They are deep and are well drained and somewhat excessively drained. They formed in gravelly and cobbly alluvium. The surface layer is gravelly loam, cobbly loam, or fine sandy loam. The underlying material is mixed alluvium that is very gravelly or cobbly. Similar soils are Ustollic Haplargids.

Of minor extent in this unit are the deep, well drained Arboles soils on valley sides and in upland valleys; deep, well drained Mikim and Sili soils on alluvial fans and toe slopes and in upland valleys; and shale Badland.

This unit is used for livestock grazing and wildlife habitat.

Low precipitation, shallow soil depth, and low soil fertility limit the kind and amount of forage plants produced.

6. Panitchen-Yenlo-Dominguez Variant

Deep, well drained, gently sloping, moderately fine textured and moderately coarse textured soils; in upland valleys

This map unit is in the southwestern part of the survey area, bordering the state line. It is in gently sloping areas along drainageways and on valley bottoms. Slope is 1 to 6 percent. The native vegetation is mainly shrubs and grasses. Elevation is 6,000 to 6,600 feet. The average annual precipitation is 12 to 15 inches, and the average annual air temperature is 47 to 52 degrees F. The average frost-free season is 120 to 130 days.

This unit makes up about 2 percent of the survey area. It is about 30 percent Panitchen and similar soils, 25 percent Yenlo and similar soils, and 20 percent Dominguez Variant and similar soils. The remaining 25 percent is soils of minor extent.

The Panitchen and similar soils are in drainageways and on valley bottoms. These soils are deep and well drained. They formed in alluvium derived dominantly from sandstone and shale. The surface layer is silty clay loam, and the underlying material is silty clay loam stratified with thin layers of sandy loam, loamy sand, and gravelly sandy loam. The similar soils are in the Mikim series.

The Yenlo and similar soils are in upland valleys. These soils are deep and well drained. They formed in alluvium derived dominantly from sandstone and shale. The surface layer is sandy loam, the subsoil is sandy clay loam, and the substratum is sandy loam. The similar soils are in the Florita series.

The Dominguez Variant and similar soils are along drainageways and on upland valley bottoms. These soils are deep and well drained. They formed in alluvium derived from shale. The surface layer is silty clay loam, and the subsoil and substratum are clay. The similar soils are in the Arboles and Sili series.

Of minor extent in this unit are the deep, well drained Buckle soils in upland valleys and the shallow, well drained Picante soils on cuestas and hills.

This unit is used as rangeland and wildlife habitat.

7. Durango-Zyme-Rock outcrop

Shallow and deep, well drained, gently sloping to steep, moderately fine textured to moderately coarse textured soils, and Rock outcrop; on mesas, foothills, and ridges

This map unit is in the southern part of the survey area and includes part of Mesa Mountain. It is in gently sloping to moderately steep areas on mesa tops that are dissected by drainageways and in moderately steep to steep areas on hills and ridges. Slope is 3 to 65 percent. The native vegetation is pinyon, juniper, shrubs, and

grasses. Elevation is 6,600 to 7,400 feet. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 45 to 50 degrees F. The frost-free season is 100 to 130 days.

This unit makes up about 3 percent of the survey area. It is about 50 percent Durango soils, 20 percent Zyme soils, and 15 percent Rock outcrop. The remaining 15 percent is soils of minor extent.

The Durango soils are on mesa tops and ridgetops. These soils are deep and well drained. They formed in glacial outwash. The surface layer is cobbly loam, the subsoil is clay loam, and the substratum is clay loam over clay.

The Zyme soils are on hills and ridges. These soils are shallow and well drained. They formed in residuum derived from shale. The surface layer and underlying material are clay loam. Shale is at a depth of 6 to 20 inches.

Rock outcrop is on cliffs, ridges, breaks, and ledges. It consists mostly of barren exposures of sandstone.

Of minor extent in this unit are deep, well drained Buckle soils in upland valleys and deep, well drained Sili soils on side slopes, fans, and bottoms of upland valleys.

This unit is used as rangeland and wildlife habitat.

Warm and cool soils on flood plains, terraces, and alluvial fans

This group consists of two map units. It makes up about 5 percent of the survey area.

8. Pescar-Tefton-Fluvaquents

Deep, somewhat poorly drained and poorly drained, nearly level to gently sloping, moderately coarse textured and medium textured soils; on flood plains, low terraces, and alluvial valley floors

This map unit is throughout the survey area. It is in nearly level to gently sloping areas on flood plains, low terraces, and alluvial valley floors. Slope is 0 to 3 percent. The native vegetation is sedges, rushes, grasses, willows, and cottonwoods. Elevation is 6,000 to 8,000 feet. The average annual precipitation is 15 to 22 inches, and the average annual air temperature is 42 to 53 degrees F. The average frost-free season is 90 to 130 days.

This unit makes up about 3 percent of the survey area. It is about 30 percent Pescar soils, 25 percent Tefton soils, and 15 percent Fluvaquents. The remaining 30 percent is components of minor extent.

Pescar soils are on flood plains, low terraces, and alluvial valley floors. These soils are deep, somewhat poorly drained, and frequently flooded. The surface layer and underlying material are fine sandy loam. Very gravelly sand is at a depth of 18 to 30 inches.

Tefton soils are on flood plains and alluvial valley floors. These soils are deep, somewhat poorly drained, and occasionally flooded. The surface layer is loam, and the underlying material is stratified loam and sandy loam.

Fluvaquents are on alluvial valley floors and along major drainageways. The soils are deep, poorly drained and somewhat poorly drained, and frequently flooded. The surface layer is gravelly loam, cobbly loam, or sandy loam. The underlying material is sand and gravel.

Of minor extent in this unit are deep, well drained Hayness and Hesperus soils on valley sides and alluvial fans; deep, well drained Pastorius, Sedillo, and Sycle soils on high river terraces; and deep, poorly drained Alamosa soils on alluvial valley floors, fans, and bottoms.

This unit is used mainly for irrigated field crops and pasture, rangeland, and wildlife habitat.

The principle irrigated crops are alfalfa, small grain, and pasture. The major management concerns on irrigated cropland are controlling water erosion, properly managing irrigation water, and maintaining the organic matter content and fertility of the soil.

9. Shalona-Sedillo-Mikim

Deep, well drained, nearly level to sloping, medium textured soils; on river terraces and alluvial fans

This map unit is mostly in the southern part of the survey area, along a river valley. It is in nearly level to gently sloping areas on old high terraces and in gently sloping to sloping areas on alluvial fans. Slope is 0 to 12 percent. The native vegetation is sagebrush, grasses, pinyon, and juniper. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 13 to 18 inches, and the average annual air temperature is 45 to 52 degrees F. The average frost-free season is 110 to 130 days.

The unit makes up about 2 percent of the survey area. It is about 35 percent Shalona and similar soils, 30 percent Sedillo and similar soils, and 10 percent Mikim soils. The remaining 25 percent is soils of minor extent.

Shalona and similar soils are on high river terraces. These soils are deep and well drained. They formed in mixed alluvium derived dominantly from sandstone and shale. The surface layer is loam, the subsoil is clay loam, and the substratum is loam. Similar soils are in the Harlan and Arboles series.

Sedillo and similar soils are on high river terraces. These soils are deep and well drained. They formed in cobbly glacial outwash. The surface layer is gravelly loam, the subsoil is very gravelly clay loam, and the substratum is very cobbly sandy clay loam. The similar soils are in the Pastorius and Nehar series.

Mikim soils are on alluvial fans. These soils are deep and well drained. They formed in alluvium derived dominantly from sandstone and shale. The surface layer and underlying material are loam.

Of minor extent in this unit are deep, somewhat poorly drained Tefton soils on flood plains and alluvial valley floors; deep, well drained Agua Fria and Sycle soils on high river terraces; and deep, well drained Ustic Torriorthents and Ustollic Haplargids on terrace edges.

This unit is used for irrigated field crops and pasture, nonirrigated crops, rangeland, and wildlife habitat.

The main irrigated crops are alfalfa, small grain, corn for silage, and pasture. The major management concerns in irrigated areas are preventing water erosion, properly managing irrigation water, and maintaining the organic matter content and fertility of the soil. The principle nonirrigated crop is small grain. The major management concerns in nonirrigated areas are conserving moisture and preventing water erosion. Low precipitation limits the kind and amount of forage plants.

Cool soils on hills and mountains and in intermontane valleys

This unit consists of one map unit. It makes up about 23 percent of the survey area.

10. Archuleta-Goldvale-Hesperus

Shallow and deep, well drained, gently sloping to steep, medium textured and moderately coarse textured soils; on hills, ridges, and mountainsides and in valleys

This map unit is in the northwestern to east-central part of the survey area, in the vicinity of Thompson Park and Durango and north of Bayfield. It is in moderately steep to steep areas on hills, ridges, and mountainsides and in gently sloping to sloping areas on alluvial fans, valley sides, and valley bottoms. Slope is 3 to 65 percent. The native vegetation is ponderosa pine, oak brush and other shrubs, and grasses. Elevation is 7,000 to 8,500 feet. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 40 to 45 degrees F. The average frost-free season is 90 to 110 days.

This unit makes up about 23 percent of the survey area. It is about 40 percent Archuleta and similar soils, 25 percent Goldvale and similar soils, and 15 percent Hesperus and similar soils. The remaining 20 percent is components of minor extent.

Archuleta and similar soils are on hills, ridges, and mountainsides. These soils are shallow and well drained. They formed in residuum derived dominantly from interbedded sandstone and shale. The surface layer is loam, and the underlying layer is clay loam. Interbedded sandstone and shale are at a depth of 10 to 20 inches. The similar soils are in the Valto and Sanchez series.

Goldvale and similar soils are on mountainsides. These soils are deep and well drained. They formed in alluvium derived dominantly from interbedded sandstone and shale. The surface layer is very stony fine sandy loam, and the subsoil to a depth of 60 inches or more is stony clay. The similar soils are in the Pinata, Zau, and Fortwingate series.

Hesperus and similar soils are on alluvial fans and valley bottoms. These soils are deep and well drained. They formed in medium textured alluvium derived dominantly from sandstone and shale. The surface layer is loam, the subsoil is clay loam, and the substratum is loam. The similar soils are in the Nutriosa and Herm series.

Of minor extent in this unit are deep, poorly drained Alamosa and Big Blue soils on alluvial fans, valley bottoms, and low terraces; deep, well drained Anvik soils on mountainsides; Plome soils on mesas; and Haploborolls, Rubble Land, and Rock outcrop on mountainsides and mesa edges.

This unit is used as woodland and for livestock grazing, irrigated and nonirrigated crops, and wildlife habitat.

Most of this unit is used for the production of ponderosa pine. The major management concerns for producing and harvesting timber are reforestation and control of erosion. In areas that are irrigated, the principle crops grown are alfalfa, pasture, barley, and oats. The major management concerns in irrigated areas are preventing water erosion, maintaining fertility, and properly managing irrigation water. The principle nonirrigated crops grown are wheat and beans. The major management concerns in nonirrigated areas are conserving moisture and controlling water erosion.

Cold soils on mountains and in intermontane valleys

This group consists of two map units. It makes up about 10 percent of the survey area.

11. Horsethief-Uinta-Rock outcrop

Deep, well drained, gently sloping to steep, medium textured and moderately coarse textured soils and Rock outcrop; on mountainsides and on alluvial fans of intermontane valleys

This map unit is in the northern and northeastern parts of the survey area, in the vicinity of Vallecito Reservoir, Lemon Dam, and Electra Lake. It is in moderately steep to steep areas on mountainsides, cuestas, and hogbacks and in gently sloping to sloping areas on alluvial fans. Slope is 5 to 65 percent. The native vegetation is dominantly spruce, fir, aspen, shrubs, and grasses. Elevation is 7,800 to 10,400 feet. The average annual precipitation is 18 to 30 inches, and the average annual air temperature is 35 to 40 degrees F. The average frost-free season is 50 to 90 days.

This unit makes up about 8 percent of the survey area. It is about 40 percent Horsethief and similar soils, 25 percent Uinta and similar soils, and 15 percent Rock outcrop. The remaining 20 percent is components of minor extent.

Horsethief and similar soils are on cuestas, hogbacks, and mountainsides. These soils are deep and well drained. They formed in stony colluvium derived dominantly from sandstone and shale. The surface layer is very stony fine loam. The subsoil is extremely stony clay loam. The substratum is very stony clay loam. The similar soils are in the Leadville and Nordicol series.

Uinta and similar soils are on mountainsides and alluvial fans. These soils are deep and well drained. They formed in alluvium derived dominantly from interbedded red sandstone and shale. The surface layer is loam, the subsoil is sandy clay loam, and the substratum is loam. The similar soils are in the Anvik series.

Rock outcrop is on cliffs, ridges, and escarpments. It consists mostly of exposures of limestone and sandstone.

Of minor extent in this unit are deep, well drained Chris soils on mountainsides; deep, well drained Clayburn soils in mountain valleys and on valley sides; shallow, well drained Coni soils on mountainsides; and Haploborolls and Rubble Land on mountainsides.

This unit is used as woodland and for livestock grazing and wildlife habitat. Most of this unit is used for the production of spruce, fir, and aspen. The major management concerns for producing and harvesting timber are reforestation and prevention of erosion. The major concerns for livestock grazing are proper grazing use and use of planned grazing systems to maintain desirable quality and quantity of forage plants. Management for wildlife should include prevention of overgrazing by livestock, maintaining some wooded areas, and protection from fire.

12. Valto-Clayburn-Nordicol

Shallow and deep, well drained, medium textured and moderately coarse textured soils; on mountainsides and in narrow intermontane valleys

This map unit is in the northern part of the survey area, in the vicinity of Electra Lake. It is in sloping to steep areas on mountainsides, ridges, and breaks and in gently sloping to sloping areas in mountain valleys on toe slopes. Slopes are 3 to 65 percent. The native vegetation is spruce, fir, ponderosa pine, aspen, shrubs, and grasses. Elevation is 7,500 to 9,000 feet. The average annual precipitation is 20 to 35 inches, and the average annual air temperature is 36 to 42 degrees F. The average frost-free season is 60 to 95 days.

This unit makes up about 2 percent of the survey area. It is about 40 percent Valto soils, 30 percent Clayburn and Shawa Variant soils, and 15 percent Nordicol and Leadville soils. The remaining 15 percent is components of minor extent.

Valto soils are on mountainsides, ridges, and breaks. These soils are shallow and well drained. They formed in material weathered mainly from sandstone. The surface layer and underlying material is very stony fine sandy loam. Hard bedrock is at a depth of 6 to 20 inches.

Clayburn soils are in narrow mountain valleys on toe slopes. These soils are deep and well drained. They formed in medium textured alluvium from nearby hills. The surface layer is loam, the subsoil is clay loam, and the substratum is fine sandy loam and loam.

Nordicol soils are on mountainsides. These soils are deep and well drained. They formed in colluvium and alluvium derived dominantly from sandstone. The surface layer is very stony sandy loam, and the subsoil is stony sandy clay loam that extends to a depth of 60 inches or more.

Of minor extent in this unit are deep, well drained Anvik soils on mountainsides and Rock outcrop.

This unit is used as woodland and for livestock grazing and wildlife habitat.

Much of this unit is used for the production of spruce, fir, aspen, and ponderosa pine. The major management concerns for producing and harvesting timber are reforestation and the control of erosion.

Broad Land Use Considerations

The decision to use land for urban development is becoming increasingly important in the survey area. Each year additional land is converted from cropland, rangeland, or woodland to urban land.

Soils that are suitable for cropland generally are also suitable for urban development. General soil map units 2, 3, 8, 9, 10, and 12 are in the main population centers in the survey area. Units 2 and 3 are mostly irrigated cropland and some rangeland. Most of the soils in these areas have high shrink-swell potential and slow permeability, which adversely affect their use for urban development. Unit 8 is mostly irrigated pastureland, hayland, and rangeland. The main limitations of these soils for urban development are a high water table and a hazard of flooding. Unit 9 is used as cropland and rangeland. Most of the soils in this unit have potential for urban development. Units 10 and 12 are used mostly as woodland and rangeland. Steepness of slope, shallow depth to bedrock, and stoniness adversely affect the use of these soils for urban development.

Some areas should be maintained for wildlife habitat. These areas generally can be on soils that have lower potential for other uses. Units 4 and 5 have low potential for most other uses. Some parts of unit 10 are well suited to use as wildlife habitat. Units 11 and 12 provide good habitat during summer and fall, but heavy snows drive the big game animals to lower lying areas during winter.

The soils in unit 1 have the best potential for nonirrigated crops. Some of these soils also have good potential for irrigated crops if irrigation water is available. Very little urban development has occurred on this unit because of the distance to populated areas.

The areas of soils best suited to irrigated crops are those in units 2, 3, 8, and 9 and parts of unit 1. Some areas of these units, however, are not suitable for crops because of steepness of slope and shallow depth to bedrock.

Most areas of soils that are well suited to commercial woodland are in units 10, 11, and 12. Some of the soils

in these units do not support trees and are used as rangeland. Others are poorly suited to woodland because of shallow depth to bedrock or excessive stoniness.

The general soil map at the back of this publication and the general soil map units give more information for broad land use considerations. For planning specific uses, the information in the section "Detailed Soil Map Units" should be used.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit is given under "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavior divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bayfield silty clay loam, 1 to 3 percent slopes, is one of several phases in the Bayfield series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Archuleta-Sanchez complex, 12 to 65 percent slopes, is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Riverwash is an example.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables")

give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

1—Agua Fria loam. This deep, well drained soil is on old river terraces. It formed in eolian sediment that overlies gravelly and cobbly glacial outwash. Slope is 1 to 3 percent. Elevation is 6,000 to 6,500 feet. The average annual precipitation is 14 to 18 inches. The average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is brown loam about 4 inches thick. The subsoil is reddish brown and light reddish brown clay loam about 26 inches thick. Below this is extremely cobbly glacial outwash that extends to a depth of 60 inches or more.

Included in this unit are about 10 percent Harlan cobbly loam, moist, 10 percent Shalona loam, and 5 percent Nehar stony sandy loam.

Permeability of this Agua Fria soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is slow, and the hazard of erosion is slight.

This unit is used mainly for irrigated field crops, for irrigated pasture, and as rangeland. The main irrigated crops are alfalfa, barley, and oats.

The main concerns of management for irrigated crops are controlling erosion, properly using irrigation water, and maintaining the organic matter content and fertility. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, and helps to control erosion. Land smoothing is needed to achieve more uniform distribution and more efficient use of irrigation water. Application of manure and fertilizer is needed to maintain the fertility and productivity of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation methods suitable for use on this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is well suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow irrigation is suited to row crops. Corrugation irrigation is suited to alfalfa, small grain, and pasture. Regardless of the irrigation method used, water should be applied carefully to control erosion and ensure the most efficient use of water.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, junegrass, blue grama, big sagebrush, rabbitbrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Brush control and rangeland seeding facilitate revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas that are in poor to fair condition. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by lack of sufficient rainfall in summer. Supplemental irrigation is needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Wildlife such as mule deer, cottontail, squirrel, pheasant, mourning dove, and meadowlark use this unit.

This unit produces vegetation that provides food, protective cover, and nesting areas for wildlife. Nearby areas of pinyon and juniper also provide cover and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and other disturbances that deplete wildlife habitat.

Shrink-swell potential and the high content of cobbles in the lower part of the subsoil limit homesite and urban development. Engineering designs and measures are needed to overcome these limitations. Roads should be designed to overcome the limitation of low soil strength and high shrink-swell potential. The moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal or installed at a greater depth and in more permeable material. Sewage lagoons may need lining to reduce seepage from the extremely cobbly substratum.

This map unit is in capability subclass IVs, irrigated and nonirrigated.

2—Alamosa loam. This deep, poorly drained soil is on alluvial valley floors, fans, and bottoms. It formed in alluvium. Elevation is 7,000 to 8,000 feet. Slope is 0 to 2 percent. The average annual precipitation is about 18 to 24 inches. The average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 100 to 115 days.

Typically, the surface layer is gray loam about 3 inches thick. The upper part of the subsoil is dark gray clay loam about 5 inches thick, the next part is dark gray silty clay loam about 12 inches thick, and the lower part is gray sandy clay loam about 12 inches thick. The substratum to a depth of 60 inches or more is light gray sandy clay loam. In some areas the surface layer is clay loam.

Included in this unit are about 15 percent Hesperus loam, 10 percent Big Blue clay loam, and small areas of Tefton loam and Nutrioso loam.

Permeability of this Alamosa soil is moderately slow. Effective rooting depth is limited by a seasonal high water table that is at a depth of 12 to 24 inches. Available water capacity is high. Runoff is slow, and the hazard of erosion is slight. The water table fluctuates between depths of 1 foot and 2 feet. This soil is subject to brief periods of flooding during May and June.

This unit is used mainly for irrigated hay and pasture and as rangeland.

The main management concerns for irrigated pasture or hay are properly using irrigation water and maintaining the quality and quantity of grasses and legumes. Irrigation methods suited to the unit are corrugation, flooding, and sprinkler systems. Land leveling is needed in most areas for flood irrigation. Drainage is needed in some areas to control the level of the water table. Productivity and fertility can be maintained by applying nitrogen and phosphorus. Desirable pasture vegetation can be maintained by proper irrigation and grazing management. Depth to the high water table determines the kind of vegetation that is best suited to this unit. Desirable introduced species for irrigated pasture and hay include timothy, smooth brome, orchardgrass, and, where the material is deepest, alfalfa. Plants adapted to the wetter areas include redtop, Kentucky bluegrass, and reed canarygrass.

The native vegetation on this unit is mainly sedges, rushes, tufted hairgrass, bluejoint reedgrass, redtop, and slender wheatgrass. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the desirable grasses and forbs. Seeding facilitates revegetation of pasture in areas depleted by heavy grazing, cultivation, and other disturbances. Fencing and deferred grazing help to keep the range in good condition.

This unit is used by wildlife such as mule deer, elk, cottontail, coyote, and waterfowl and other birds. They obtain their food from pasture and nearby cropland. The nearby forested areas provide protective cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and maintaining wet areas for waterfowl. Areas of tall grasses and forbs in fence rows and odd corners of pasture can be managed to improve or to create wildlife habitat.

The hazard of flooding, the fluctuating high water table, and wetness are the main limitations for homesite and urban development. Roads should also be designed to overcome the limitation of low soil strength. Drainage and protection from flooding commonly are needed. The construction of sanitary facilities poses a potential pollution problem to nearby water.

This map unit is in capability subclasses IIIw, irrigated, and Vw, nonirrigated.

3—Anvik loam, 12 to 45 percent slopes. This deep, well drained soil is on mountainsides. It formed in colluvial and alluvial material derived from sandstone and shale. Elevation is 8,200 to 10,000 feet. The average annual precipitation is about 20 to 28 inches. The average annual air temperature is about 36 to 42 degrees F, and the average frost-free period is about 60 to 80 days.

Typically, the surface is covered by a layer of organic material 4 inches thick. The surface layer is dark brown loam about 13 inches thick. The next layer is light yellowish brown sandy loam about 6 inches thick. The upper part of the subsoil is light yellowish brown and brown sandy clay loam about 4 inches thick, the next part is brown sandy clay loam about 23 inches thick, and the lower part is brown sandy clay loam that extends to a depth of 60 inches or more.

Included in this unit is about 15 percent Nordicol very stony sandy loam. Also included are small areas of Leadville very stony sandy loam and Valto very stony fine sandy loam.

Permeability of this Anvik soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as woodland and for livestock grazing. Some small areas are used for homesite development. The unit is also used for wildlife habitat.

This unit is well suited to the production of white fir. On the basis of a site index of 65, the potential production of marketable timber per acre is 13,050 cubic feet or 87,350 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old. Other trees suited to this unit are Douglas-fir, Engelmann spruce, and aspen.

Figure 1.—Aspen in an area of Anvik loam, 12 to 45 percent slopes.

The main concerns in producing and harvesting timber are reforesting and providing protection from erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation.

Among the trees that are suitable for planting are Douglas-fir, Engelmann spruce, and lodgepole pine. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly white fir, Douglas-fir, and Engelmann spruce. Other important plants that characterize the unit are aspen (fig. 1), Arizona fescue, elk sedge, spike trisetum, mountain brome, wild rose, bluegrass, Oregon-grape, ferns, snowberry, buffaloberry, wild celery, and strawberry.

Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves areas in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, bear, wild turkey, squirrel, blue grouse, cottontail, and snowshoe rabbit use this unit. Forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing, controlling timber harvesting, and providing protection from wildfire.

Steepness of slope is the main limitation for homesite and urban development. Slope also limits establishment of septic tank absorption fields and sewage lagoons.

This map unit is in capability subclass VIIe, nonirrigated.

4—Arboles silty clay loam, 0 to 3 percent slopes. This deep, well drained soil is on terraces and alluvial fans. It formed in fine textured alluvium derived from shale. Elevation is 6,000 to 6,600 feet. The average annual precipitation is about 14 to 18 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is brown silty clay loam about 6 inches thick. The subsoil is brown clay loam about 24 inches thick. The substratum is brown and reddish yellow clay loam that extends to a depth of 60 inches or more. In some areas the surface layer is clay loam.

Included in this unit are about 10 percent Agua Fria loam and small areas of Bayfield silty clay loam and Sili clay loam.

Permeability of this Arboles soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated field crops, for irrigated pasture, and as rangeland. Small grain and alfalfa are the main irrigated crops. Wheat is the main nonirrigated crop.

In irrigated areas, the main concerns of management are controlling erosion, maintaining fertility, and properly using irrigation water. Returning crop residue to the soil increases the water intake rate, improves tilth, and helps to control erosion. Including green manure crops and grasses and legumes in the cropping system helps to maintain the fertility of the soil. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing and proper management of irrigation water are needed in some areas to ensure a more nearly uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler systems are well suited to most crops. Corrugation systems are well suited to alfalfa, small grain, and pasture. Regardless of the irrigation method used, water should be applied carefully to minimize runoff and erosion.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas in poor to fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by lack of sufficient rainfall in summer. Supplemental irrigation is needed when planting and during the early stages of growth. Cultivation to reduce plant competition usually is necessary, particularly while the plantings are young.

Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Wildlife such as mule deer, cottontail, squirrel, coyote, and various species of bird use this unit. They obtain their food and shelter mainly in areas of cropland and from nearby pinyon and juniper woodland. Suitable management for wildlife should include protecting the unit from overgrazing, providing protection from wildfire, and maintaining adequate plant cover. Areas of woodland and tall grasses in fence rows and odd corners can be managed for wildlife habitat.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The slow permeability should be considered when designing septic tank absorption fields. Sewage lagoons normally work well.

This map unit is in capability subclasses IIIe, irrigated, and IVc, nonirrigated.

5—Arboles clay, 3 to 12 percent slopes. This deep, well drained soil is on side slopes and in upland valleys. It formed in fine textured alluvium derived from shale. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 14 to 18 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is brown clay about 6 inches thick. The subsoil is brown clay about 24 inches thick. The substratum is brown and reddish yellow clay loam that extends to a depth of 60 inches or more. In most undisturbed areas the surface layer is silty clay loam.

Included in this unit are about 15 percent Bodot clay and small areas of Bayfield silty clay loam, Sili clay loam, and Zyme clay loam.

Permeability of this Arboles soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate. When the soil is dry, it has deep, wide cracks that extend to the surface.

This unit is used mainly for irrigated field crops, for irrigated pasture, and as rangeland. Small grain, such as wheat, barley, oats, and corn for silage, and alfalfa are the main irrigated crops. The irrigated pasture is mostly a mixture of grasses and alfalfa.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the fertility and organic matter content of the surface layer, and properly using irrigation water. Incorporating crop residue into the soil increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and alfalfa responds to phosphorus. Land smoothing is needed in some areas to ensure a more nearly uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is suited to row crops. Sprinkler irrigation is well suited to

most crops. Corrugation irrigation is suited to alfalfa, small grain, and pasture. Regardless of the method used, water should be applied carefully to achieve adequate infiltration and to minimize erosion.

The rangeland vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, big sagebrush, Gambel oak, squaw-apple, bitterbrush, pinyon, and Rocky Mountain juniper. Sagebrush becomes dominant in rangeland areas that are in poor to fair condition. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor or fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by lack of sufficient rainfall in summer and slow permeability. Supplemental irrigation is needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Wildlife such as mule deer, cottontail, coyote, squirrel, pheasant, and mourning dove use this unit. Rangeland and nearby wooded areas provide food, shelter, and nesting areas for wildlife. Irrigated areas also provide food and some cover. Suitable management for wildlife should include protecting the unit from overgrazing, providing protection from wildfire, and maintaining a few areas of pinyon and juniper.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. Roads and building foundations should be designed to overcome these limitations. The slow permeability should be considered when designing septic tank absorption fields. Sewage lagoons normally work well in the more gently sloping areas.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

6—Archuleta loam, 12 to 65 percent slopes. This shallow, well drained soil is hills, ridges, and mountainsides. It formed in residuum derived dominantly from interbedded sandstone and shale. Elevation is 7,000 to 8,500 feet. The average annual precipitation is about 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 90 to 110 days.

Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is light brownish gray loam about 4 inches thick. The next layer is pale brown clay loam about 8 inches thick over interbedded sandstone and shale. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is sandy loam.

Included in this unit is about 20 percent Sanchez very stony sandy clay loam. Also included are small areas of Zyme clay loam, Herm loam, and Hesperus loam.

Permeability of this Archuleta soil is moderate. Effective rooting depth is 10 to 20 inches because of the presence of soft bedrock. Available water capacity is low. Runoff is rapid, and the hazard of erosion is moderate.

This unit is used for wildlife habitat, livestock grazing, woodland, and homesite development.

The native vegetation on this unit is mainly ponderosa pine, Gambel oak, antelope bitterbrush, and needlegrass. Other important plants that characterize the unit are fringe sagebrush, mountain muhly, mountainmahogany, serviceberry, snowberry, Arizona fescue, mountain brome, bluegrasses, elk sedge, and a few pinyon and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system consists of practices to maintain the quality and quantity of the rangeland vegetation. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of livestock and promote the production of the desirable understory plants.

This unit is suited to the production of ponderosa pine. On the basis of a site index of 45, the potential production per acre of marketable timber is 1,990 cubic feet or 6,200 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are the risk of erosion along roads and skid trails, the high seedling mortality rate, and the shallow depth to bedrock. Careful consideration of road systems and harvesting methods is needed to avoid deep cuts in the shallow soil and to minimize erosion. Reforestation should be carefully managed to reduce competition from undesirable understory plants.

This unit is used by wildlife such as elk, mule deer, cottontail, coyote, squirrel, and wild turkey. They obtain their food from the understory, nearby cropland, and native pasture. The forested areas provide shelter and nesting areas. Suitable management for wildlife includes

protecting the unit from overgrazing and wildfire and avoiding clearcutting.

Depth to bedrock and steepness of slope are the main limitations for homesite and urban development. These limitations apply to the the construction of sewage lagoons and septic tank absorption fields. If sewage lagoons are constructed in the underlying bedrock, they should be lined to reduce seepage.

This map unit is in capability subclass VIIe, nonirrigated.

7—Archuleta-Sanchez complex, 12 to 65 percent slopes.

This map unit is on hills, ridges, and mountainsides. Elevation is 7,000 to 8,500 feet. The average annual precipitation is about 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 90 to 110 days.

This unit is 45 percent Archuleta loam and 30 percent Sanchez very stony sandy clay loam.

Included in this unit are about 10 percent Corta loam, 5 percent Hesperus loam, and 10 percent Rock outcrop, Bodot clay, Zyme clay loam, and Arboles clay.

The Archuleta soil is shallow and well drained. It formed in residuum derived from interbedded sandstone and shale. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is light brownish gray loam about 4 inches thick. Below this is pale brown clay loam about 8 inches thick over interbedded sandstone and shale. Depth to bedrock ranges from 10 to 20 inches. In some places the surface layer is sandy loam.

Permeability of this Archuleta soil is moderate. Effective rooting depth is 10 to 20 inches because of the presence of soft bedrock. Available water capacity is low. Runoff is rapid, and the hazard of erosion is moderate.

The Sanchez soil is shallow and well drained. It formed in residuum derived from interbedded sandstone and shale. Typically, the surface layer is pale brown very stony sandy clay loam about 5 inches thick. The subsoil is light brownish gray very stony clay loam about 6 inches thick. The substratum is light brownish gray stony sandy clay loam. Sandstone is at a depth of 15 inches. Depth to bedrock ranges from 11 to 20 inches. In some places the surface layer is very stony sandy loam.

Permeability of this Sanchez soil is moderately slow. Effective rooting depth is 11 to 20 inches because of the presence of hard bedrock. Available water capacity is very low. Runoff is rapid, and the hazard of erosion is moderate.

This unit is used mainly for wildlife habitat, livestock grazing, woodland, and homesite development.

The native vegetation on this unit is ponderosa pine, Gambel oak, bitterbrush, fringed sagebrush, mountainmahogany, serviceberry, snowberry, Oregon-grape, Arizona fescue, mountain brome, bluegrass, elk sedge, and a few pinyon and Rocky Mountain juniper. Proper range management consists of practices to maintain the quality and quantity of the desirable rangeland vegetation. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of livestock and promote the production of the desirable understory plants.

This unit is suited to the production of ponderosa pine (fig. 2). On the basis of a site index of 45, the potential production per acre of marketable timber is 1,990 cubic feet or 6,200 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

Shallow soil depth and very low available water capacity limit the growth of ponderosa pine on this unit. The main concerns in producing and harvesting timber are the moderate hazard of erosion, the high seedling mortality rate, and the shallow depth to bedrock. Careful consideration of road systems and harvesting methods is needed to minimize erosion and to avoid deep cuts in the shallow soils. Reforestation should be carefully managed to reduce competition from undesirable understory plants.

This unit is used by wildlife such as elk, mule deer, cottontail, coyote, squirrel, and wild turkey. They obtain their food from the understory, nearby cropland, and native pasture. The forested areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and avoiding clearcutting.

Depth to bedrock and steepness of slope are the main limitations for homesite and urban development. These limitations affect the construction of sewage lagoons and septic tank absorption fields. If sewage lagoons are built in the underlying bedrock, they should be lined to reduce seepage.

This map unit is in capability subclass VIIe, nonirrigated.

8—Baca Variant loam, 3 to 12 percent slopes. This deep, well drained soil is in upland valleys and on mesas. It formed in moderately fine textured material derived from shale. Elevation is 6,500 to 7,000 feet. The average annual precipitation is 14 to 16 inches. The average annual air temperature is 45 to 58 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is pale brown and brown loam about 6 inches thick. The next layer is brown sandy clay loam about 6 inches thick. The upper part of the subsoil is brown clay loam about 12 inches thick, and the lower part is brown clay loam about 16 inches thick. The substratum is light brown, calcareous clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 5 percent Agua Fria loam, 15 percent Buckle loam, and small areas of Falfa clay loam.

Permeability of this Baca Variant soil is moderately slow. Effective rooting depth is 60 inches or more.

Figure 2.—Ponderosa pine in an area of Archuleta-Sanchez complex, 12 to 65 percent slopes.

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

The unit is used mainly as irrigated cropland, irrigated pasture, and nonirrigated cropland and rangeland. Small grain, such as barley and oats, and alfalfa are the main irrigated crops. Wheat is grown in nonirrigated areas.

If irrigated crops are grown, the main concerns of management are controlling water erosion, properly using irrigation water, and maintaining the organic matter content and fertility of the surface layer. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content. The use of fertilizer helps to maintain the fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is suited to row crops. Corrugation irrigation is suited to alfalfa and small grain. Sprinkler irrigation is well suited to most crops. Regardless of the irrigation method used, water should be applied at a slow rate to reduce runoff and minimize erosion.

In nonirrigated cropland areas, management is needed to control erosion, conserve moisture, and maintain the fertility of the soil. Using stubble mulch tillage and returning crop residue to the soil help to reduce runoff and erosion. These practices also increase the water intake rate and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the penetration of water. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation on this unit is mainly big sagebrush, western wheatgrass, Indian ricegrass, and blue grama. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding speeds up revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas in poor to fair condition.

Wildlife such as mule deer, cottontail, coyote, squirrel, and various birds use this unit. They obtain their food from areas of cropland and rangeland. Nearby areas of pinyon and juniper and rangeland provide cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and maintaining adequate plant cover, including nearby areas of pinyon and juniper.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. Building foundations and roads should be designed to compensate for these limitations. The moderately slow permeability should be considered when designing septic tank absorption fields. Absorption fields may need to be made larger than normal or installed deeper and in more permeable material. Sewage lagoons are suitable if they are sealed.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

9—Badland. This map unit consists of steep and very steep areas of barren land that is dissected by many intermittent drainageways that have entrenched into the Mancos Shale (fig. 3). The areas of Badland support sparse vegetation and are easily eroded. Runoff is rapid.

Included in this unit are small areas of Zyme clay loam. These areas support some vegetation but have very limited value as forage for livestock and wildlife. The vegetation is dominantly Rocky Mountain juniper, pinyon, and Gambel oak. Included areas make up about 10 percent of the unit.

Badland is used as wildlife habitat. It is severely limited for all other uses.

This map unit is in capability subclass VIIIe, nonirrigated.

10—Bayfield silty clay loam, 1 to 3 percent slopes. This deep, well drained soil is in broad valleys (fig. 4). It formed in fine textured alluvium derived from shale. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 13 to 16 inches. The average annual air temperature is 46 to 48 degrees F, and the frost-free period is 110 to 130 days.

Typically, the surface layer is light brownish gray and grayish brown silty clay loam about 4 inches thick. The next layer is pale brown silty clay about 4 inches thick. The underlying material is light brownish gray and grayish brown silty clay loam and silty clay that extend to a depth of 60 inches or more. In some places the surface layer is silty clay.

Included in this unit are about 20 percent Sili clay loam and small areas of Arboles silty clay loam.

Permeability of this Bayfield soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is high.

This unit is used mainly for irrigated pasture and hay and as rangeland. In irrigated areas the main crops grown are alfalfa hay, pasture, and small grain.

If irrigated crops are grown, the main concerns of management are controlling erosion, properly using irrigation water, and maintaining the organic matter content of the surface layer. Incorporating crop residue into the surface layer helps to control erosion, increases the water intake rate, and helps to maintain the organic matter content. Land smoothing, proper water management, and irrigation structures are needed in some areas to achieve a more nearly uniform distribution and use of irrigation water. Applications of manure or fertilizer containing nitrogen and phosphorus are needed to maintain the fertility of the soil. Irrigation methods suited to this unit are corrugation and sprinkler systems. These systems are well suited to most crops. Regardless of the irrigation method used, water should be applied at a slow rate to control erosion and to avoid perching water above the slowly permeable subsoil.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, junegrass, big sagebrush, and rabbitbrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

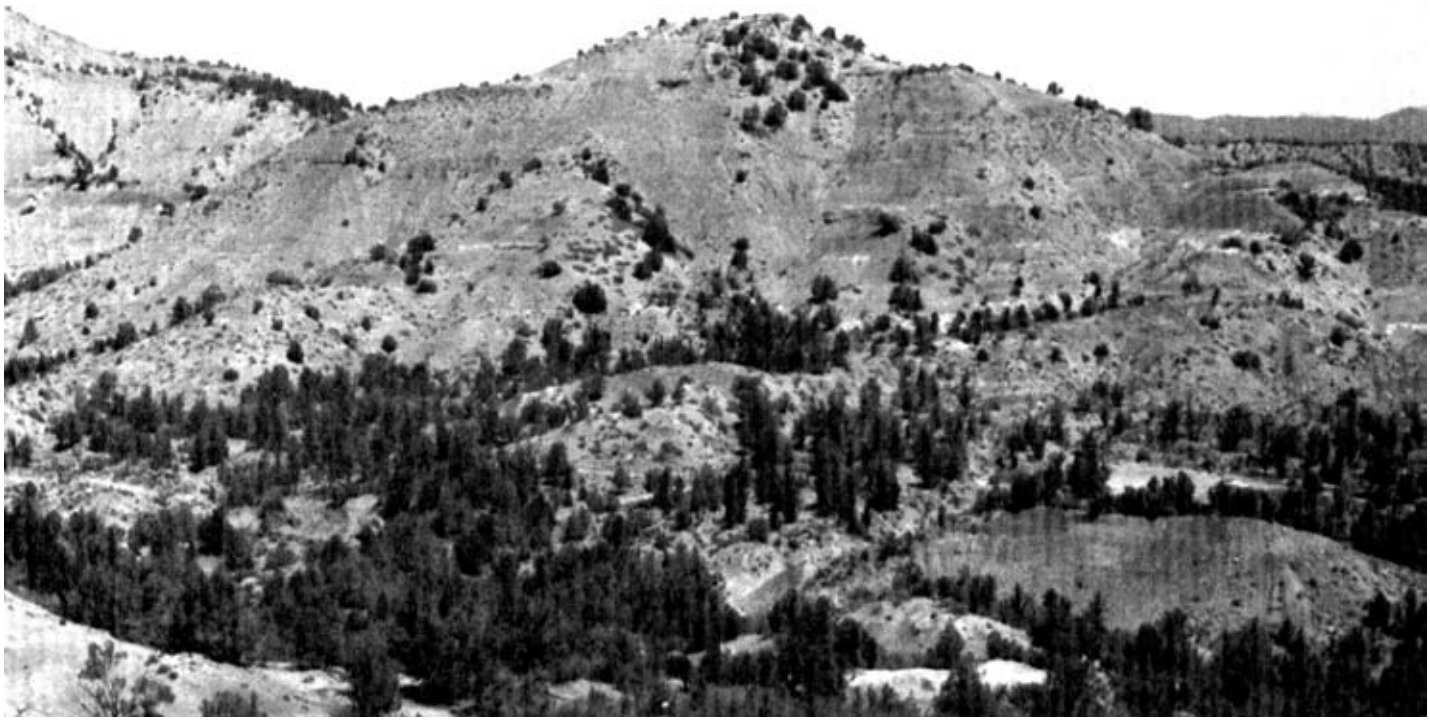


Figure 3.—Typical area of Badland.

Wildlife such as mule deer, cottontail, coyote, and various species of bird use this unit. The irrigated cropland provides food for wildlife, and the rangeland areas provide shelter, nesting areas, and food. Suitable management for wildlife should include protecting the unit from overgrazing.

High shrink-swell potential is the main limitation for homesite and urban development. The foundations for buildings should be designed to compensate for this limitation. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The slow permeability of the soil should be considered when designing septic tank absorption fields. Sewage lagoons work well.

This map unit is in capability subclasses IIIe, irrigated, and VIe, nonirrigated.

11—Bayfield silty clay loam, gullied, 1 to 3 percent slopes. This deep, well drained soil is on the lowest positions in broad valleys (fig. 5). It formed in fine textured alluvium derived from shale. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 13 to 16 inches. The average annual air temperature is 46 to 48 degrees F, and the frost-free period is 110 to 130 days.

Typically, the surface layer is light brownish gray and grayish brown silty clay loam about 4 inches thick. The next layer is pale brown silty clay about 4 inches thick. The underlying material is light brownish gray and grayish brown silty clay loam and silty clay that extend to a depth of 60 inches or more.

Included in this unit are about 20 percent Sili clay loam and small areas of Arboles silty clay loam and Bayfield silty clay loam, seeped.

Permeability of this Bayfield soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is high. This soil is subject to severe gully erosion. Gullies are 15 to 20 feet deep and 15 to 50 feet wide.

This unit is used mainly as rangeland.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, junegrass, big sagebrush, and rabbitbrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by grazing, erosion, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Stabilization of gullies is an important part of management on this unit. Shaping and seeding gullies with a sod-forming grass stabilizes the side slopes. A series of erosion control dams or brush and rock dams in the smaller gullies would reduce erosion and would cause the gullies gradually to be filled with sediment.

Wildlife such as mule deer, cottontail, coyote, and various species of bird use this unit. Rangeland areas provide food, shelter, and nesting areas for wildlife. Suitable management for wildlife areas should include protecting the unit from overgrazing.

High shrink-swell potential is the main limitation for homesite and urban development. The foundations of buildings should be designed to compensate for this limitation. Roads should be designed to overcome the limitation of low soil strength and high shrink-swell potential. The eroded condition of the soil must also be

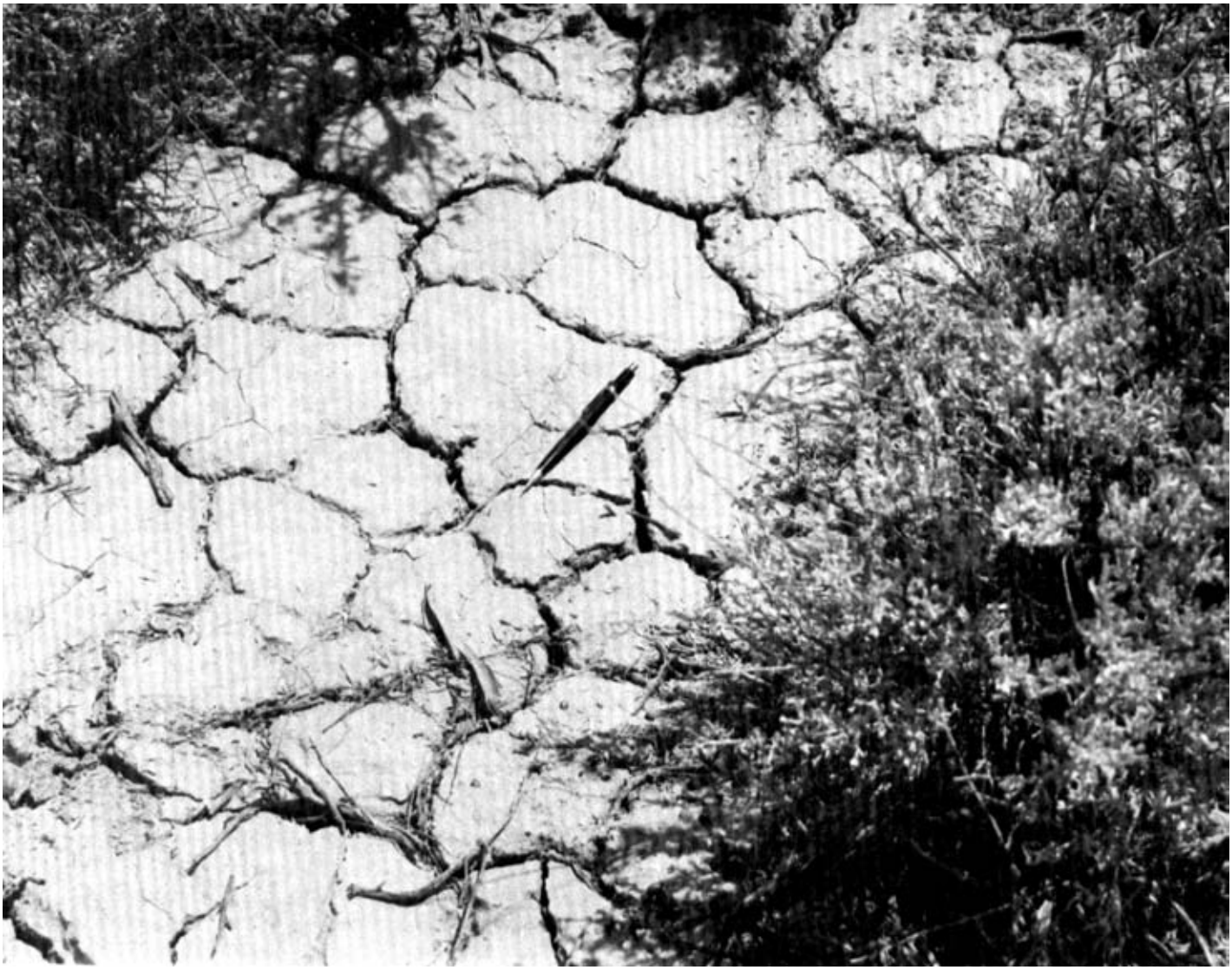


Figure 4.—Area of Bayfield silty clay loam, 1 to 3 percent slopes.

considered. The slow permeability of the soil should be considered when designing septic tank absorption fields. Sewage lagoons work well in areas that are not gullied.

This map unit is in capability subclass VIIe, nonirrigated.

12—Bayfield silty clay loam, seeped, 1 to 3 percent slopes. This deep, poorly drained soil is in broad valleys. It formed in fine textured alluvium derived from shale. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 13 to 16 inches. The average annual air temperature is 46 to 48 degrees F, and the frost-free period is 110 to 130 days.

Typically, the surface layer is light brownish gray and grayish brown silty clay loam about 4 inches thick. The next layer is pale brown silty clay about 4 inches thick. The underlying material is light brownish gray and grayish brown silty clay loam and silty clay that extend to a depth of 60 inches or more. In some places the surface layer is silty clay.

Included in this unit are about 20 percent Sili clay loam and small areas of Arboles silty clay loam.

Permeability of this Bayfield soil is slow. Effective rooting depth is about 20 to 40 inches because of the presence of a high water table. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight. This soil is affected by seepage, which is caused by water losses from irrigated land at higher elevations and from irrigation supply systems.

This unit is used mainly as irrigated cropland, irrigated pasture, and rangeland. Barley, oats, and alfalfa hay are the main irrigated crops.

If irrigated crops are grown, the main concerns of management are properly using irrigation water, maintaining fertility, and controlling the level of the water table. Good irrigation water management is needed to reduce seepage into the water table. Drainage systems are needed. Application of manure and commercial fertilizer containing nitrogen and phosphorus is needed to maintain the fertility of the soil.

The native vegetation on this unit is mainly sedges, rushes, western wheatgrass, alkali sacaton, redtop, and cattails. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates revegetation in areas depleted by heavy grazing, cultivation, and other disturbances. Fencing and deferred grazing help to maintain the range in good condition.

Wildlife such as mule deer, coyote, cottontail, and ducks and other species of bird use this unit. Wetland wildlife use this unit for food, shelter, and nesting areas. Other wildlife use nearby range and woodland as shelter and nesting areas. Suitable management for wildlife should include providing protection from fire and overgrazing and maintaining some of the seeped areas.

High shrink-swell potential and poor drainage are the main limitations for homesite and urban development. The foundations for buildings should be designed to compensate for the high shrink-swell potential of the soil. Poor drainage, low soil strength, and high shrink-swell potential should be considered in constructing roads. Drainage commonly should precede any construction. Poor drainage and slow permeability should be considered when designing septic tank absorption fields and sewage lagoons. After drainage is established, lagoons can be installed.

This map unit is in capability subclasses IVw, irrigated, and VIw, nonirrigated.

13—Big Blue clay loam. This deep, poorly drained soil is on low terraces and valley bottoms and on alluvial valley floors. It formed in fine textured alluvium derived from shale. Slope is 0 to 6 percent. Elevation is 7,000 to 8,000 feet. The average annual precipitation is 16 to 20 inches. The average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 90 to 110 days.

Typically, the upper part of the surface layer is very dark gray clay loam about 4 inches thick and the lower part is very dark gray silty clay about 6 inches thick. The underlying material to a depth of 60 inches or more is gray silty clay. Gleyed colors and mottles are common in the underlying material. In some areas the surface layer is loam.

Included in this unit are small areas of Alamosa loam, Arboles silty clay loam, Bayfield silty clay loam, seeped, and Sili clay loam.

Permeability of this Big Blue soil is slow. Effective rooting depth is about 18 to 24 inches because of the presence of a high water table. Available water capacity is high. Runoff is slow, and the hazard of erosion is slight. This soil has a fluctuating water table that rises to a depth of about 18 inches during most of the year. The soil is subject to occasional flooding in spring and summer.

This unit is used mainly for irrigated pasture and as rangeland.

The main concerns of management on irrigated pasture are properly using irrigation water and maintaining the desired grasses. An irrigation method that is suited to this unit is flooding from contour ditches. Special care is needed in applying irrigation water. Short irrigation runs and light, frequent irrigations are needed to reduce seepage into the water table. Drainage ditches may also be needed to control the level of the water table.

The native vegetation consists mainly of tufted hairgrass, slender wheatgrass, redtop, sedges, and rushes. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates revegetation of areas that have been depleted by overgrazing, cultivation, and other disturbances. Fencing

Figure 5.—Area of Bayfield silty clay loam, gullied, 1 to 3 percent slopes.

improves the distribution of grazing and helps to maintain range condition.

This unit is used by wildlife such as ducks, cottontail, coyote, and small birds. The availability of moisture because of the presence of the high water table allows production of wetland plants that provide nesting areas and protective cover for wetland wildlife. Wetland areas are easily created. Management for wildlife should include protecting the unit from overgrazing and wildfire and providing drainage.

Occasional flooding, wetness, and high shrink-swell potential are the main limitations for homesite and urban development. These limitations should be overcome if buildings or other structures are planned. The hazard of flooding, the high water table, and slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Drainage and protection from flooding should precede any construction. Absorption fields may need to be larger than normal.

This map unit is in capability subclass Vw, irrigated and nonirrigated.

14—Bodot clay, 3 to 10 percent slopes. This moderately deep, well drained soil is on hills. It formed in residuum derived from shale. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 14 to 17 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is gray clay about 6 inches thick. The underlying material is gray clay about 27 inches thick. Shale is at a depth of 33 inches. Depth to shale is 20 to 40 inches. In some places the surface layer is clay loam.

Included in this unit are about 15 percent Zyme clay loam, 10 percent Arboles silty clay loam, and small areas of Rock outcrop.

Permeability of this Bodot soil is slow. Effective rooting depth is 20 to 40 inches because of the presence of soft bedrock. Available water capacity is low. Runoff is medium, and the hazard of erosion is high.

This unit is used mainly for irrigated field crops, pasture, and hay and as rangeland. Alfalfa, wheat, barley, and oats are the main irrigated crops grown.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Pasture and hayland management should include deferred grazing, proper grazing use, and irrigation water management. The use of fertilizer helps to maintain the fertility. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing is needed in some areas to achieve a more uniform distribution of irrigation water. Irrigation methods suited to this unit are corrugation and sprinkler systems. Regardless of the irrigation method used, water should be applied carefully to control erosion, achieve adequate infiltration, and ensure the most efficient use of water.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, blue grama, serviceberry, bitterbrush, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

This unit is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from this unit. The unit is capable of producing about 12 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot if all limbs larger than 2 inches in diameter are used.

The main limitations for woodland production are moderate depth to bedrock, low available water capacity, and the high hazard of erosion. Limiting soil disturbances when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas of pinyon and juniper can be maintained by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can be established.

Wildlife such as cottontail, elk, mule deer, coyote, squirrel, and mourning dove use this unit. Rangeland and wooded areas provide food, shelter, and nesting areas for wildlife. Irrigated areas also provide food. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining areas of pinyon and juniper.

Depth to bedrock and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The slow permeability and depth to bedrock should be considered when designing septic tank absorption fields and sewage lagoons. Sewage lagoons can be constructed if the limitation of slope is overcome and excavations extend to the bedrock. They should be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

15—Borohemists, ponded. This map unit consists of permanently wet swamps and marshes in low, undrained areas along rivers, creeks, and other drainageways. The areas are mainly in the northern part of the survey area. They formed in alluvium weathered mainly from shale and in organic material. Elevation is 6,500 to 9,000 feet. The average annual precipitation ranges from 18 to 30 inches.

Typically, the soils have an organic surface layer 16 to 36 inches thick over clay or clay loam. Water stands in areas of these soils much of the time, and it is within a few inches of the surface the rest of the time. Because the areas are in low places on the landscape, they have no natural drainage outlets. The areas are used mainly for wildlife habitat. They do have limited value for grazing around the edges during the driest part of the year. In areas where the organic surface layer is thick enough, the soils could be used as a limited source of peat.

The native vegetation consists of cattails, sedges, rushes, and willows. A few spruce and fir trees grow in

some areas. The areas provide good cover and nesting areas for wildlife such as beaver, muskrats, and ducks.

This map unit is in capability subclass VIIIw, nonirrigated.

16—Buckle loam. This deep, well drained soil is in upland valleys. It formed in alluvium and material derived from sandstone. Slope is 1 to 6 percent. Elevation is 6,000 to 7,200 feet. The average annual precipitation is about 12 to 14 inches. The average annual air temperature is 45 to 50 degrees F, and the frost-free period is 110 to 130 days.

Typically, the surface layer is light brownish gray loam 10 inches thick. The subsoil is brown clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Witt loam and 10 percent Yenlo sandy loam.

Permeability of this Buckle soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as rangeland and wildlife habitat.

The native vegetation on this unit is mainly big sagebrush, western wheatgrass, blue grama, galleta, and Indian ricegrass. Mechanical or chemical brush control followed by seeding with grasses adapted to the area improves areas that have dense stands of sagebrush. Deferred and rotation grazing, cross fencing, and developing livestock watering facilities can be used to prevent deterioration of the range and to promote the production of the preferred plants.

Wildlife such as mule deer, squirrel, coyote, cottontail, and various species of bird use this unit. Grasses, forbs, and shrubs on the soil provide food and cover for wildlife. Nearby areas of pinyon and juniper also provide protective cover and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire.

The main limitations for homesite and urban development are low soil strength and moderate shrink-swell potential. Foundations and roads should be designed to offset the effects of these limitations. Absorption fields should be designed to overcome the limitation of moderately slow permeability. They may need to be made larger than normal. Sewage lagoons work well.

This map unit is in capability subclass IVe, nonirrigated.

17—Chris very stony loam, 9 to 25 percent slopes. This deep, well drained soil is on mountainsides. It formed in stony, fine textured colluvium and local alluvium. Elevation is 8,000 to 10,000 feet. The average annual precipitation ranges from 25 to 40 inches. The average annual air temperature is 38 to 42 degrees F, and the average frost-free period is about 75 to 100 days.

Typically, the surface is covered with a layer of organic material 2 inches thick. The surface layer is very dark grayish brown very stony loam about 4 inches thick. The next layer is pink gravelly loam about 7 inches thick. The upper part of the subsoil is pink and reddish yellow very cobbly clay loam about 10 inches thick, and the lower part is reddish yellow very cobbly clay about 26 inches thick. The substratum to a depth of 60 inches or more is strong brown very cobbly clay loam.

Permeability of this Chris soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is moderate.

Included in this unit are about 10 percent Fortwingate stony fine sandy loam, 5 percent Goldvale very stony fine sandy loam, 5 percent Coni loam, and small areas of Rock outcrop.

This unit is used mainly as woodland and wildlife habitat. It is also used for limited livestock grazing.

This unit is well suited to the production of white fir. On the basis of a site index of 60, it is capable of producing about 11,500 cubic feet of marketable timber per acre or 74,000 board feet (International rule) from a fully stocked, even-aged stand of trees 100 years old. Other trees well suited to this unit are Engelmann spruce, Douglas-fir, and, at the lower elevations, ponderosa pine.

The main concerns for producing and harvesting timber are the hazard of erosion along roads and logged areas and reforestation. Harvesting may be restricted during periods when snow accumulates to a great depth and during periods of snowmelt and high rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation.

Among the trees that are suitable for planting are Douglas-fir, Engelmann spruce, and lodgepole pine. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly white fir, Douglas-fir, Engelmann spruce, and ponderosa pine. Other important plants that characterize this unit are aspen, Arizona fescue, mountain brome, bluegrass, Oregon-grape, ferns, wild celery, strawberry, oak brush, snowberry, serviceberry, and bearberry. Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to ensure the desired quality and quantity of the native

vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Developing livestock watering facilities and fencing improve the distribution of livestock and help to maintain the understory.

Wildlife such as elk, mule deer, bear, squirrel, and wild turkey use this unit. They obtain their food from areas of forbs, shrubs, and grasses. The forested areas provide shelter. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Steepness of slope and large stones are the main limitations for homesite and urban development. The slow permeability and slope should be considered in the design of septic tank absorption fields or sewage lagoons. Septic tank absorption fields may need to be made larger than normal.

This map unit is in capability subclass VIIe, nonirrigated.

18—Clark Fork very cobbly sandy loam. This deep, somewhat excessively drained soil is on river terraces, alluvial fans, and old flood plains. It formed in very gravelly and cobbly alluvium that is mainly granitic. Slope is 1 to 6 percent. Elevation is 7,000 to 8,000 feet. The average annual precipitation is about 20 to 30 inches. The average annual air temperature is 40 to 46 degrees F, and the average frost-free period is 90 to 100 days.

Typically, the surface layer is grayish brown very cobbly sandy loam about 5 inches thick. The underlying material is pale brown extremely cobbly sandy loam about 15 inches thick over extremely cobbly sand that extends to a depth of 60 inches or more. In some places the surface layer is very cobbly loam.

Included in this unit are about 5 percent Leadville very stony sandy loam and small areas of Pescar fine sandy loam and Tefton loam.

Permeability of this Clark Fork soil is moderately rapid. Effective rooting depth is 15 to 30 inches because of the presence of extremely cobbly material. Available water capacity is very low. Runoff is slow, and the hazard of erosion is slight.

This unit is used mainly as woodland and homesites. It is also used as rangeland.

This unit is suited to the production of ponderosa pine. On the basis of a site index of 73, it is capable of producing about 4,759 cubic feet of marketable timber per acre or 24,760 board feet (International rule) from a fully stocked, even-aged stand of trees 100 years old. Other trees suited to this unit are Douglas-fir and Engelmann spruce. The main limitations for the production of timber are the difficulty of reforestation because of the droughtiness of the soil and the presence of cobbles and stones. Reforestation should be carefully managed to reduce competition from undesirable understory plants and to compensate for the droughtiness of the soil. Hand planting of nursery stock commonly is necessary because of the cobbles and stones.

The native vegetation on this unit is Douglas-fir, ponderosa pine, Engelmann spruce, aspen, Arizona fescue, western wheatgrass, junegrass, mountainmahogany, Gambel oak, serviceberry, wild rose, bluegrass, and sedges. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as elk, mule deer, coyote, squirrel, and birds use this unit. They obtain their food from areas of grasses, forbs, and shrubs. Forested areas provide shelter. Suitable management for wildlife includes protecting the unit from overgrazing and maintaining areas as woodland.

The presence of large stones is the main limitation for homesite and urban development. The moderately rapid permeability and potential pollution of ground water are the main limitations for the construction of septic tank absorption fields and sewage lagoons. This limitation can be overcome by backfilling with finer textured material. Sewage lagoons should be lined to reduce seepage.

This map unit is in capability subclass VIIs, nonirrigated.

19—Clayburn loam, 3 to 12 percent slopes. This deep, well drained soil is in intermontane valleys and mountain toe slopes (fig. 6). It formed in medium textured alluvial material from nearby hills. Elevation is 8,000 to 8,800 feet. The average annual precipitation is 20 to 30 inches. The average annual air temperature is 38 to 42 degrees F, and the average frost-free period is 60 to 80 days.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is dark grayish brown clay loam about 21 inches thick. The substratum is brown and light brownish gray fine sandy loam that extends to a depth of 60 inches or more.

Included in this unit are about 10 percent Nordicol very stony sandy loam, 10 percent Shawa Variant loam, and small areas of Anvik loam.

Permeability of this Clayburn soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight.

The unit is used mainly as rangeland and wildlife habitat.

The native vegetation on this unit is mainly Arizona fescue, western wheatgrass, mountain muhly, mountain brome, bluegrass, elk sedge, serviceberry, and Gambel oak. If the range is overgrazed, the preferred forage

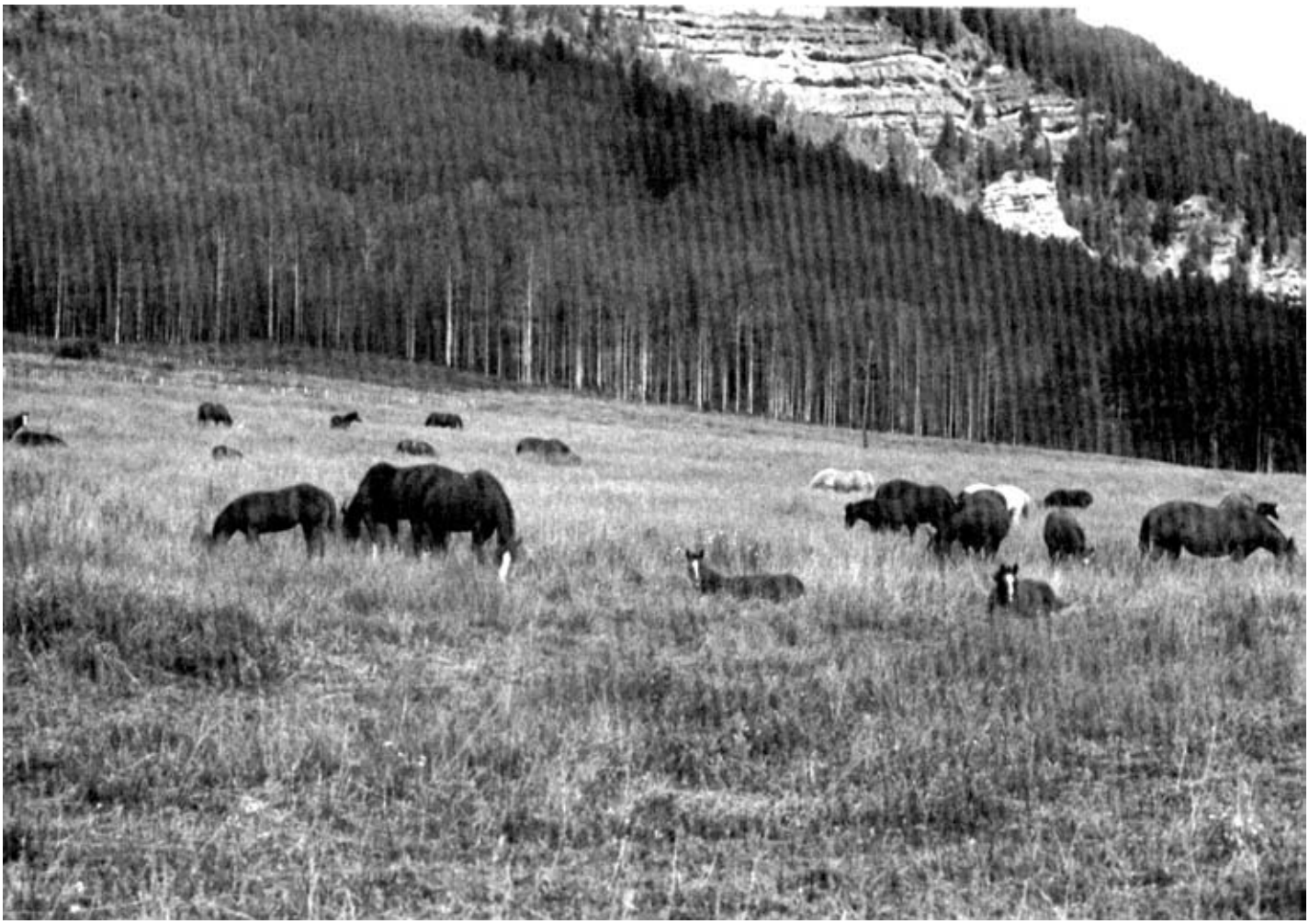


Figure 6.—Area of Clayburn loam, 3 to 12 percent slopes.

plants decrease and the less preferred plants increase; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use as part of a planned grazing system is an important practice that can be used to maintain the desired quantity and quality of the native vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure.

Deferred grazing speeds up revegetation and improves areas of rangeland in poor condition. Seeding is a suitable practice if the rangeland vegetation is in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and help to maintain the condition of the rangeland.

Wildlife such as mule deer, elk, coyote, cottontail, and wild turkey use this unit. The surrounding forested areas provide protective cover and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

Low soil strength and moderate shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings can be designed to compensate for the moderate shrink-swell potential. Roads should be designed to overcome the limitation of low soil strength. The moderately slow permeability should be considered when designing septic tank absorption fields. Absorption fields can be made larger than normal or installed deeper and in more permeable material. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IVe, nonirrigated.

20—Clayburn cobbly loam, 6 to 25 percent slopes. This deep, well drained soil is on mountainsides and toe slopes. It formed in medium textured alluvial and colluvial material. Elevation is 8,000 to 9,200 feet. The average annual precipitation is 25 to 35 inches. The average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 60 to 80 days.

Typically, the surface layer is dark grayish brown cobbly loam about 18 inches thick. The subsoil is brown sandy clay loam about 25 inches thick. The substratum is brown and light brown loam that extends to a depth of 60 inches or more.

Included in this unit are about 5 percent Shawa Variant loam, 15 percent Nordicol very stony sandy loam, and small areas of Anvik loam.

Permeability of this Clayburn soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

The unit is used mainly for timber production, livestock grazing, and wildlife habitat.

This unit is suited to the production of Douglas-fir. On the basis of a site index of 75, it is capable of producing about 4,945 cubic feet of marketable timber per acre or 26,600 board feet (International rule) from a fully stocked, even-aged stand of trees 100 years old. This unit is also suited to the production of Engelmann spruce and aspen.

The main concerns of management for timber production are reforestation and providing protection from erosion where the plant cover has been removed, such as in logged areas or along roads. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, and during periods of high rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock facilitates reforestation. Proper design of road drainage systems and care in the placement of culverts help to control erosion.

The native vegetation on this soil consists of Douglas-fir, white fir, aspen, Engelmann spruce, Arizona fescue, mountain brome, bluegrass, elk sedge, and Gambel oak. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient height to withstand grazing pressure. Proper grazing use as part of a planned grazing system helps to maintain the desired quantity and quality of understory. Deferred grazing speeds up revegetation and improves areas in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as mule deer, elk, bear, squirrel, snowshoe rabbit, and wild turkey use this unit. The forested areas provide food and protective cover for wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Steepness of slope is the main limitation for homesite and urban development. The slow permeability and slope should be considered when designing septic tank absorption fields or lagoons. Absorption fields may need to be made larger than normal or installed deeper and in more permeable material. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass VIe, nonirrigated.

21—Coni loam, 4 to 25 percent slopes. This shallow, well drained soil is on mountainsides and in parks. It formed in residuum derived from sandstone and shale. Elevation is 7,600 to 8,900 feet. The average annual precipitation ranges from 20 to 28 inches. The average annual air temperature ranges from 40 to 45 degrees F, and the average frost-free period is 90 to 100 days.

Typically, the surface layer is brown and grayish brown loam about 7 inches thick. The upper part of the subsoil is pale brown loam about 4 inches thick, and the lower part is light yellowish brown clay loam about 6 inches thick. Hard sandstone is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are about 20 percent Chris very stony loam and small areas of Goldvale very stony fine sandy loam and Fortwingate stony fine sandy loam.

Permeability of this Coni soil is moderate. Effective rooting depth is 10 to 20 inches because of the presence of hard bedrock. Available water capacity is low. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as rangeland and for wildlife habitat.

The native vegetation on this unit is dominated by Arizona fescue, mountain muhly, western wheatgrass, junegrass, and oak brush. Proper grazing use as part of a planned grazing system helps to maintain the desired quantity and quality of native vegetation. Deferred grazing speeds up revegetation and improves areas in poor condition. Desirable grasses for seeding overgrazed pasture are brome, bluegrasses, and Arizona fescue.

Wildlife such as elk, mule deer, and wild turkey use this unit. They obtain their food from forbs, grasses, and shrubs. Nearby forested areas provide protective cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing.

Depth to bedrock and slope are the main limitations for homesite and urban development. Building foundations and roads should be designed to overcome these limitations. These limitations should also be considered when designing septic tank absorption fields or lagoons.

This map unit is in capability subclass VIs, nonirrigated.

22—Corta loam, 1 to 3 percent slopes. This deep, well drained soil is on mesa tops, ridgetops, and old pediment surfaces. It formed in fine textured alluvium derived from shale and mixed with loess. Elevation is 6,700 to 7,200 feet. The average annual precipitation is about 18 to 22 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is about 110 to 130 days.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is reddish brown and brown clay about 33 inches thick. The substratum is reddish yellow clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 20 percent Falfa clay loam and small areas of Plome fine sandy loam.

Permeability of this Corta soil is very slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated field crops and irrigated pasture. Small areas of woodland are used for timber production and livestock grazing. Barley, oats, and alfalfa are the main irrigated crops.

The main management concerns in irrigated areas are maintaining the organic matter content and fertility of the surface layer, controlling water erosion, and properly using irrigation water. The incorporation of crop residue into the surface layer increases the water intake rate, improves tilth, helps to control erosion, and helps to maintain the organic matter content. Grains and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing is needed in some areas to ensure a more nearly uniform distribution of water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is suited to most crops. Furrow irrigation is suited to row crops, and corrugation irrigation is well suited to pasture and small grain.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 80, the potential production of marketable timber per acre is 5,410 cubic feet or 31,200 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and controlling erosion, mainly along roads and skid trails. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt in spring, and during rainy periods in fall. Reforestation should be carefully managed to reduce competition from undesirable understory plants.

The native vegetation on this unit consists of ponderosa pine, junegrass, mountain muhly, and Gambel oak. Other important plants that characterize this unit are mountain brome, Arizona fescue, bluegrass, serviceberry, snowberry, mountainmahogany, Oregon-grape, and elk sedge. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Seeding cleared areas is advisable when the native vegetation is in poor condition. Deferred grazing speeds up revegetation and improves areas of rangeland in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, coyote, cottontail, turkey, squirrel, and mourning dove use this unit, particularly the wooded areas. They obtain their food from areas of cropland, irrigated pasture, and native plants. The forested areas provide shelter. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling the harvesting of timber.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations for buildings should be designed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The very slow permeability limits the operation of septic tank absorption fields. Sewage lagoons work well.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

23—Corta loam, 3 to 8 percent slopes. This deep, well drained soil is on mesa tops, ridgetops, and old pediment surfaces. It formed in fine textured alluvium derived from shale and mixed with loess. Elevation is 6,700 to 7,200 feet. The average annual precipitation is about 18 to 22 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is about 110 to 130 days.

Typically, the surface layer is brown loam about 6 inches thick. The subsoil is reddish brown and brown clay about 33 inches thick. The substratum is reddish yellow clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Plome fine sandy loam and small areas of Falfa clay loam.

Permeability of this Corta soil is very slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as irrigated cropland, pastureland, and woodland. The main irrigated crops are small grain, alfalfa, and pasture.

The main management concerns on irrigated cropland are controlling erosion, maintaining the organic matter content, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, helps to control erosion, and helps to maintain the organic matter content and fertility of the soil. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grass respond to nitrogen, and legumes respond to

phosphorus. Irrigation methods suited to this unit are sprinkler, corrugation, and furrow systems. Furrow irrigation is suited to row crops, and corrugation irrigation is suited to alfalfa, small grain, and pasture.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 80, the potential production of marketable timber per acre is 5,410 cubic feet or 31,200 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and controlling erosion, mainly along roads and skid trails. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt in spring, and during rainy periods in fall. Reforestation should be carefully managed to reduce competition from undesirable understory plants.

The native vegetation on this unit is mainly ponderosa pine, junegrass, mountain muhly, and Gambel oak. Other important plants that characterize this unit are mountain brome, Arizona fescue, bluegrass, serviceberry, snowberry, mountainmahogany, Oregon-grape, and elk sedge. In cleared areas, the native vegetation is dominated by western wheatgrass, mountain muhly, Arizona fescue, Gambel oak, and fringed sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Seeding cleared areas is advisable when the native vegetation is in poor condition. Deferred grazing speeds up revegetation and improves areas of rangeland in poor condition. Developing livestock watering facilities and fencing can improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, coyote, cottontail, turkey, squirrel, and mourning dove use this unit, particularly the wooded areas. They obtain their food from areas of cropland, irrigated pasture, and native plants. Forested areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations for buildings should be designed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The very slow permeability limits the operation of septic tank absorption fields and sewage lagoons. Sewage lagoons work well.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

24—Dulce-Travessilla-Rock outcrop complex, 6 to 50 percent slopes. This map unit is on foothills and ridges. Elevation is 6,000 to 7,000 feet. The average annual precipitation ranges from 13 to 16 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period ranges from 115 to 140 days.

This unit is about 40 percent Dulce sandy loam, 25 percent Travessilla sandy loam, and 25 percent Rock outcrop.

Included in this unit are about 5 percent Lazear stony loam, 5 percent Mikim loam, and small areas of Yenlo sandy loam and Florita sandy loam.

The Dulce soil is shallow and well drained. It formed in residuum derived from sandstone. Typically, the surface layer is brown sandy loam about 4 inches thick. The upper part of the underlying material is grayish brown sandy loam about 5 inches thick, and the lower part is very pale brown sandy loam about 4 inches thick. Soft sandstone is at a depth of about 13 inches. Depth to bedrock ranges from 8 to 20 inches. In some places the surface layer is loam.

Permeability of the Dulce soil is moderately rapid. Effective rooting depth is less than 20 inches because of the presence of soft bedrock. Available water capacity is very low. Runoff is slow to medium, and the hazard of erosion is moderate.

The Travessilla soil is shallow and well drained. It formed in residuum derived from sandstone. Typically, the surface layer is light brownish gray sandy loam about 5 inches thick. The underlying material is light yellowish brown sandy loam about 6 inches thick. Sandstone is at a depth of about 11 inches. Depth to bedrock ranges from 6 to 20 inches.

Permeability of the Travessilla soil is moderately rapid. Effective rooting depth is less than 20 inches because of the presence of hard bedrock. Available water capacity is very low. Runoff is slow to medium, and the hazard of erosion is moderate.

Rock outcrop consists of areas of exposed sandstone.

This unit is used mainly for livestock grazing and wildlife habitat.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, junegrass, sand dropseed, needleandthread, blue grama, Fendler threeawn, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of native vegetation. Seeding along with deferred grazing facilitates revegetation of areas depleted by heavy grazing and other disturbances. Seeding should be done by hand broadcasting or aerial methods. The main limitations for seeding are slope, the areas of Rock outcrop, and shallow depth to rock. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of livestock and help to maintain the condition of the rangeland.

This unit is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from this unit. The Dulce soil is capable of

producing about 15 cords of firewood per acre, and the Travessilla soil about 13 cords. Both production figures are for stands of trees that average 5 inches in diameter at a height of 1 foot and apply if all limbs larger than 2 inches in diameter are used.

The main limitations for woodland production are shallow depth to bedrock, low available water capacity, and steepness of slope. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, elk, jackrabbit, cottontail, coyote, eagles, and squirrel use this unit for food, shelter, and nesting areas. They also obtain food from nearby areas of rangeland and cropland. Suitable management for wildlife should include protecting the unit from overgrazing and maintaining the areas of pinyon and juniper woodland.

Depth to bedrock and slope are the main limitations for the construction of homesites and urban development. Proper design is needed to overcome these limitations. Shallow depth to bedrock and slope limit design and installation of septic tank absorption fields or sewage lagoons. Community sewage systems are more satisfactory.

This map unit is in capability subclass VIIs, nonirrigated.

25—Durango cobbly loam, 3 to 20 percent slopes. This deep, well drained soil is on mesa tops and ridgetops that are dissected by drainageways. It formed in glacial outwash. Elevation is 6,800 to 7,400 feet. The average annual precipitation is 15 to 18 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 130 days.

Typically, the surface layer is brown cobbly loam about 3 inches thick. The upper part of the subsoil is brown clay loam about 5 inches thick, and the lower part is reddish brown and light reddish brown clay loam about 23 inches thick. The substratum is brown clay loam about 11 inches thick over light gray clay that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Witt loam and small areas of Nehar stony sandy loam, Ustic Torriorthents, and Ustollic Haplargids.

Permeability of this Durango soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight.

The unit is used mainly as rangeland and wildlife habitat.

The native vegetation on this unit is mainly Indian ricegrass, needleandthread, junegrass, western wheatgrass, bluegrass, pinyon, juniper, oak brush, skunkbrush, snowberry, big sagebrush, bitterbrush, and mountainmahogany. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Seeding should be done by hand broadcasting or aerial methods because of the cobbly surface layer. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

This unit is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. The unit is capable of producing about 18 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitation for the production of timber is stoniness. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, cottontail, squirrel, coyote, and mourning dove use this unit as a source of food, shelter, and nesting areas. Nearby areas of rangeland also provide food for some of the wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining areas in pinyon and juniper.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. Cobbles and stones limit the unit for lawns. The moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons would work well if the limitation of slope were overcome.

This map unit is in capability subclass VIIs, nonirrigated.

26—Falfa clay loam, 1 to 3 percent slopes. This deep, well drained soil is on mesa tops. It formed in calcareous loess. Elevation is 6,500 to 7,000 feet. The

average annual precipitation is 15 to 18 inches. The average annual air temperature is about 45 to 49 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is reddish brown clay loam about 9 inches thick. The upper part of the subsoil is reddish brown clay loam about 5 inches thick, the next part is reddish brown clay about 20 inches thick, and the lower part is reddish brown clay loam about 23 inches thick. The substratum to a depth of 60 inches or more is yellowish red clay loam.

Included in this unit are about 10 percent Corta loam, 5 percent soils that are similar to this Falfa soil but have a dark-colored surface layer, and small areas of Witt loam and Simpatico loam.

Permeability of this Falfa soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated crops, nonirrigated crops, rangeland, and homesites. The main irrigated crops are corn for silage; small grain such as wheat, barley, and oats; pasture; and alfalfa hay. The main nonirrigated crops are wheat and pinto beans.

In areas used for irrigated crops, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain adequate organic matter content. Land smoothing and irrigation structures are needed in some areas to achieve a more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is best suited to row crops. Sprinkler irrigation is well suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Corrugation systems are suited to alfalfa, pasture, and small grain. Regardless of the irrigation method used, water should be applied carefully to reduce runoff and control erosion. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain the fertility and tilth. The use of fertilizer helps to maintain the fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus.

In areas used for nonirrigated crops, management is needed to conserve moisture, control erosion, and maintain the productivity of the soil. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and erosion and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation is mainly western wheatgrass, muttongrass, junegrass, Indian ricegrass, big sagebrush, Gambel oak, serviceberry, Rocky Mountain juniper, and pinyon. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. The production of forage is limited by low rainfall in summer. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor or fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by lack of sufficient rainfall in summer. Supplemental irrigation may be needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from these areas. The unit is capable of producing about 18 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as cottontail, mule deer, coyote, squirrel, pheasant, and mourning dove use this unit. Irrigated cropland provides food and shelter for some wildlife. Native rangeland and nearby pinyon and juniper areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover, including areas of pinyon and juniper. In cropland areas, favorable habitat can be developed by maintaining plant cover along fences and ditches and in corners of fields.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell

potential. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The slow permeability should be considered when planning septic tank absorption fields. Sewage lagoons work well.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

27—Falfa clay loam, 3 to 8 percent slopes. This deep, well drained soil is on mesa tops. It formed in calcareous loess. Elevation is 6,500 to 7,000 feet. The average annual precipitation is 15 to 18 inches. The average annual air temperature is about 48 to 49 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is reddish brown clay loam about 9 inches thick. The upper part of the subsoil is reddish brown clay loam about 5 inches thick, the next part is reddish brown clay about 20 inches thick, and the lower part is reddish brown clay loam about 23 inches thick. The substratum is yellowish red clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 10 percent Corta loam, 5 percent soils that are similar to this Falfa soil but have a dark-colored surface layer, and small areas of Witt loam and Simpatico loam.

Permeability of this Falfa soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated and nonirrigated crops and as rangeland and homesites. The main irrigated crops are corn for silage; small grain such as wheat, barley, and oats; pasture; and alfalfa hay. The main nonirrigated crops are wheat and pinto beans.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain adequate organic matter content. Realignment of ditches and irrigation structures is needed in some areas to achieve a more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is best suited to row crops. Furrows should run across the slope. Sprinkler irrigation is well suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Corrugation systems are suited to alfalfa, pasture, and small grain. Regardless of the irrigation method used, water should be applied carefully to reduce runoff and control erosion. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain the fertility and tilth. The use of fertilizer helps to maintain the fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus.

In nonirrigated areas, management is needed to conserve moisture, control erosion, and maintain the productivity of the soil. Stubble mulch tillage and returning crop residue help to reduce runoff and erosion and to conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation of the unit consists of western wheatgrass, muttongrass, junegrass, Indian ricegrass, big sagebrush, Gambel oak, serviceberry, Rocky Mountain juniper, and pinyon. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. The production of forage is limited by low rainfall in summer. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor or fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by lack of sufficient rainfall in summer. Supplemental irrigation may be needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young.

Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac. Some areas support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from these areas. The unit is capable of producing about 18 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as cottontail, mule deer, coyote, squirrel, pheasant, and mourning dove use this unit. Irrigated

cropland provides food and shelter for some wildlife. Native rangeland and nearby areas of pinyon and juniper provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing, providing protection from wildfire, and maintaining adequate plant cover, including areas of pinyon and juniper. In cropland areas, favorable habitat can be developed by maintaining plant cover along fences and ditches and in corners of fields.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The slow permeability should be considered when planning septic tank absorption fields. Sewage lagoons work well if the limitation of slope is overcome.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

28—Fluvaquents, sandy, frequently flooded. This unit consists of deep, somewhat poorly drained and poorly drained, nearly level soils that formed in recent alluvial deposits bordering major drainageways on alluvial valley floors. The areas are dissected by old river channels and by smaller streams. Elevation is 6,000 to 8,000 feet. The average annual precipitation is 15 to 20 inches. The average annual air temperature is 42 to 50 degrees F, and the frost-free period is 90 to 130 days.

The soils in this unit are extremely variable. The surface layer ranges from gravelly or cobbly loam to sandy loam. Stratified sandy loam, sand, and gravel are at a depth of 5 to 20 inches.

Permeability of these Fluvaquents is moderately rapid or rapid. Effective rooting depth is 12 to 40 inches or more because of the presence of a fluctuating water table. Available water capacity is very low to low. Runoff is slow, and the hazard of erosion is slight. The soils have a fluctuating water table between depths of 12 and 40 inches year round.

Included in this unit are small areas of Pescar fine sandy loam, Tefton loam, Riverwash, gravel, and sand bars.

This unit is used for livestock grazing and wildlife habitat.

The native vegetation is mainly cottonwood, willows, sedges, rushes, tufted hairgrass, yarrow, and iris. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of the rangeland vegetation. Deferred grazing facilitates revegetation and improves areas of rangeland in poor condition. Brush control may be needed in some places.

Wildlife such as squirrel, mule deer, coyote, rabbit, and waterfowl use this unit. The unit is suited to the production of wetland plants that provide nesting areas, protective cover, and food for waterfowl. The location of this unit near areas of irrigated cropland makes it valuable to both wetland and rangeland wildlife. Suitable management for wildlife should include protecting the unit from overgrazing.

If this unit is used for homesite development, the main limitations are the fluctuating water table and hazard of flooding. Buildings and roads should be designed to overcome these limitations. These limitations restrict the construction of sewage systems and may contribute to the pollution of ground water. Drainage and protection from flooding should be established before construction is begun.

This map unit is in capability subclass VIIw, nonirrigated.

29—Fortwingate stony sandy loam, 3 to 12 percent slopes. This moderately deep, well drained soil is on mountainsides. It formed in material derived from sandstone and mixed with loess. Elevation is 7,600 to 8,800 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature 41 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typically, the surface is covered with a layer of organic material 1 inch thick. The surface layer is brown stony fine sandy loam about 1 inch thick. The next layer is pinkish gray stony fine sandy loam about 6 inches thick. The upper part of the subsoil is light brown loam about 5 inches thick, the next part is reddish brown clay loam about 13 inches thick, and the lower part is reddish yellow stony sandy clay loam about 7 inches thick over sandstone. Sandstone commonly is at a depth of 20 to 40 inches. In some places the surface layer is stony loam.

Included in this unit are about 15 percent Goldvale very stony fine sandy loam and small areas of Rock outcrop, Valto very stony fine sandy loam, Nordicol very stony sandy loam, and Anvik loam.

Permeability of this Fortwingate soil is moderately slow. Effective rooting depth is 20 to 40 inches because of the presence of hard bedrock. Available water capacity is low. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly as woodland and for livestock grazing and homesite development. It is also used for wildlife habitat.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 65, the potential production of marketable timber per acre is 4,025 cubic feet or 18,300 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and providing protection from erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods of heavy snowfall or rainfall or during snowmelt. Reforestation should be carefully managed to reduce

competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation. Among the trees that are suitable for planting are ponderosa pine and lodgepole pine. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is ponderosa pine, junegrass, mountain muhly, mountain brome, Arizona fescue, bluegrasses, elk sedge, Gambel oak, serviceberry, snowberry, and mountainmahogany. Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, bear, wild turkey, squirrel, and cottontail use this unit. Forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Shrink-swell potential and depth to bedrock are the main limitations for homesite and urban development. Building foundations should be designed to compensate for these limitations. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The moderately slow permeability and depth to bedrock should be considered when designing septic tank absorption fields or sewage lagoons.

This map unit is in capability subclass VIe, nonirrigated.

30—Fortwingate-Rock outcrop complex, 6 to 25 percent slopes. This map unit on mountainsides. Elevation is 7,600 to 8,800 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature 41 to 45 degrees F, and the frost-free period is 90 to 110 days.

This unit is about 45 percent Fortwingate stony fine sandy loam and 35 percent Rock outcrop.

Included in this unit are about 15 percent Goldvale very stony fine sandy loam and 5 percent Valto very stony fine sandy loam, Nordicol very stony sandy loam, and Anvik loam.

The Fortwingate soil is moderately deep and well drained. It formed in material derived from sandstone and mixed with loess. Typically, the surface is covered with a layer of organic material 1 inch thick. The surface layer is dark brown stony fine sandy loam about 1 inch thick. The next layer is pinkish gray stony fine sandy loam about 6 inches thick. The upper part of the subsoil is light brown loam about 5 inches thick, the next part is reddish brown clay loam about 13 inches thick, and the lower part is reddish yellow stony sandy clay loam about 7 inches thick over sandstone. Depth to sandstone ranges from 20 to 40 inches. In some places the surface layer is stony loam.

Permeability of this Fortwingate soil is moderately slow. Effective rooting depth is 20 to 40 inches because of the presence of hard bedrock. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is slight.

Rock outcrop consists of exposed areas of sandstone.

This unit is used mainly as woodland and for livestock grazing. It is also used for wildlife habitat and homesite development.

The Fortwingate soil is well suited to the production of ponderosa pine. On the basis of a site index of 65, the potential production of marketable timber per acre is 4,025 cubic feet or 18,300 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are constructing roads to avoid areas of Rock outcrop, reforesting, and providing protection from erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation.

Among the trees that are suitable for planting are ponderosa pine and lodgepole pine. Road systems should be carefully planned to avoid areas of Rock outcrop. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on the Fortwingate soil is mainly ponderosa pine, Gambel oak, mountainmahogany, and junegrass. Other important plants that characterize this unit are Arizona fescue, mountain brome, mountain muhly, serviceberry, snowberry, wild rose, bluegrass, Oregon-grape, ferns, wild celery, and strawberry. Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the desirable forage plants have achieved sufficient growth to withstand grazing pressure. Deferred

grazing speeds up revegetation and improves the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, bear, wild turkey, squirrel, and rabbit use this unit. Forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and controlling timber harvesting.

The areas of Rock outcrop, shrink-swell potential, slope, and depth to bedrock are the main limitations for homesite and urban development on the Fortwingate soil. Building foundations should be designed to compensate for these limitations. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. Depth to bedrock, slope, and the moderately slow permeability must also be considered when designing septic tank absorption fields and sewage lagoons.

This map unit is in capability subclass VIIs, nonirrigated.

31—Goldvale very stony fine sandy loam, 15 to 65 percent slopes. This deep, well drained soil is on mountainsides and valley sides. It formed in alluvium derived from interbedded sandstone and shale. Elevation is 7,500 to 8,500 feet. The average annual precipitation ranges from 18 to 25 inches. The average annual air temperature is 41 to 45 degrees F, and the average frost-free period is about 90 to 110 days.

Typically, the surface is covered by a layer of organic material 1 inch thick. The surface layer is reddish gray very stony fine sandy loam about 3 inches thick. The next layer is pinkish gray very stony fine sandy loam about 10 inches thick. The upper part of the subsoil is mixed light reddish brown and pinkish gray stony sandy clay loam about 8 inches thick, the next part is reddish brown stony clay about 24 inches thick, and the lower part is mixed reddish brown and yellowish brown stony clay that extends to a depth of 60 inches or more.

Included in this unit are about 10 percent Fortwingate stony fine sandy loam and small areas of Valto very stony fine sandy loam, Anvik loam, and Nordicol very stony sandy loam.

Permeability of this Goldvale soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is slight.

This unit is used as woodland and for livestock grazing, homesite development, and wildlife habitat.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 70, the potential production of marketable timber per acre is 4,480 cubic feet or 22,000 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and controlling erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation. Among the trees that are suitable for planting are ponderosa pine and lodgepole pine. Stones on the surface may interfere with logging in many places. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly ponderosa pine, Arizona fescue, and western wheatgrass. Other important plants that characterize this unit are aspen, junegrass, mountain brome, wild rose, bluegrass, mountainmahogany, Gambel oak, serviceberry, snowberry, and strawberry. Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, bear, wild turkey, squirrel, and rabbit use this unit. Forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Large stones, high shrink-swell potential, and slopes are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential. The moderately slow permeability, large stones, and slope should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal to overcome the limitation of moderately slow permeability. Sewage lagoons can be sealed to eliminate seepage.

This map unit is in capability subclass VIIs, nonirrigated.

32—Haploborolls-Rubble Land complex, 10 to 60 percent slopes. This map unit is on mountainsides.

Areas of the unit typically are below rock escarpments. Elevation is 6,600 to 10,000 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 38 to 47 degrees F, and the average frost-free period is 75 to 115 days.

This unit is about 40 percent Haploborolls and 40 percent Rubble Land.

Included in this unit is about 30 percent Nordicol very stony sandy loam, Valto very stony fine sandy loam, Clayburn cobbly loam, and Fortwingate stony fine sandy loam.

Haploborolls are moderately deep and deep and are well drained. These soils vary considerably in their properties, but generally the surface layer is very cobbly loam about 16 inches thick. The underlying material is very cobbly loam, extremely stony loam, or very stony clay loam. In some places the surface layer is very stony loam, and in some places it is extremely stony loam.

Permeability of these Haploborolls is moderate to moderately slow. Effective rooting depth is 20 inches or more. Available water capacity is low to moderate. Runoff is medium, and the hazard of erosion is moderate.

Rubble Land consists of rock fragments. It is 50 to 80 percent boulders and stones that have broken from rock ledges and cliffs above the unit.

This unit is used almost entirely as rangeland and wildlife habitat.

The native vegetation on this unit is mainly Arizona fescue, Thurber fescue, mountain muhly, junegrass, Gambel oak, serviceberry, snowberry, Douglas-fir, ponderosa pine, aspen, pinyon, and Rocky Mountain juniper. Proper grazing use is needed to maintain the quality and quantity of the preferred rangeland vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the soil from excessive erosion. Steepness of slope limits access by livestock and promotes overgrazing of less sloping areas. Developing livestock watering facilities and fencing improve the distribution of livestock and improve the understory.

Wildlife such as elk, mule deer, bear, squirrel, cottontail, coyote, and various species of bird use this unit. They obtain food from shrubs, grasses, and forbs on the unit and from nearby areas of rangeland and cropland. Wooded areas provide protective cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire.

Large stones and steepness of slope are the main limitations for homesite and urban development. These limitations must also be considered in planning septic tank absorption fields and sewage lagoons.

This map unit is in capability subclass VIIe, nonirrigated.

33—Harlan cobbly loam, moist, 1 to 3 percent slopes. This deep, well drained soil is on high terraces. It formed in cobbly alluvium and glacial outwash. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 14 to 18 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is reddish brown cobbly loam about 8 inches thick. The upper part of the subsoil is light reddish brown and reddish brown clay loam about 12 inches thick, the middle part is reddish brown cobbly clay loam about 14 inches thick, and the lower part is light reddish brown cobbly clay loam about 10 inches thick. The substratum is light reddish brown extremely cobbly sandy loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Witt loam and small areas of Nehar stony sandy loam.

Permeability of this Harlan soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is slow, and the hazard of erosion is slight.

The unit is used mainly as irrigated cropland, nonirrigated cropland, pasture, and rangeland. Some areas are used for homesite and urban development. The main irrigated crops are alfalfa hay, corn for silage, and small grain, such as barley, oats, and wheat. The main nonirrigated crop is wheat.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining adequate organic matter content and fertility of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing and proper water management are needed in some areas to achieve a more uniform distribution of irrigation water.

Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is well suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow irrigation is suited to row crops. Corrugation irrigation is suited to alfalfa, small grain, and pasture. Regardless of the irrigation method used, water should be applied carefully to control erosion and ensure the most efficient use of water.

In nonirrigated cropland areas, management is needed to conserve moisture, control erosion, and maintain the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of terraces, diversions, and grassed waterways. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and help

to conserve moisture. Terracing reduces runoff and erosion and conserves moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, blue grama, Gambel oak, serviceberry, and big sagebrush. Proper grazing use as part of a planned grazing system can be used to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

Wildlife such as mule deer, cottontail, coyote, and mourning dove use this unit. Areas of irrigated cropland and rangeland provide food for wildlife. Rangeland and nearby wooded areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

This unit is suited to homesite and urban development. The main limitations are the cobbles and large stones, which make excavation difficult, and moderate shrink-swell potential. The foundations of buildings should be designed to compensate for the moderate shrink-swell potential. The limitations of cobbles and stones and the moderate permeability should be considered when designing septic tank absorption fields or sewage lagoons. Sewage lagoons can be sealed to eliminate seepage.

This map unit is in capability subclasses IVe, irrigated, and IVs, nonirrigated.

34—Harlan cobbly loam, moist, 3 to 15 percent slopes. This deep, well drained soil is on terraces and along drainageways on mesas. It formed in cobbly alluvium and glacial outwash. Elevation is 6,000 to 7,500 feet. The average annual precipitation is 14 to 18 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is reddish brown cobbly loam about 8 inches thick. The upper part of the subsoil is light reddish brown and reddish brown clay loam about 12 inches thick, the middle part is reddish brown cobbly clay loam about 14 inches thick, and the lower part is light reddish brown cobbly clay loam about 10 inches thick. The substratum is light reddish brown extremely cobbly sandy loam that extends to a depth of 60 inches or more.

Included in this unit is about 15 percent Witt loam.

Permeability of this Harlan soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is slow, and the hazard of erosion is moderate.

The unit is used mainly as rangeland and wildlife habitat.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, blue grama, Gambel oak, serviceberry, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, cottontail, coyote, and mourning dove use this unit. Areas of irrigated cropland and rangeland provide food for wildlife, and areas of rangeland and nearby wooded areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

This unit is suited to homesite and urban development. The main limitations are the moderate shrink-swell potential, slope, and large stones. Cobbles and stones make excavation difficult. The foundations of buildings should be designed to compensate for the moderate shrink-swell potential. The content of cobbles and stones, slope, and moderate permeability should be considered when designing septic tank absorption fields or sewage lagoons. Sewage lagoons can be sealed to eliminate seepage.

This map unit is in capability subclass VIe, nonirrigated.

35—Hayness loam, 1 to 3 percent slopes. This deep, well drained soil is on alluvial fans. It formed in medium textured alluvium derived from red-bed sandstone. Elevation is 6,500 to 7,600 feet. The average annual precipitation is 18 to 20 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is weak red loam about 18 inches thick. The underlying material is reddish brown loam or silt loam that extends to a depth of 60 inches or more.

Included in this unit are small areas of Tefton loam and soils that have more clay in the profile than is typical of this Hayness soil.

Permeability of this Hayness soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly for homesite development, irrigated crops, and rangeland. Small grain, such as

wheat, barley, and oats, and alfalfa hay and pasture are the main irrigated crops. Many gardens are grown on this unit.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, controls erosion, and helps to maintain the organic matter content and fertility. The use of fertilizer helps to maintain the fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land leveling or land smoothing and irrigation structures are needed in some areas to achieve a more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is well suited to most crops. Furrow irrigation is well suited to row crops. Corrugation irrigation is suited to small grain, alfalfa, and pasture. Regardless of the irrigation method used, water should be applied carefully to reduce runoff and control erosion.

The native vegetation on this unit is mainly Arizona fescue, mountain muhly, needleandthread, junegrass, western wheatgrass, Gambel oak, and serviceberry. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as elk, mule deer, cottontail, coyote, and various birds use this unit. Areas of irrigated cropland and native grasses, forbs, and shrubs provide food for wildlife. Nearby wooded areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing, maintaining adequate plant cover, and maintaining adequate open space between built-up areas to provide game crossings.

This unit is suited to homesite and urban development. Low soil strength is a limitation for building roads and streets. The moderate permeability of the soil should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to eliminate seepage.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

36—Hayness loam, 3 to 12 percent slopes. This deep, well drained soil is on alluvial fans and valley sides. It formed in medium textured alluvium derived from red-bed sandstone. Elevation is 6,500 to 7,600 feet. The average annual precipitation is 18 to 20 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is weak red loam about 18 inches thick. The underlying material is reddish brown loam or silt loam that extends to a depth of 60 inches or more. In some places the surface layer is fine sandy loam.

Included in this unit are small areas of Uinta loam and soils that have more gravel and cobbles than is typical of this Hayness soil. These gravelly soils are in a small band at the base of talus slopes.

Permeability of this Hayness soil is moderately. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for homesite development, irrigated crops, and rangeland. Small grain, such as wheat, barley, and oats; pasture; and alfalfa hay are the main irrigated crops. Many gardens are grown on this unit.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content and fertility. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus.

Irrigation structures are needed in some areas to achieve a more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinklers are well suited to most crops. Furrow irrigation is well suited to row crops. Corrugation is suited to small grain, alfalfa, and pasture. Regardless of the irrigation method used, water should be applied carefully to control erosion and ensure the most efficient use of water.

The native vegetation on this unit is mainly Arizona fescue, mountain muhly, needleandthread, junegrass, western wheatgrass, Gambel oak, ponderosa pine, and pinyon. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as elk, mule deer, cottontail, coyote, bear, squirrel, and various birds use this unit. Areas of irrigated cropland and native grasses, forbs, and shrubs provide food for wildlife. Nearby wooded areas provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing, maintaining adequate plant cover, and

maintaining adequate open space between built-up areas to provide game crossings.

This unit is suited to homesite and urban development. Low soil strength is a limitation for building roads and streets. The moderate permeability of the soil should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be used if the limitation of slope is overcome. They should be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

37—Herm loam, 6 to 25 percent slopes. This deep, well drained soil is on mountainsides and valley floors. It formed in alluvium derived from shale. Elevation is 7,000 to 8,500 feet. The average annual precipitation is 16 to 25 inches. The average annual air temperature is 40 to 42 degrees F, and the average frost-free period is 90 to 115 days.

Typically, the surface is covered with a mat of pine needles and leaves about 2 inches thick. The upper part of the surface layer is dark reddish gray loam about 4 inches thick, and the lower part is reddish gray loam about 3 inches thick. The upper 7 inches of the subsoil is reddish gray clay loam, and the lower 20 inches is pale brown clay. The substratum to a depth of 60 inches or more is light brown clay loam.

Included in this unit is about 15 percent Hesperus loam. Also included are small areas of Archuleta loam, Sanchez very stony sandy clay loam, and soils that have an eroded surface layer.

Permeability of this Herm soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight.

This unit is used as woodland, livestock grazing, and homesite development.

This unit is well suited to the production of ponderosa pine (fig. 7). On the basis of a site index of 72, the potential production of marketable timber per acre is 4,666 cubic feet or 23,840 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and providing protection from erosion along roads, skid trails, and landings. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Gambel oak limits the natural regeneration of ponderosa pine. Careful consideration of road systems and harvesting methods is needed to minimize erosion.

The native vegetation on this unit is mainly ponderosa pine, junegrass, mountain muhly, and Gambel oak. Other important plants that characterize this unit are mountain brome, Arizona fescue, bluegrass, serviceberry, snowberry, mountainmahogany, Oregon-grape, and elk sedge. Proper grazing use as part of a planned grazing system helps to ensure the desired quality and quantity of rangeland vegetation. Seeding cleared areas is advisable when the native vegetation is in poor condition. Deferred grazing speeds up revegetation and improves areas of rangeland in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, turkey, coyote, bear, squirrel, and cottontail use this unit. Forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and avoiding clearcutting.

If this unit is used for homesite development, the main limitations are the slow permeability, high shrink-swell potential, slope, and low soil strength. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Buildings and roads should be designed to offset the limited ability of the soil to support a load. If this unit is used for septic tank absorption fields, the limitations of slow permeability and slope should be considered. Sewage lagoons work well if the limitation of slope is overcome.

This map unit is in capability subclass VIe, nonirrigated.

38—Herm Variant clay loam, 2 to 8 percent slopes. This deep, well drained soil is on alluvial fans and side slopes. It formed in alluvium derived from sandstone and shale. Elevation is 7,200 to 7,800 feet. The average annual precipitation is about 18 to 20 inches. The average annual air temperature is 38 to 42 degrees F, and the average frost-free period is 90 to 110 days.

Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The upper part of the subsoil is grayish brown clay loam about 6 inches thick, and the lower part is light brownish gray clay about 25 inches thick. The substratum to a depth of 60 inches or more is light gray clay loam. In some places the surface layer is loam.

Included in this unit are 10 percent Big Blue clay loam, 5 percent Hesperus loam, and 5 percent Pinata loam.

Permeability of this Herm Variant soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated pasture and irrigated field crops. Alfalfa is the main irrigated crop.

In irrigated areas, the main concerns of management are controlling water erosion, properly using irrigation water, and maintaining the organic matter content and fertility of the surface layer. Incorporating crop residue into the surface helps to control erosion, increases the water intake rate, and helps to maintain the organic

Figure 7.—Ponderosa pine in an area of Herm loam, 6 to 25 percent slopes.

matter content. Land smoothing, water management, and irrigation structures are needed in some areas to achieve a more uniform distribution of irrigation water. Applications of manure or fertilizer containing nitrogen and phosphorus are needed to maintain the fertility of the soil. Irrigation methods suited to this unit corrugation and sprinkler systems. These systems of irrigation are well suited to pasture and alfalfa. Regardless of the irrigation method used, water should be applied at a slow rate to minimize runoff and reduce erosion.

The native vegetation on this unit is mainly western wheatgrass, bluegrass, Indian ricegrass, junegrass, Gambel oak, snowberry, and rabbitbrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff.

This unit is used by mule deer, elk, coyote, cottontail, and various birds. They obtain food from irrigated areas and from the grasses, forbs, and shrubs in rangeland areas. Nearby areas of woodland and pasture provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and from wildfire.

Shrink-swell potential and low soil strength are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the shrink-swell potential. Roads should be designed to overcome the limitations of low soil strength and shrink-swell potential. The slow permeability

should be considered when designing septic tank absorption fields. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

39—Hesperus loam, 3 to 12 percent slopes. This deep, well drained soil is on alluvial fans and valley bottoms. It formed in medium textured alluvium. Elevation is 7,000 to 8,500 feet. The average annual precipitation is about 18 to 24 inches. The average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 90 to 110 days.

Typically, the surface layer is dark grayish brown loam about 14 inches thick. The upper part of the subsoil is dark grayish brown clay loam about 31 inches thick, and the lower part is brown loam about 10 inches thick. The substratum is light yellowish brown loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Herm loam and small areas of Nutrioso loam, Alamosa loam, and Shawa Variant loam.

Permeability of this Hesperus soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly as rangeland, irrigated cropland, and homesites. Small areas are used as nonirrigated cropland. Wheat, oats, barley, alfalfa, and pasture are the main irrigated crops. Wheat is the main nonirrigated crop.

In irrigated areas, the main concerns of management are controlling water erosion, properly using irrigation water, and maintaining the organic matter content and fertility of the surface layer. Incorporating crop residue into the surface layer helps to control erosion, increases the water intake rate, and helps to maintain the organic matter content and fertility of the soil. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation structures may be needed for a more uniform distribution of irrigation water. Irrigation methods suited to this unit are corrugation and sprinkler systems. These systems are well suited to most crops grown on the unit. Regardless of the irrigation method used, water should be applied carefully to reduce erosion.

The main concerns on nonirrigated cropland are reducing runoff and erosion, conserving moisture, and maintaining the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of diversions and grassed waterways. Maintaining crop residue on or near the surface increases the water intake rate, reduces runoff and erosion, and helps to maintain soil tilth and organic matter content. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation on this unit is mainly bluegrass, western wheatgrass, Arizona fescue, mountain muhly, big sagebrush, mountain bromegrass, Gambel oak, serviceberry, and lupine. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as elk, mule deer, wild turkey, cottontail, coyote, and various birds use this unit. They obtain their food from shrubs, grasses, and forbs in areas of rangeland and from areas of cropland. Nearby forested areas provide protective cover and nesting areas. Suitable management for wildlife include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

This unit is suited to homesite and urban development. The moderate permeability and slope should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

40—Horsethief stony fine sandy loam, 20 to 65 percent slopes. This deep, well drained soil is on cuestas, hogbacks, and mountainsides. It formed in stony colluvial material derived dominantly from sandstone and shale. Elevation 8,000 to 10,000 feet. The average annual precipitation is 18 to 30 inches. The average annual air temperature is 36 to 40 degrees F, and the average frost-free period is 60 to 90 days.

Typically, the surface is covered by a layer of undecomposed leaves, needles, and twigs about 2 inches thick. The surface layer is grayish brown very stony fine sandy loam about 2 inches thick. The next layer is very pale brown and light gray stony and very stony fine sandy loam about 22 inches thick. The upper part of the subsoil is light brownish gray and light gray extremely stony clay loam and extremely stony fine sandy loam about 8 inches thick, and the lower part is brownish yellow and pale brown extremely stony clay loam about 10 inches thick. The substratum is light brownish gray very stony clay loam about 8 inches thick. Shale and sandstone are at a depth depth of 40 to 60 inches or more.

Included in this unit are about 15 percent Nordicol stony sandy loam, 10 percent Uinta loam, and small

areas of Valto very stony fine sandy loam and Rock outcrop.

Permeability of this Horsethief soil is moderately slow. Effective rooting depth is 40 to 60 inches or more because of the presence of soft bedrock. Available water capacity is low. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mostly for wildlife habitat. The less sloping areas are also used for timber production and livestock grazing.

The less sloping areas of this unit are suited to the production of Douglas-fir. On the basis of a site index of 75, the potential production per acre of marketable timber is 4,945 cubic feet or 26,600 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old. Other trees suited to this unit are Engelmann spruce, white fir, and aspen.

The main concerns in producing and harvesting timber are reforestation, providing protection from erosion along roads and in other areas where vegetation has been removed, and steepness of slope. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock facilitates reforestation. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavation is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly white fir, Douglas-fir, ponderosa pine, Engelmann spruce, and aspen. Other important plants that characterize this unit are Arizona fescue, mountain brome, bluegrass, elk sedge, bearberry, Oregon-grape, serviceberry, snowberry, and Gambel oak. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the soil from excessive erosion. Steepness of slope limits access by livestock and promotes overgrazing of less sloping areas. Developing livestock watering facilities and fencing improve the distribution of livestock and improve the understory.

Wildlife such as elk, mule deer, bear, snowshoe rabbit, squirrel, and blue grouse use this unit. They obtain food from areas of grasses and shrubs in this unit and from adjacent areas. The wooded areas provide good shelter and protective cover. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Steepness of slope, stones, and a hazard of landsliding limit homesite and urban development. The presence of stones at a depth of as little as 40 inches is a limitation in some areas. The moderately slow permeability should be considered when designing septic tank absorption fields. The use of an alternate system should be considered.

This map unit is in capability subclass VIIs, nonirrigated.

41—Lazear stony loam, 6 to 25 percent slopes. This shallow, well drained soil is on the tops and edges of mesas. It formed in residuum derived from sandstone. Elevation is 6,000 to 7,800 feet. The average annual precipitation is about 14 to 18 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the upper part of the surface layer is brown stony loam about 5 inches thick and the lower part is light yellowish brown loam about 3 inches thick. The underlying material is very pale brown loam about 7 inches thick. Sandstone is at a depth of 15 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are about 15 percent Pulpit loam and small areas of soils in which the subsoil has more clay than is typical of this Lazear soil.

Permeability of this Lazear soil is moderate. Effective rooting depth is 10 to 20 inches because of the presence of hard bedrock. Available water capacity is very low. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as rangeland and for wildlife habitat.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, needleandthread, muttongrass, junegrass, pinyon, Rocky Mountain juniper, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting improve the water intake rate reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

This unit is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. The unit is capable of producing about 16 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitations for the production of pinyon and juniper are shallow depth to bedrock, low available water capacity, stoniness, and a moderate hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence

seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, coyote, cottontail, squirrel, and mourning dove use this unit. They obtain food from areas of grasses and shrubs and from nearby areas of cropland. The wooded areas provide shelter and nesting areas. Suitable management for wildlife should include providing protection from wildfire and overgrazing and maintaining areas in pinyon and juniper.

Steepness of slope and shallow depth to bedrock are the main limitations for homesite and urban development. These limitations should also be considered when planning septic tank absorption fields or sewage lagoons. The use of an alternate system should be considered.

This map unit is in capability subclass VIIs, nonirrigated.

42—Lazear-Rock outcrop complex, 12 to 65 percent slopes. This map unit is on the edges of mesas and breaks (fig. 8). Elevation is 6,000 to 7,800 feet. The average annual precipitation is 14 to 18 inches. The average annual air temperature is 47 to 50 degrees F, and the frost-free period is 110 to 130 days.

This unit is about 50 percent Lazear very stony loam and 30 percent Rock outcrop.

Figure 8.—Typical area of Lazear very stony loam in an area of Lazear-Rock outcrop, 12 to 65 percent slopes.

Included in this unit are about 10 percent Pulpit loam and 10 percent shallow soils that are similar to the Pulpit soils.

The Lazear soil is shallow and well drained. It formed in residual material derived from sandstone and shale. Typically, the upper part of the surface layer is brown very stony loam about 5 inches thick and the lower part is light yellowish brown loam about 3 inches thick. The underlying material is very pale brown loam about 7 inches thick. Sandstone is at a depth of 15 inches. Depth to sandstone ranges from 10 to 20 inches.

Permeability of this Lazear soil is moderate. Effective rooting depth is 10 to 20 inches because of the presence of hard bedrock. Available water capacity is very low. Runoff is medium, and the hazard of erosion is moderate.

Rock outcrop consists of nearly barren exposures of sandstone. It is typically on mesa rims and includes many vertical cliffs.

This unit is used mainly as rangeland and for wildlife habitat.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, needleandthread, muttongrass, Mormon-tea, junegrass, pinyon, Rocky Mountain juniper, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing and other disturbances. Seeding should be done by hand broadcasting or aerial methods. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

The Lazear soil is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from this unit. The unit is capable of producing about 14 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitations for the production of pinyon and juniper are the shallow depth to bedrock, low available water capacity, steepness of slope, stoniness, and moderate hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, coyote, cottontail, squirrel, and mourning dove use this unit. They obtain food from areas of grasses and shrubs and from nearby areas of cropland. The wooded areas provide shelter and nesting areas. Suitable management for wildlife should include providing protection from wildfire and overgrazing and maintaining areas in pinyon and juniper.

Steepness of slope and shallow depth to bedrock are the main limitations for homesite and urban development on the Lazear soil. These limitations should also be considered when planning septic tank absorption fields or sewage lagoons. The use of an alternate system should be considered.

This map unit is in capability subclass VIIs, nonirrigated.

43—Leadville very stony sandy loam, 15 to 55 percent slopes. This deep, well drained soil is on mountainsides. It formed in glacial till and alluvial and colluvial material. Elevation is 8,000 to 10,000 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 38 to 43 degrees F, and the average frost-free period is 60 to 80 days.

Typically, the surface is covered with a mat of pine needles and leaves about 2 inches thick. The surface layer is brown very stony sandy loam about 2 inches thick. The next layer is pinkish gray very stony sandy loam about 17 inches thick. The upper part of the subsoil is mixed pinkish gray and reddish brown very stony sandy clay loam about 4 inches thick, and the lower part is reddish brown very stony sandy clay loam about 30 inches thick. The substratum is reddish brown very stony sandy loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Horsethief stony fine sandy loam, 15 percent Uinta loam, and 15 percent soils that have less gravel than does this Leadville soil.

Permeability of this Leadville soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is low. Runoff is medium, and the hazard of erosion is slight.

This unit is used for timber production and wildlife habitat and for limited livestock grazing.

This unit is suited to the production of Engelmann spruce. On the basis of a site index of 60, it is capable of producing about 5,000 cubic feet or 27,500 board feet (International rule) of marketable timber per acre from a fully stocked, even-aged stand of trees 100 years old. The unit is also suited to the production of Douglas-fir, white fir, and aspen.

The main concerns for the management of timber are controlling cutting and controlling erosion along roads and in other areas where the plant cover has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, and during periods of high rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Careful consideration of road systems and harvesting methods is needed to minimize erosion.

The native vegetation on this unit is mainly Engelmann spruce, Douglas-fir, white fir, and aspen. Other important plants that characterize this unit are blue grass, nodding brome, spike trisetum, Thurber fescue, elk sedge, snowberry, serviceberry, and Oregon-grape. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of understory.

Wildlife such as elk, mule deer, bear, squirrel, and wild turkey use this unit. Woodland areas provide food, shelter, and protective cover for wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and limiting the cutting of timber.

Steepness of slope and large stones are the main limitations for homesite and urban development. Large stones affect excavation for buildings, utility lines, and roads. These limitations should also be considered when designing sewage lagoons or septic tank absorption fields. Sewage lagoons can be used if the limitation of slope is overcome. They should be lined to reduce seepage.

This map unit is in capability is VIIe, nonirrigated.

44—Mikim loam, 3 to 12 percent slopes. This deep, well drained soil is on alluvial fans and in foothill valleys. It formed in medium textured alluvium. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 13 to 16 inches. The average annual air temperature is 45 to 50 degrees F, and the frost-free period is 110 to 130 days.

Typically, the surface layer is pale brown loam about 9 inches thick. The underlying material is grayish brown and pale brown loam that extends to a depth of 60 inches or more. In some places the surface layer is sandy loam.

Included in this unit are about 10 percent Arboles silty clay loam, 5 percent Buckle loam, and small areas of Sili clay loam.

Permeability of this Mikim soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is high.

This unit is used mainly for irrigated field crops and pasture, nonirrigated crops, and rangeland. Small grain, such as wheat, barley, oats, and corn for silage and alfalfa are the main irrigated crops. The irrigated pasture is a mixture of grasses and alfalfa. Wheat is the main nonirrigated crop.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the fertility and organic matter content of the surface layer, and properly using irrigation water. Returning crop residue to the soil increases the water intake rate, improves tilth, helps to control erosion, and helps to maintain the organic matter content. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is suited to row crops. Sprinkler irrigation is well suited to most crops. Corrugation irrigation is suited to alfalfa, small grain, and pasture. Regardless of the method used, water should be applied carefully to achieve adequate infiltration and to minimize soil erosion.

In nonirrigated areas, management is needed to conserve moisture, control erosion, and maintain the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of terraces, diversions, and grassed waterways. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and conserve moisture. Terracing reduces runoff and erosion and conserves moisture. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, muttongrass, western wheatgrass, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use and planned grazing systems help to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas in dense stands of sagebrush. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting improve water filtration and reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. The unit is capable of producing about 16 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitation for the production of pinyon and juniper is the high hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, squirrel, coyote, cottontail, and various species of bird use this unit. Areas of rangeland provide shelter for wildlife, and areas of cropland and the native plants in the areas of rangeland provide food for wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and

wildfire and maintaining areas of pinyon and juniper woodland.

This unit is suited to homesite and urban development. The moderate permeability and slope should be considered when planning septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be used if the limitation of slope can be overcome. They should be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

45—Nehar stony sandy loam. This deep, well drained soil is on terraces along major drainageways. It formed in cobbly and stony glacial outwash or till. Slope is 1 to 6 percent. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 13 to 16 inches. The average annual air temperature is 45 to 50 degrees F, and the frost-free period is 110 to 130 days.

Typically, the upper part of the surface layer is light brown stony sandy loam about 4 inches thick and the lower part is reddish brown stony loam about 5 inches thick. The next layer is reddish brown stony clay loam 4 inches thick. The upper part of the subsoil is reddish brown very cobbly clay loam over stony clay loam about 18 inches thick, and the lower part is yellowish red very cobbly clay loam about 11 inches thick. The substratum is light reddish brown extremely stony sandy loam that extends to a depth of 60 inches or more.

Included in this unit are 20 percent Agua Fria loam and small areas of Harlan cobbly loam and Sedillo gravelly loam.

Permeability of this Nehar soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is low. Runoff is slow, and the hazard of erosion is slight.

This unit is used mainly as rangeland and for wildlife habitat.

The native vegetation on this unit is mainly western wheatgrass, slender wheatgrass, Indian ricegrass, junegrass, blue grama, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Brush control, rangeland seeding, and deferment of grazing facilitate revegetation of areas depleted by heavy grazing and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, cottontail, squirrel, coyote, pheasant, mourning dove, and various other species of bird use this unit. Areas of rangeland and nearby areas of pinyon and juniper woodland provide shelter and nesting areas and some food for wildlife. Nearby cropland areas are sources of food. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

High shrink-swell potential, large stones, and low soil strength are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. Cobbles and stones limit excavations for basements, utility lines, and roads. The moderately slow permeability and the presence of cobbles and stones should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields can be made larger than normal or installed deeper, where the soil material is more permeable. Sewage lagoons can be lined to overcome the limitation of seepage.

This map unit is in capability subclass VIe, nonirrigated.

46—Nordicol very stony sandy loam, 6 to 25 percent slopes. This deep, well drained soil is on mountainsides. It formed in colluvium and alluvium derived from sandstone. Elevation is 7,800 to 10,000 feet. The average annual precipitation is 20 to 25 inches. The average annual air temperature is 38 to 42 degrees F, and the frost-free period is 60 to 80 days.

Typically, the surface is covered with a layer of undecomposed needles, leaves, and twigs about 1 inch thick. The surface layer is dark grayish brown and brown very stony sandy loam about 12 inches thick. The next layer is light brownish gray very stony sandy loam about 12 inches thick. The upper part of the subsoil is light brown and brown very stony sandy clay loam about 12 inches thick, and the lower part to a depth of 60 inches or more is brown very stony sandy clay loam. In some places the surface layer is very stony loam.

Included in this unit are about 20 percent Anvik loam and small areas of Goldvale very stony fine sandy loam, Fortwingate stony fine sandy loam, and Chris very stony loam.

Permeability of this Nordicol soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is slow, and the hazard of erosion is slight.

This unit is used mainly as woodland and for limited homesite development. It is also used for wildlife habitat and limited livestock grazing.

This unit is well suited to the production of Douglas-fir. On the basis of a site index of 80, the potential production of marketable timber per acre is 5,410 cubic feet or 31,200 board feet (International rule) from a fully stocked, even-aged stand of trees 100 years old. Other trees generally suited to this unit are white fir, aspen, Engelmann spruce, and ponderosa pine.

The main concerns in producing and harvesting timber are equipment limitations because of the presence of

stones and the hazard of erosion along roads and in other disturbed areas. Management that minimizes the risk of erosion is essential in harvesting timber. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills. If site preparation is not adequate, competition from undesirable plants can prevent or prolong natural or artificial reforestation. Hand planting of nursery stock commonly is necessary to establish or improve a stand. Large stones limit the kinds of equipment that can be used in forest management. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall.

The native vegetation on this unit is mainly white fir, Douglas-fir, aspen, Engelmann spruce, and ponderosa pine. Other important plants that characterize this unit are Arizona fescue, Thurber fescue, bluegrass, elk sedge, bearberry, Oregon-grape, serviceberry, snowberry, and wild rose. Proper grazing use as part of a planned grazing system helps to maintain the desired quantity and quality of the pasture plants. Deferred grazing speeds up revegetation and improves areas in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, squirrel, coyote, snowshoe rabbit, wild turkey, blue grouse, and bear use this unit. Areas of native vegetation provide food and cover. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Large stones and steepness of slope are the main limitations for homesite and urban development. Large stones affect excavation for buildings, utility lines, and roads. These limitations should also be considered when designing septic tank absorption fields or sewage lagoons. If the limitations of slope and large stones can be overcome, septic tank absorption fields can be installed if they are made larger than normal. Sewage lagoons can be used if they are lined to reduce seepage.

This map unit is in capability subclass VIIs, nonirrigated.

47—Nutrioso loam. This deep, well drained soil is on valley bottoms and alluvial fans. It formed in medium textured alluvium. Slope is 1 to 3 percent. Elevation is 7,000 to 8,000 feet. The average annual precipitation is 18 to 24 inches. The average annual air temperature is 43 to 46 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The next layer is dark grayish brown loam that is stratified with fine sandy loam and is about 35 inches thick. The underlying material is dark grayish brown loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Hesperus loam and small areas of Vosburg fine sandy loam. Also included are areas of soils that have a fine sandy loam surface layer.

Permeability of this Nutrioso soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is slow, and the hazard of erosion is moderate.

This unit is used mainly as rangeland and for wildlife habitat. Some small areas are used for irrigated crops.

If irrigated crops are grown, the main concerns of management are controlling water erosion, maintaining the organic matter content of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, and helps to control erosion. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Corrugation irrigation is well suited to small grain and pasture. If corrugation systems are used, land smoothing is needed for more uniform distribution and more efficient use of irrigation water. Sprinkler irrigation is suited to most crops; because areas of this unit are narrow, however, irrigation commonly is not practical regardless of the method used. Water should be applied carefully to avoid eroding the surface layer.

The native vegetation on this unit is mainly Arizona fescue, mountain muhly, needleandthread, western wheatgrass, and Gambel oak. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding along with deferment of grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing help to distribute grazing and to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

Wildlife such as elk, mule deer, coyote, cottontail, and mourning dove use this unit. Nearby irrigated areas provide food for much of the wildlife, and the rangeland areas provide shelter, nesting areas, and food. Suitable management for wildlife should include protecting the unit from overgrazing and from wildfire.

This unit is well suited to homesite and urban development. The main limitation is the moderate permeability, which should be considered when constructing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

48—Panitchen-Dominguez Variant silty clay loams. This map unit is along drainageways and on valley bottoms. Slope is 1 to 6 percent. Elevation is 6,000 to

6,500 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is 45 to 50 degrees F, and the frost-free period is 120 to 130 days.

This unit is about 50 percent Panitchen silty clay loam and about 35 percent Dominguez Variant silty clay loam.

Included in this unit is about 15 percent Mikim loam.

The Panitchen soil is deep and well drained. It formed in alluvium derived from shale and sandstone. Typically, the upper part of the surface layer is light brownish gray silty clay loam about 6 inches thick. The lower part of the surface layer and the underlying material are grayish brown, stratified silty clay loam, sandy loam, loamy sand, and gravelly sandy loam that extend to a depth of 60 inches or more.

Permeability of this Panitchen soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is moderate, and the hazard of erosion is high. This soil is slightly affected by alkali.

The Dominguez Variant soil is deep and well drained. It formed in alluvium derived from shale and sandstone. Typically, the surface layer is grayish brown silty clay loam about 3 inches thick. The upper part of the subsoil is grayish brown clay about 22 inches thick, and the lower part is light brownish gray clay about 10 inches thick. The substratum is light brownish gray clay that extends to a depth of 60 inches or more. In some areas the surface layer is silty clay.

Permeability of this Dominguez Variant soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is rapid, and the hazard of erosion is high. This soil is moderately affected by alkali.

This unit is used as rangeland and for wildlife habitat.

The native vegetation in most areas of this unit is mainly greasewood, Indian ricegrass, western wheatgrass, alkali sacaton, big sagebrush, and fourwing saltbush. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates the revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities and deferring grazing help to improve the distribution of grazing and to maintain the condition of the rangeland.

Wildlife such as mule deer, coyote, cottontail, and mourning dove use this unit. The rangeland areas provide food, shelter, and nesting areas for some of the wildlife. Other kinds of wildlife find shelter in nearby wooded areas. Suitable management for wildlife should include protecting the unit from overgrazing and maintaining adequate plant cover.

If this unit is used for homesite development, the main limitations are the low soil strength and moderate shrink-swell potential. Buildings should be designed to compensate for the moderate shrink-swell potential. Roads should be designed to offset the limited ability of the Dominguez Variant soil to support a load and to offset the effects of shrinking and swelling. The moderately slow and slow permeability of the soils should be considered when designing septic tank absorption fields. Absorption fields may need to be made larger than normal. Sewage lagoons work well where slope is not a limitation.

This map unit is in capability subclass VIs, nonirrigated.

49—Pastorius cobbly loam. This deep, well drained soil is in gently sloping areas on river terraces. It formed in cobbly alluvium. Elevation is 8,000 to 9,000 feet. Slope is 1 to 3 percent. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 40 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typically, the surface layer is brown cobbly loam about 20 inches thick. The upper part of the subsoil is reddish brown very cobbly or extremely cobbly clay loam about 19 inches thick, and the lower part is reddish brown extremely cobbly sandy clay loam about 17 inches thick. The substratum is extremely cobbly sand that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Sedillo gravelly loam and small areas of Harlan cobbly loam and Nehar stony sandy loam.

Permeability of this Pastorius soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is slow, and hazard of erosion is slight.

This unit is used for irrigated pasture and wildlife habitat and as rangeland.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the soil, and properly using irrigation water. Applications of fertilizer or manure help to maintain the organic matter content and fertility of the soil. Careful application of irrigation water is needed to obtain efficient use of water. Suitable irrigation methods are flooding from contour ditches and sprinkler systems. Use of sprinkler systems permits the even, controlled application of water.

The native vegetation on this unit is mainly Arizona fescue, mountain muhly, needlegrass, junegrass, western wheatgrass, slender wheatgrass, rabbitbrush, oak brush, and serviceberry. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing and other disturbances. Developing livestock watering facilities, fencing, and

deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, elk, cottontail, coyote, and various species of bird use this unit. Rangeland areas provide food, shelter, and nesting areas for wildlife. Nearby cropland areas also provide food, and nearby wooded areas provide shelter and nesting areas. Suitable management for wildlife should include proper grazing use, protection from wildfire, and maintaining adequate plant cover.

The high content of cobbles in the soil is the main limitation for homesite and urban development. The cobbles limit excavation for basements, utility lines, and roads. The content of cobbles and the moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be lined to reduce seepage.

This map unit is in capability subclass VIs, irrigated and nonirrigated.

50—Pescar fine sandy loam. This deep, somewhat poorly drained soil is on flood plains, low terraces, and alluvial valley floors. It formed in stratified calcareous alluvium. Slope is 0 to 2 percent. Elevation is 6,500 to 8,000 feet. The average annual precipitation ranges from 18 to 22 inches. The average annual air temperature is 42 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typically, the surface layer is light brownish gray fine sandy loam about 8 inches thick. The upper 12 inches of the underlying material is light brownish gray fine sandy loam that is stratified with loam and loamy fine sand, and the lower part to a depth of 60 inches or more is light brownish gray very gravelly sand.

Included in this unit are about 15 percent Tefton loam, small areas of soils that are wetter than this Pescar soil, and small areas of soils that are drier than this Pescar soil.

Permeability of this Pescar soil is moderately rapid. Effective rooting depth is 18 to 30 inches because of the presence of a high water table. Available water capacity is low. Runoff is very slow, and the hazard of erosion is slight. This soil has a fluctuating water table that is between depths of 18 and 30 inches in spring and summer. The soil is subject to frequent flooding from April through September.

This unit is used mainly for irrigated pasture and hay and as rangeland.

The main concerns of management in irrigated areas are properly using irrigation water and maintaining the desired grasses and legumes. Special care is needed in applying irrigation water on this unit. Short irrigation runs and light, frequent irrigations are needed to control the fluctuating water table. Drainage ditches may also be needed to control the water table.

The native vegetation on this unit is mainly sedges, rushes, tufted hairgrass, slender wheatgrass, yarrow, iris, willows, and cottonwood. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of the rangeland vegetation. Deferred grazing facilitates revegetation and improves areas of rangeland in poor condition.

This unit is well suited to wildlife habitat. It provides habitat for mule deer, muskrat, and coyote and for waterfowl and other birds. Wildlife habitat can be enhanced by planting trees and shrubs and by leaving areas of grasses and legumes. Shallow water areas can be developed to attract waterfowl.

Frequent flooding, seepage, and the high water table limit use of this unit for homesite and urban development. Intensive engineering designs are needed to overcome these limitations. These limitations should be considered when constructing sewage systems, which present a risk of polluting ground water. Drainage and protection from flooding are needed if buildings are constructed.

This map unit is in capability subclass IVw, irrigated and nonirrigated.

51—Picante-Rock outcrop complex, 10 to 45 percent slopes. This map unit is on cuestas and hills. Elevation is 6,000 to 6,600 feet. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 45 to 50 degrees F, and the frost-free period is 120 to 140 days.

This unit is about 50 percent Picante clay loam and about 25 percent Rock outcrop.

Included in this unit are about 10 percent Dulce sandy loam, 5 percent Ustic Torriorthents, 5 percent Ustollic Haplargids, and 5 percent Mikim loam.

The Picante soil is shallow and well drained. It formed in residuum derived from interbedded siltstone and shale. Typically, the surface layer is light yellowish brown clay loam about 3 inches thick. The underlying material is light gray silty clay loam about 11 inches thick. Soft siltstone or shale is at a depth of 14 inches. Depth to soft interbedded siltstone or shale ranges from 10 to 20 inches.

Permeability of this Picante soil is moderate. Effective rooting depth is 10 to 20 inches because of the presence of soft bedrock. Available water capacity is low. Runoff is medium to rapid, and the hazard of erosion is high.

Rock outcrop consists of nearly barren exposures of sandstone and siltstone.

This unit is used as rangeland and for wildlife habitat.

The native vegetation is mainly pinyon, Rocky Mountain juniper, Indian ricegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance

of species is maintained in the plant community. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing and other disturbances. The suitability of this unit for rangeland seeding is poor. The main limitations for seeding are slope, the areas of Rock outcrop, and depth to rock. Developing livestock watering facilities and fencing improve the distribution of livestock.

The Picante soil is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the soil. It is capable of producing about 10 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitations for the production of pinyon and juniper are shallow depth to bedrock, low available water capacity, steepness of slope, and the hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as elk, mule deer, cottontail, squirrel, coyote, and various species of bird use areas of this unit for food and cover. Suitable management for wildlife should include protecting the unit from overgrazing and maintaining areas of woodland.

If this unit is used for homesite development, the main limitations are the shallow depth to bedrock and slope. Shallow depth to bedrock affects excavation for foundations, utility lines, and roads. The main limitations affect the construction of sewage lagoons and septic tank absorption fields. Other systems may be more satisfactory.

This map unit is in capability subclass VIIs, nonirrigated.

52—Pinata loam, 1 to 12 percent slopes. This deep, well drained soil is on mountainsides and mesa tops. It formed in glacial outwash or till that has been mixed with eolian sediment. Elevation is 7,000 to 8,200 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F, and the frost-free period is 90 to 115 days.

Typically, the surface layer is brown loam about 7 inches thick. The upper part of the subsoil is brown clay loam about 4 inches thick, the next part is reddish brown gravelly clay about 10 inches thick, and the lower part is reddish brown very cobbly or extremely cobbly clay about 17 inches thick. The substratum is mixed strong brown and pinkish gray extremely cobbly sandy clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Plome fine sandy loam and small areas of soils that are similar to this Pinata soil but have fewer coarse fragments.

Permeability of this Pinata soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly for timber production, livestock grazing, and wildlife habitat. A few small areas are used for irrigated pasture and hay.

In irrigated areas the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the soil, and properly using irrigation water. Applications of fertilizer or manure help to maintain the organic matter content and fertility of the soil. Careful application of irrigation water is needed to obtain efficient use of water. Suitable methods of applying irrigation water are flooding from contour ditches and sprinklers. Use of sprinklers permits the even, controlled application of water.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 88, it is capable of producing about 6,442 cubic feet or 38,480 board feet (International rule) of marketable timber per acre from a fully stocked, even-aged stand of trees 100 years old.

The main concerns of management for timber production are controlling cutting and controlling erosion along roads and in other areas where the plant cover has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, and during periods of high rainfall. Reforestation should be managed to reduce competition from undesirable understory plants. Oak brush limits the natural regeneration of ponderosa pine.

The native vegetation on this unit is mainly ponderosa pine, junegrass, mountain muhly, mountain brome, Arizona fescue, and Gambel oak. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of understory. Developing livestock watering facilities and fencing improve the distribution of livestock and increase the production of understory.

Wildlife such as elk, mule deer, cottontail, squirrel, coyote, turkey, and various species of bird use this unit. Woodland areas provide food, shelter, and nesting areas for wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and limiting the cutting of timber.

High shrink-swell potential, slow permeability, and cobbles are the main limitations for homesite and urban development. The large amount of cobbles makes excavation for foundations, utility lines, and roads difficult. The foundations of buildings should be constructed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high

shrink-swell potential. The slow permeability should be considered when planning septic tank absorption fields. Absorption fields may need to be made larger than normal or installed deeper and in more permeable material. Sewage lagoons work well if the limitation of slope is overcome.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

53—Pinata loam, 12 to 40 percent slopes. This deep, well drained soil is on mountainsides. It formed in glacial outwash or till that has been mixed with eolian sediment. Elevation is 7,000 to 8,200 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 40 to 45 degrees F, and the frost-free period is 90 to 115 days.

Typically, the surface layer is brown loam about 7 inches thick. The upper part of the subsoil is brown clay loam about 4 inches thick, the next part is reddish brown gravelly clay about 10 inches thick, and the lower part is reddish brown very cobbly or extremely cobbly clay about 17 inches thick. The substratum is mixed strong brown and pinkish gray extremely cobbly sandy clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Plome fine sandy loam and small areas of soils that are similar to this Pinata soil but have fewer coarse fragments.

Permeability of this Pinata soil is slow. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for timber production, livestock grazing, and wildlife habitat.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 76, it is capable of producing about 5,038 cubic feet or 27,520 board feet (International rule) of marketable timber per acre from a fully stocked, even-aged stand of trees 100 years old.

The main concerns of management for timber production are controlling cutting and controlling erosion along roads and in other areas where the plant cover has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, and during periods of high rainfall. Reforestation should be managed to reduce competition from undesirable understory plants. Oak brush limits the natural regeneration of ponderosa pine. Careful consideration of road systems and harvesting methods is needed to minimize erosion.

The native vegetation on this unit is mainly ponderosa pine, junegrass, mountain muhly, mountain brome, Arizona fescue, and Gambel oak. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and increase the production of understory.

Wildlife such as elk, mule deer, cottontail, squirrel, coyote, turkey, and various species of bird use this unit. Woodland areas provide food, shelter, and nesting areas for wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and limiting the cutting of timber.

High shrink-swell potential, slope, and slow permeability are the main limitations for homesite and urban development. The foundations of buildings should be constructed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The slow permeability and slope should be considered when planning septic tank absorption fields or lagoons. Sewage lagoons will work if the limitation of slope is overcome.

This map unit is in capability subclass VIIe, nonirrigated.

54—Pits, gravel. This map unit consists of open excavations and borrow areas from which soil and underlying material have been removed. The pits are mainly in deep deposits of gravelly alluvium and glacial outwash on mesas and river bottoms. Elevation ranges from 6,000 to 8,500 feet. The average annual precipitation ranges from 13 to 27 inches, the average annual air temperature ranges from 40 to 50 degrees F, and the frost-free period ranges from 90 to 130 days.

Included in this unit are small areas of deep soils where the gravel has not been removed.

The pits are normally barren of vegetation except for shrubs and annual weeds. They are very low in natural fertility and are subject to erosion. Abandoned pits can be reshaped and covered with topsoil to encourage revegetation and control erosion. Such areas should be seeded to adapted species late in fall so that germination can take place when adequate moisture is available in spring.

This map unit is in capability subclass VIIIs, nonirrigated.

55—Plome fine sandy loam, 3 to 12 percent slopes. This deep, well drained soil is on mountainsides and mesas. It formed in eolian material. Elevation is 7,000 to 8,200 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 42 to 45 degrees F, and the frost-free period is 90 to 110 days.

Typically, the surface is covered with a layer of organic material 2 inches thick. The surface layer is light brown fine sandy loam about 6 inches thick. The next layer is light brown and yellowish red clay loam about 3 inches thick. The upper part of the subsoil is yellowish red clay loam about 20 inches thick, and the lower part is reddish yellow clay loam that extends to a depth of 60 inches or more. In some areas the surface layer is loam.

Included in this unit are about 15 percent Pinata loam and small areas of Fortwingate stony fine sandy loam and Witt loam.

Permeability of this Plome soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated and nonirrigated crops and as woodland and rangeland. The main irrigated crops are barley, oats, and alfalfa hay. The main nonirrigated crops are wheat, pinto beans, and alfalfa.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, and helps to control erosion and to maintain the organic matter content and fertility of the surface layer. The use of fertilizer helps to maintain the fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing and irrigation structures are needed in some areas to achieve a more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is best suited to row crops. Corrugation irrigation is suited to alfalfa, small grain, and pasture. Sprinkler irrigation is well suited to most crops. Regardless of the irrigation method used, water should be applied carefully to minimize erosion.

In nonirrigated areas, management is needed to conserve moisture, control erosion, and maintain the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of terraces, diversions, and grassed waterways. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and conserve moisture. Terracing reduces runoff and erosion and conserves moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 80, the potential production of marketable timber per acre is 5,410 cubic feet or 31,200 board feet of (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and controlling erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation.

Among the trees that are suitable for planting are ponderosa pine and lodgepole pine. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly ponderosa pine, Arizona fescue, and mountain muhly. Other important plants that characterize this unit are Gambel oak, junegrass, mountain brome, wild rose, bluegrass, and Oregon-grape. Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of the native vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, squirrel, cottontail, coyote, and various species of bird use this unit. Woodland areas provide food, shelter, and protective cover for wildlife. Nearby areas of rangeland and cropland also provide food. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Moderate shrink-swell potential and slope are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the moderate shrink-swell potential. Roads should be designed to overcome the limitations of low soil strength and moderate shrink-swell potential. The moderate permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

56—Pulpit loam, 3 to 12 percent slopes. This moderately deep, well drained soil is on mesas. It formed in loess deposits. Elevation is 6,200 to 7,500 feet. The average annual precipitation is about 14 to 17 inches. The average annual air temperature is 48 to 52 degrees F, and the frost-free period is 110 to 130 days.

Typically, the surface layer is reddish gray loam about 5 inches thick. The upper part of the subsoil is reddish brown silty clay loam about 16 inches thick, and the lower part is light reddish brown loam about 8 inches thick. The substratum is very pale brown loam about 6

inches thick. Sandstone is at a depth of 35 inches. Depth to sandstone ranges from 20 to 40 inches.

Included in this unit are about 15 percent Witt loam and small areas of Lazear stony loam and Rock outcrop.

Permeability of this Pulpit soil is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as irrigated cropland, nonirrigated cropland, and rangeland. The main irrigated crops are alfalfa, oats, and barley. The main nonirrigated crops are wheat, pinto beans, and alfalfa.

In irrigated areas, the main concerns of management are controlling water erosion, properly using irrigation water, and maintaining the organic matter content and fertility of the surface layer. Incorporating crop residue into the surface layer helps to control erosion, increases the water intake rate, and helps to maintain the organic matter content of the surface layer. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation water management and irrigation structures are needed for a more uniform distribution of water and for its efficient use. Irrigation methods suited to this unit are corrugation and sprinkler systems. These systems are well suited to most crops. Regardless of the irrigation method used, water should be applied carefully to control erosion.

In nonirrigated areas, management is needed to conserve moisture, control erosion, and maintain the productivity of the soil. Using stubble mulch tillage and returning crop residue to the soil help to reduce runoff and erosion and to conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, junegrass, blue grama, muttongrass, big sagebrush, pinyon, and Rocky mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective on rangeland in poor to fair condition.

Most areas of this unit are suited to windbreaks and environmental plantings. The unit is limited mainly by lack of sufficient rainfall in summer. Supplemental irrigation may be needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Some areas of this unit support stands of pinyon and juniper. The unit is suited to this production. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from this unit. The unit is capable of producing about 18 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitation for the production of pinyon and juniper is the moderate available water capacity. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as cottontail, mule deer, coyote, and mourning dove use this unit. They obtain food from areas of grasses, forbs, and shrubs and from nearby cropland areas. Areas of rangeland and pinyon and juniper provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining some areas in pinyon and juniper.

Depth to bedrock is the main limitation for homesite and urban development. Roads should be designed to overcome the limitation of low soil strength. Permeability and depth to bedrock should be considered when designing septic tank absorption fields and sewage lagoons. If sewage lagoons are excavated to bedrock, they should be lined to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

57—Riverwash. This unit consists of poorly drained undifferentiated sand, gravel, and cobbles in meanders and oxbows of major drainageways on alluvial valley floors. The unit has a high water table throughout the year and is subject to frequent flooding. It supports little or no vegetation. The small amount of vegetation that occurs consists of water tolerant grasses and scattered cottonwood trees and willows.

This unit has good potential as a source of construction material such as sand and gravel.

This map unit is in capability subclass VIIIw, nonirrigated.

58—Rock outcrop. This map unit is on cliffs, breaks, ridges, and mountainsides. It consists mainly of areas of exposed sandstone, but in the northern part of the area it includes limestone, quartzite, granite, schist, and conglomerate. Elevation ranges from 6,000 to 10,000 feet. The average annual precipitation ranges from 13 to

30 inches. The average annual air temperature ranges from 38 to 50 degrees F, and the frost-free period ranges from 60 to 130 days.

Included in this unit are small areas of soils that are shallow and very shallow over bedrock.

The native vegetation is sparse. It grows in the small areas of inclusions and in cracks and fissures in the Rock outcrop. It varies with elevation and consists of pinyon, Rocky Mountain juniper, ponderosa pine, spruce, fir, and various shrubs and grasses.

This unit is used as wildlife habitat and for limited amounts of construction material.

Wildlife such as marmots, eagles, hawks, squirrel, and bear use this unit for cover and nesting areas, and they obtain food from included areas and nearby soils.

This map unit is in capability subclass VIIIs, nonirrigated.

59—Sedillo gravelly loam, 0 to 3 percent slopes. This deep, well drained soil is old high terraces of major river valleys. It formed in cobbly glacial outwash. Elevation is 6,000 to 6,700 feet. The average annual precipitation is 13 to 16 inches. The average annual air temperature is about 50 to 52 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is brown gravelly loam about 6 inches thick. The upper part of the subsoil is reddish brown very gravelly clay loam about 15 inches thick, and the lower part is brown very gravelly sandy clay loam about 6 inches thick. The substratum is pinkish white very cobbly or very gravelly sandy clay loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Nehar stony sandy loam and small areas of Agua Fria loam.

Permeability of this Sedillo soil is moderately slow. Effective rooting depth is 60 inches or more. The available water capacity is moderate. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly as rangeland and for wildlife habitat.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, blue grama, muttongrass, Fendler threeawn, big sagebrush, bitterbrush, serviceberry, pinyon, and Rocky Mountain juniper (fig. 9). Use of proper grazing and planned grazing systems are the most important practices that can be used to maintain the quality and quantity of grasses. Seeding speeds up revegetation of areas of rangeland that have deteriorated because of overgrazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Some areas of the unit support stands of pinyon and juniper. This unit is suited to this production. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. It is capable of producing about 16 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, cottontail, coyote, and various birds use this unit. They obtain their food from areas of rangeland and from nearby areas of cropland. Nearby areas of pinyon and juniper provide cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and maintaining areas of pinyon and juniper. Areas of rangeland and tall grasses in fence rows and odd corners of fields can be managed as wildlife habitat.

This unit is suited to homesite and urban development. Cobbles and gravel make excavations for roads, utilities, and other development difficult. The moderately slow permeability of the soil should be considered when planning for septic tank absorption fields or lagoons. Sewage lagoons can be lined to reduce seepage. Absorption fields may need to be made larger than normal.

Gravel on the surface limits recreational development such as playgrounds, picnic areas, camp areas, and golf courses.

This map unit is in capability subclass VIs, nonirrigated.

60—Shalona loam. This deep, well drained soil is on old high terraces. It formed in mixed alluvium derived from sandstone and shale. Slope is 1 to 6 percent. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 14 to 18 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the upper part of the surface layer is pinkish gray loam about 2 inches thick and the lower part is brown clay loam about 5 inches thick. The upper part of the subsoil is dark grayish brown clay loam about 7 inches thick, and the lower part is brown clay loam about 29 inches thick. The substratum is pale brown loam that extends to a depth of 60 inches or more. In some places the surface layer is light clay loam.

Included in this unit are about 15 percent Agua Fria loam and small areas of Mikim loam and Harlan cobbly loam.

Permeability of this Shalona soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is slow, and the hazard of erosion is slight.

Figure 9.—Native vegetation in an area of Sedillo gravelly loam, 0 to 3 percent slopes.

This unit is used mainly for irrigated field crops and pasture and as rangeland. It is also used for homesite and urban development. Alfalfa, barley, and oats are the main irrigated crops.

The main management concerns in areas of irrigated cropland are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Land smoothing improves distribution of irrigation water. The incorporation of crop residue into the surface layer increases the water intake rate, improves tilth, helps to maintain the organic matter content of the surface layer, and reduces erosion. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is well suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Furrow irrigation is suited to row crops. Corrugation irrigation is suited to alfalfa, small grain, and pasture. Regardless of the irrigation method used, water should be applied carefully to control erosion and ensure the most efficient use of water.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, junegrass, blue grama, slender wheatgrass, muttongrass, squirreltail, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of grasses. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that have dense stands of sagebrush. Seeding speeds up revegetation of areas

of rangeland that have deteriorated because of overgrazing, cultivation, and other disturbance. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by a lack of sufficient rainfall in summer. Supplemental irrigation may be needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Wildlife such as mule deer, cottontail, coyote, and mourning dove and other birds use this unit. They obtain food from areas of irrigated cropland and from areas of rangeland. Nearby wooded areas of rangeland provide protective cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and maintaining adequate plant cover. Areas of rangeland and tall grasses in fence rows and odd corners of fields can be managed to improve or to create wildlife habitat.

This unit is moderately suited to homesite and urban development. Low soil strength and shrink-swell potential are the main limitations. The foundations of buildings can be designed to compensate for the shrink-swell potential. Roads should be designed to overcome the limitation of low soil strength. The moderately slow permeability of the soil should be considered when planning septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IIIe, irrigated and nonirrigated.

61—Shawa Variant loam, 5 to 20 percent slopes. This deep, well drained soil is on mountainsides. It formed in alluvial and colluvial material. Elevation is 6,800 to 8,400 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 90 to 110 days.

Typically, the surface layer is grayish brown loam about 23 inches thick. The next layer is grayish brown loam about 17 inches thick. The underlying material is light brownish gray cobbly loam that extends to a depth of 60 inches or more.

Included in this unit are about 15 percent Nutrioso loam and small areas of a soil that has more coarse fragments between depths of 10 and 40 inches than is typical of this Shawa Variant soil.

Permeability of this Shawa Variant soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly as woodland, for livestock grazing, and for homesite development.

This unit is well suited to the production of ponderosa pine. On the basis of a site index of 78, the potential production of marketable timber per acre is 5,224 cubic feet or 29,360 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and providing protection from erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock facilitates reforestation. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly ponderosa pine, junegrass, mountain muhly, mountain brome, Arizona fescue, bluegrass, serviceberry, and Gambel oak. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred understory. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing or other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as elk, mule deer, cottontail, coyote, squirrel, and various species of bird use this unit Wooded areas provide food, shelter, and protective cover for wildlife. Nearby areas of cropland also provide food for some of the wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and limiting the cutting of timber.

Slope is the main limitation for homesite and urban development. Dwellings and roads should be designed to overcome these limitations. The moderate permeability and slope of the soil should be considered when designing septic tank absorption fields or sewage lagoons. If the limitation of slope is overcome, septic tank absorption fields can be used if they are made larger than normal. Sewage lagoons may need to be sealed to reduce seepage.

This map unit is in capability subclass VIe, nonirrigated.

62—Sili clay loam, 1 to 3 percent slopes. This deep, well drained soil is on upland valley bottoms and fans. It formed in moderately fine textured alluvium derived from shale. Elevation is 6,000 to 7,200 feet. The average

annual precipitation is 12 to 18 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is light brownish gray clay loam about 7 inches thick. The subsoil is light brownish gray clay loam about 15 inches thick. The substratum to a depth of 60 inches or more is light brownish gray clay loam.

Included in this unit are about 15 percent Arboles silty clay loam and small areas of Mikim loam and Bodot clay.

Permeability of this Sili soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

The unit is used mainly for irrigated and nonirrigated field crops, for irrigated pasture and as rangeland. Barley, oats, and alfalfa are the main irrigated crops. Wheat is the main nonirrigated crop.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility in the surface layer, and properly using irrigation water. Incorporating crop residue into the soil increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content content and fertility. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing may be needed for a more uniform distribution of irrigation water. Irrigation methods suitable for use on this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is suited to row crops. Sprinkler irrigation is well suited to most crops. Corrugation irrigation is suited to small grain, alfalfa, and pasture. Regardless of the irrigation method used, water should be applied carefully to minimize runoff and erosion.

In nonirrigated cropland areas, management is needed to control erosion, to conserve moisture, and to maintain the fertility of the soil. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and erosion and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that support dense stands of sagebrush. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas in poor to fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by lack of sufficient rainfall in summer. Supplemental irrigation is needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young.

Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Wildlife such as cottontail, squirrel, mule deer, coyote, meadowlark, and mourning dove use this unit. They obtain their food and shelter from the natural vegetation of the area or from areas of cropland. Nearby areas of pinyon and juniper also provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

Low soil strength and high shrink-swell potential are the main limitations for the construction of homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The moderately slow permeability of the soil should be considered when designing septic tank absorption fields. Absorption fields may need to be made larger than normal. Sewage lagoons work well.

This map unit is in capability subclasses IIIe, irrigated, and IVc, nonirrigated.

63—Sili clay loam, 3 to 6 percent slopes. This deep, well drained soil is on upland valley bottoms and fans. It formed in moderately fine textured alluvium derived from shale. Elevation is 6,000 to 7,200 feet. The average annual precipitation is 12 to 18 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is light brownish gray clay loam about 7 inches thick. The subsoil is light brownish gray clay loam about 15 inches thick. The substratum is light brownish gray clay loam that extends to a depth of 60 inches or more. In some of the more steeply sloping areas, these horizons are thinner.

Included in this unit are about 15 percent Arboles silty clay loam and small areas of Bodot clay and Mikim loam.

Permeability of this Sili soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated cultivated crops and pasture, nonirrigated crops, and rangeland. Barley,

oats, and alfalfa are the main irrigated crops. Wheat is the main nonirrigated crop.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Returning crop residue to the soil increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content and fertility of the soil. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation structures may be needed for the more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is suited to row crops. Sprinkler irrigation is well suited to most crops. Corrugation irrigation is suited to small grain, alfalfa, and pasture. Regardless of the irrigation method used, water should be applied carefully to minimize runoff and erosion.

In nonirrigated cropland areas, management is needed to control erosion, to conserve moisture, and to maintain the fertility of the soil. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and erosion and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, big sagebrush, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas under dense stands of sagebrush. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas that are in poor to fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by a lack of sufficient rainfall in summer. Supplemental irrigation is needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young.

Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Wildlife such as cottontail, squirrel, mule deer, coyote, meadowlark, and mourning dove use this unit. They obtain their food and shelter from the native vegetation. Nearby areas of pinyon and juniper also provide shelter and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

Low soil strength and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential of the soil. Roads should be designed to overcome the limitations of low soil strength and high shrink-swell potential. The moderately slow permeability of the soil should be considered when designing septic tank absorption fields. Absorption fields may need to be made larger than normal. Sewage lagoons work well if the limitation of slope is overcome.

This map unit is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

64—Simpatico loam. This deep, well drained soil is in drainageways on mesa tops. It formed in alluvium derived from nearby loess deposits. Slope is 1 to 3 percent. Elevation is 6,600 to 7,200 feet. The average annual precipitation is 15 to 18 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 125 days.

Typically, the upper part of the surface layer is grayish brown loam about 6 inches thick and the lower part is grayish brown silt loam about 6 inches thick. The upper part of the subsoil is brown silty clay loam about 22 inches thick, and the lower part is reddish brown silty clay loam about 11 inches thick. The substratum is light brown very cobbly loam that extends to a depth of 60 inches or more.

Included in this unit in areas east of the Animas River are about 15 percent Falfa clay loam and about 15 percent soils that are underlain by gravel and cobbles at a depth of 40 inches. Also included in areas west of the Animas River are small areas of Witt loam and Vosburg fine sandy loam.

Permeability of this Simpatico soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is slow, and the hazard of erosion is slight. The soil is subject to flooding during periods of heavy rainfall and snowmelt.

The unit is used mainly for irrigated and nonirrigated crops and as rangeland. The main irrigated crops are barley, oats, pasture, and alfalfa hay. The main nonirrigated crops are pinto beans and wheat.

In irrigated areas, the main concerns of management are controlling erosion, maintaining the organic matter content and fertility of the soil, and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic

matter content. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Irrigation structures are needed in some places for a more uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is well suited to row crops. Corrugation and sprinkler irrigation systems are well suited to small grain, alfalfa, and pasture. Sprinkler irrigation is suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Regardless of the irrigation method used, water should be applied carefully to control erosion.

In nonirrigated cropland areas, management is needed to control erosion, conserve moisture, and maintain the organic matter content and fertility of the soil. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and erosion and conserve moisture. Diversions and grassed waterways may be needed to reduce gully erosion. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly Indian ricegrass, muttongrass, western wheatgrass, blue grama, junegrass, needleandthread, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, cottontail, coyote, and mourning dove use this unit. Irrigated areas are a good source of food for wildlife. Rangeland areas provide food, shelter, and nesting areas. Management for wildlife should include providing protection from overgrazing and wildfire and maintaining adequate plant cover.

The hazard of flooding is the main limitation for homesite and urban development. Use of diversions, drainage, and other protective measures is necessary for homesite and urban development. Low soil strength and moderate shrink-swell potential are also limitations. The foundations of buildings should be designed to compensate for the shrink-swell potential of the soil. Roads should be designed to overcome the limitation of low soil strength. The hazard of flooding and the moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. If protection from flooding can be provided, septic tank absorption fields may be suitable if the absorption field is made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

65—Sycle fine sandy loam. This deep, well drained soil is on terraces of major drainageways. It formed in alluvium overlying river-deposited cobbles and gravel. Slope is 1 to 3 percent. Elevation is 6,000 to 6,800 feet. The average annual precipitation is 15 to 19 inches. The average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is reddish brown sandy clay loam about 12 inches thick. The underlying material is calcareous, light reddish brown gravelly sandy loam about 4 inches thick over sand, cobbles, and gravel that extend to a depth of 60 inches or more.

Included in this unit are 5 percent Harlan cobbly loam, 10 percent Sedillo gravelly loam, and small areas of Tefton loam.

Permeability of this Sycle soil is moderate. Effective rooting depth is 30 to 40 inches because of the presence of extremely cobbly material. Available water capacity is low. Runoff is slow, and the hazard of erosion is slight.

This unit is used mainly for irrigated cultivated crops and pasture and as rangeland. The main irrigated crops are alfalfa, barley, oats, and wheat.

If irrigated crops are grown, the main concerns of management are controlling erosion and properly using irrigation water. Incorporating crop residue into the surface layer increases the water intake rate, improves tilth, and helps to control erosion. The use of fertilizer helps to maintain the fertility. Grain and grasses respond to nitrogen, and alfalfa responds to phosphorus. Land smoothing and water management are needed for a more uniform distribution and more efficient use of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is well suited to most crops. Corrugation systems are suited to alfalfa, small grain, and pasture. Furrow irrigation is suited to row crops. Regardless of the irrigation method used, water should be applied carefully to control erosion and to ensure the most efficient use of irrigation water.

The native vegetation on this unit is mainly Indian ricegrass, needleandthread, western wheatgrass, and sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, cottontail, coyote, mourning dove, and meadowlark use this unit. This unit produces plants that provide food, protective cover, and nesting areas for some of the wildlife. Nearby wooded areas also provide cover and nesting areas.

Management for wildlife should include protecting the unit from overgrazing and other disturbances.

This unit is suited to homesite and urban development. Cobbles and gravel in the substratum affect excavation for foundations and utility lines. Construction of sanitary facilities poses a risk of polluting nearby water. This limitation can be overcome by excavating and backfilling with finer textured material to reduce seepage. Sewage lagoons should be lined to reduce seepage.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

66—Tefton loam. This deep, somewhat poorly drained soil is on flood plains and alluvial valley floors (fig. 10). It formed in mixed alluvium. The soil is dissected by oxbows and old channels in many places. Slope is 1 to 3 percent. Elevation is 6,000 to 7,500 feet. The average annual precipitation is 16 to 19 inches. The average annual air temperature is 45 to 53 degrees F, and the average frost-free period is 105 to 130 days.

Typically, the upper part of the surface layer is light brownish gray loam about 5 inches thick and the lower part is pale brown loam and fine sandy loam about 12 inches thick. The underlying material is pinkish gray loam that is stratified with very fine sandy loam and fine sandy loam and is about 39 inches thick. Below this are sand and gravel that extend to a depth of 60 inches or more. In some places the surface layer is fine sandy loam.

Included in this unit are about 20 percent Pescar fine sandy loam, about 10 percent Alamosa loam, and small

Figure 10.—Area of Tefton loam that has been flooded.

areas of soils that are similar to this Tefton soil but are better drained.

Permeability of this Tefton soil is moderate or moderately slow. Effective rooting depth is 24 to 36 inches because of the presence of a high water table. Available water capacity is high. Runoff is slow, and the hazard of erosion is moderate. This soil has a fluctuating water table in most places that rises to within 2 to 3 feet of the surface during spring and summer. The soil is subject to flooding except where protected by building upstream dams or channeling by streams. Flooding commonly occurs during spring snowmelt or during the rainy season in fall.

This unit is used mainly for irrigated cultivated crops and pasture and as rangeland. Alfalfa, barley, and oats are the main irrigated crops. The irrigated pasture is a mixture of alfalfa and introduced grasses.

The main management concerns on irrigated pasture and cropland are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. On irrigated pasture, proper grazing use and planned grazing systems help to maintain the quality and quantity of grasses and legumes. Erosion can be controlled by maintaining a plant cover on the soil. Irrigation methods suited to this unit are corrugation, flooding, and sprinkler systems. Corrugation and sprinkler systems are suited to small grain, alfalfa, and pasture. Flood irrigation can also be used for pasture. Regardless of the irrigation method used, water should be applied at a rate slow enough to minimize erosion.

The native vegetation on this unit is mainly tufted hairgrass, slender wheatgrass, redtop, Nebraska sedge, Baltic rush, cottonwood, bluejoint reedgrass, and willows. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates the revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, cottontail, muskrat, squirrel, and coyote and waterfowl and various other birds use this unit. They obtain their food and shelter from irrigated cropland and pasture and from native rangeland. Areas of rangeland, tall grasses in fence rows, and odd corners of fields can be managed to improve or to create wildlife habitat.

The hazards of flooding and wetness because of the fluctuating water table are the main limitations for homesite and urban development. The construction of sanitary facilities poses a risk of polluting nearby water. Drainage and protection from flooding commonly are needed before any building construction is started.

This map unit is in capability subclass IIIw, irrigated and nonirrigated.

67—Uinta loam, 5 to 15 percent slopes. This deep, well drained soil is on mountainsides and alluvial fans. It formed in alluvium derived from interbedded red sandstone and shale. Elevation is 7,800 to 9,800 feet. The average annual precipitation is 20 to 28 inches. The average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 60 to 80 days.

Typically, the surface is covered with a layer of organic material 4 inches thick. The surface layer is reddish brown loam about 15 inches thick. The next layer is reddish brown sandy clay loam about 8 inches thick. The upper part of the subsoil is reddish brown sandy clay loam about 9 inches thick, and the lower part is red sandy clay loam about 13 inches thick. The substratum is red loam that extends to a depth of 60 inches or more. In some places the surface layer is fine sandy loam.

Included in this unit are about 5 percent Valto very stony fine sandy loam and small areas of Horsethief very stony fine sandy loam and Leadville very stony sandy loam.

Permeability of this Uinta soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as woodland and for livestock grazing. It is also used for wildlife habitat.

This unit is well suited to the production of Engelmann spruce. On the basis of a site index of 80, the potential production of marketable timber per acre is 5,410 cubic feet or 31,200 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old. Other trees well suited to this unit are white fir, Douglas-fir, subalpine fir, and aspen.

The main concerns in producing and harvesting timber are reforestation and providing protection from erosion along roads and in other areas where vegetation has been removed. Harvesting may be restricted during periods when much snow accumulates, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked normal stand of trees. Planting nursery stock facilitates reforestation.

Among the trees that are suitable for planting are Douglas-fir, Engelmann spruce, and lodgepole pine. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation on this unit is mainly white fir, Douglas-fir, and Engelmann spruce. Other important plants that characterize this unit are aspen, subalpine fir, Arizona fescue, mountain brome, elk sedge, wild rose,

bluegrass, Oregon-grape, serviceberry, snowberry, ferns, meadowrue, and penstemon (fig. 11). Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, bear, wild turkey, blue grouse, squirrel, snowshoe rabbit, and cottontail use this unit. Areas of forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife include protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Moderate shrink-swell potential and slope are the main limitations for homesite and urban development. Roads

Figure 11.—Douglas-fir in an area of Uinta loam, 5 to 15 percent slopes.

and foundations for buildings should be designed to compensate for the shrink-swell potential of the soil. Slope and the moderate permeability of the soil should be considered when designing septic tank absorption fields or sewage lagoons. If the limitation of slope can be overcome, septic tank absorption fields may be suitable if they are made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass VIe, nonirrigated.

68—Uinta loam, 15 to 60 percent slopes. This deep, well drained soil is on mountainsides and alluvial fans. It formed in alluvium derived from interbedded red sandstone and shale. Elevation is 7,800 to 10,400 feet. The average annual precipitation is 20 to 28 inches. The average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 50 to 75 days.

Typically, the surface is covered with a layer of organic material 4 inches thick. The surface layer is reddish brown loam about 15 inches thick. The next layer is reddish brown sandy clay loam about 8 inches thick. The upper part of the subsoil is reddish brown sandy clay loam about 9 inches thick, and the lower part is red sandy clay loam about 13 inches thick. The substratum is red loam that extends to a depth of 60 inches or more. In some places the surface layer is fine sandy loam.

Included in this unit are about 5 percent Valto very stony fine sandy loam, 5 percent Rock outcrop, 10 percent Horsethief very stony fine sandy loam, and small areas of Coni loam and Leadville very stony sandy loam.

Permeability of this Uinta soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is medium to rapid, and the hazard of erosion is moderate.

This unit is used mainly as woodland and for livestock grazing. It is also used for wildlife habitat.

This unit is well suited to the production of Engelmann spruce. On the basis of a site index of 80, the potential production of marketable timber per acre is 5,410 cubic feet or 31,200 board feet (International rule) from an even-aged, fully stocked stand of trees 100 years old. Other trees well suited to this unit are white fir, Douglas-fir, subalpine fir, and aspen.

The main concerns in producing and harvesting timber are reforestation, providing protection from erosion along roads and in other areas where vegetation has been removed, and equipment limitations in the steeper areas. Harvesting may be restricted during periods when snow accumulates to a great depth, during snowmelt, or during periods of heavy rainfall. Reforestation should be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock facilitates reforestation.

Among the trees that are suitable for planting are Douglas-fir, Engelmann spruce, and lodgepole pine. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing diversions and by seeding cuts and fills.

The native vegetation of this unit is mainly white fir, Douglas-fir, and Engelmann spruce. Other important plants that characterize this unit are aspen, subalpine fir, Arizona fescue, mountain brome, elk sedge, wild rose, bluegrass, Oregon-grape, serviceberry, snowberry, ferns, meadowrue, and penstemon. Logged areas and many forested areas are used for grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of native vegetation. Steepness of slope limits access by livestock and promotes overgrazing of less sloping areas. Grazing should be delayed until the soil is firm and the preferred forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves the understory. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

Wildlife such as elk, mule deer, bear, wild turkey, blue grouse, squirrel, snowshoe rabbit, and cottontail use this unit. Areas of forbs, shrubs, and grasses provide food, and forested areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Steepness of slope is the main limitation for homesite and urban development. Roads and foundations for buildings are also affected by the moderate shrink-swell potential. They should be designed to compensate for the shrinking and swelling of the soil. Slope and the moderate permeability of the soil should be considered when designing septic tank absorption fields or sewage lagoons. If the limitation of slope can be overcome, septic tank absorption fields may be suitable if they are made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass VIIe, nonirrigated.

69—Umbarg loam. This deep, moderately well drained soil is on alluvial fans and upland valley bottoms of major drainageways. It formed in moderately fine textured alluvium. Slope is 3 to 6 percent. Elevation is 6,000 to 7,200 feet. The average annual precipitation is 15 to 20 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface layer is dark grayish brown loam about 17 inches thick. The upper 12 inches of the

underlying material is grayish brown loam, and the lower part to a depth of 60 inches or more is light brownish gray clay loam.

Included in this unit are about 10 percent Shalona loam and small areas of Mikim loam and Harlan cobbly loam.

Permeability of this Umbarg soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is slow, and the hazard of erosion is slight. The soil has a fluctuating water table that rises to within about 3 feet of the surface in most places.

This unit is used mainly for irrigated field crops, irrigated pasture, and homesite development and as rangeland. It is also used for wildlife habitat.

In irrigated areas, the main concerns of management are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Returning crop residue to the soil increases the water intake rate, improves tilth, and helps to control erosion. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing is needed in some areas to achieve a more uniform distribution and more efficient use of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Furrow irrigation is suited to row crops. Corrugation irrigation is well suited to small grain and pasture. Sprinkler irrigation is well suited to most crops. Regardless of the irrigation method used, water should be applied carefully to prevent runoff and erosion.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, needleandthread, mountain muhly, serviceberry, big sagebrush, and Gambel oak. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that have dense stands of sagebrush. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, pheasant, squirrel, cottontail, coyote, and mourning dove use this unit. Irrigated areas provide food, and the areas of rangeland provide shelter, nesting areas, and some food. Nearby wooded areas also provide shelter and nesting areas. Suitable management for wildlife should include protecting the rangeland from overgrazing and wildfire and maintaining adequate plant cover.

Wetness and shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the shrink-swell potential of the soil. Drainage may be needed to overcome the limitation of wetness. The construction of sanitary facilities on this unit poses a risk of polluting nearby water. The moderately slow permeability of the soil and the fluctuating water table should be considered when designing septic tank absorption fields or sewage lagoons. If drainage and protection from seepage are provided, septic tank absorption fields may be suitable if they are made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IIIe, irrigated and nonirrigated.

70—Ustic Torriorthents-Ustollic Haplargids complex, 12 to 60 percent slopes. This map unit is on terrace edges, mesa edges, and hillsides. Elevation is 6,000 to 8,500 feet. The average annual precipitation is about 14 to 19 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 130 days.

This unit is 50 percent Ustic Torriorthents and 30 percent Ustollic Haplargids. The Ustollic Haplargids are in the less sloping areas.

Included in this unit are about 15 percent soils that are underlain by bedrock at a depth of 40 inches or less and 5 percent shale and sandstone Rock outcrop.

Ustic Torriorthents are deep and somewhat excessively drained. These soils formed in outwash. No single profile of Ustic Torriorthents is typical, but one commonly observed in the survey area has a surface layer of gravelly or cobbly loam or fine sandy loam. The substratum is very gravelly or very cobbly outwash.

Ustollic Haplargids are deep and well drained. They formed in gravelly and cobbly alluvium. No single profile of Ustollic Haplargids is typical, but one commonly observed in the survey area has a surface layer of gravelly or cobbly loam or fine sandy loam. The subsoil is very cobbly or very gravelly loam, very gravelly or very cobbly sandy clay loam, or very gravelly or very cobbly fine sandy loam. The substratum is very gravelly or very cobbly outwash.

Permeability of these Ustic Torriorthents and Ustollic Haplargids varies depending on the texture of the parent material. Effective rooting depth is 40 inches or more. Available water capacity is low. Runoff is rapid, and the hazard of erosion is high.

This unit is used mainly for wildlife habitat, as rangeland, and as a source of construction material.

The native vegetation on this unit is mainly western wheatgrass, Indian ricegrass, needleandthread, blue grama, muttongrass, Fendler threeawn, junegrass, big sagebrush, rabbitbrush, pinyon, Rocky Mountain juniper, ponderosa pine, mountainmahogany, serviceberry, snowberry, and Gambel oak. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Proper grazing use as part of a

planned grazing system helps to maintain the desired quantity and quality of native vegetation. Deferred grazing speeds up revegetation of areas depleted by overgrazing and other disturbances and improves areas in poor condition. Developing livestock watering facilities and fencing improve the distribution of livestock and the production of understory plants.

This unit is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. This unit is capable of producing about 14 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitations for the production of pinyon and juniper are low available water capacity, steepness of slope, stoniness, and the high hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize soil erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, cottontail, coyote, squirrel, and various birds use this unit. They obtain their food from nearby areas of cropland and rangeland and from areas of this unit. Wooded areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing, providing protection from fire, and maintaining adequate plant cover, including pinyon and juniper.

Steepness of slope and gravel and cobbles are the main limitations for homesite and urban development. Gravel and cobbles affect excavation for foundations, utility lines, and roads. The construction of sanitary facilities is severely limited by steepness of slope and the presence of gravel and cobbles. Off-site sewage disposal systems are more satisfactory.

Areas of this unit are used as a source of gravel and roadfill. The soil material commonly requires screening or screening and crushing to eliminate large stones.

This map unit is in capability subclass VIIe, nonirrigated.

71—Valto-Rock outcrop complex, 12 to 65 percent slopes. This map unit is on mountainsides, ridges, and breaks. Elevation is 7,500 to 9,000 feet. The average annual precipitation is about 20 to 30 inches. The average annual air temperature is 39 to 43 degrees F, and the average frost-free period is 90 to 110 days.

This unit is about 45 percent Valto very stony fine sandy loam and 35 percent Rock outcrop.

Included in this unit are about 15 percent Fortwingate stony fine sandy loam and small areas of Goldvale very stony fine sandy loam.

The Valto soil is shallow and well drained. It formed in material weathered mainly from sandstone. Typically, the surface is covered with a layer of organic material 2 inches thick. The surface layer is dark reddish gray very stony fine sandy loam about 2 inches thick. The underlying material is light reddish brown very stony fine sandy loam about 10 inches thick over fractured sandstone. Depth to bedrock ranges from 10 to 20 inches.

Permeability of this Valto soil is moderately rapid. Effective rooting depth is 10 to 20 inches because of the presence of hard bedrock. Available water capacity is very low. Runoff is moderately rapid, and the hazard of erosion is slight.

Rock outcrop consists of barren exposures of sandstone. Nearly vertical cliffs are common.

This unit is used mainly as woodland. Some areas are used for homesite development and livestock grazing.

This unit is moderately suited to the production of ponderosa pine. On the basis of a site index of 59, the soil is capable of producing about 3,463 cubic feet or about 14,060 board feet (International rule) of marketable timber per acre from a fully stocked, even-aged stand of trees 100 years old. Other trees suited to this unit at the higher elevations are Douglas-fir, white fir, and Engelmann spruce.

The main limitation for the production of timber is the shallow depth to hard bedrock, which affects construction of logging roads and establishment of seedlings. Harvesting may be restricted during periods when snow accumulates to a great depth and during snowmelt. Reforestation should be done when the soil moisture content is high, and it should be carefully managed to reduce competition from undesirable plants. Hand planting of nursery stock commonly is necessary to establish a stand. Road systems should be designed to minimize cuts in this shallow soil.

The native vegetation on this unit is mainly ponderosa pine, Gambel oak, mountainmahogany, snowberry, Arizona fescue, mountain muhly, junegrass, mountain brome, bluegrasses, elk sedge, and serviceberry. Douglas-fir, white fir, and Engelmann spruce grow at the higher elevations of this unit. Logged areas and some forested areas are used for livestock grazing. Proper grazing use as part of a planned grazing system helps to maintain the desired quality and quantity of the understory. Deferred grazing speeds up revegetation and improves areas in poor condition.

Wildlife such as wild turkey, elk, mule deer, bear, squirrel, and cottontail use this unit. They obtain their food from areas of grasses, forbs, and shrubs on the unit and from adjacent areas. The forested areas provide cover and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and controlling timber harvesting.

Stoniness, steepness of slope, and depth to bedrock are the main limitations for homesite and urban

development. These limitations should also be considered when designing septic tank absorption fields or sewage lagoons. Off-site disposal systems will probably be needed.

This map unit is in capability subclass VIIs, nonirrigated.

72—Vernal fine sandy loam, 1 to 3 percent slopes. This deep, well drained soil is on high terraces. It formed in medium textured loess overlying cobbly alluvium. Elevation is 6,700 to 8,000 feet. The average annual precipitation is about 13 to 16 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is reddish brown clay loam about 28 inches thick. The substratum is light yellowish brown extremely cobbly sand that extends to a depth of 60 inches or more.

Included in this unit is about 15 percent Witt loam.

Permeability of this Vernal soil is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is moderate because of the extremely cobbly substratum. Runoff is medium, and the hazard of erosion is slight.

This unit is used mainly for irrigated and nonirrigated crops, and as rangeland. The main irrigated crops are alfalfa, barley, and oats. The main nonirrigated crops are wheat and pinto beans.

The main management concerns in irrigated areas are maintaining the organic matter content and fertility of the surface layer, controlling water erosion, and properly using irrigation water. The incorporation of crop residue into the surface layer increases the water intake rate, improves tilth, helps to control erosion, and helps to maintain the organic matter content and fertility. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Land smoothing is needed in some areas to ensure a more nearly uniform distribution of irrigation water. Irrigation methods suited to this unit are furrow, corrugation, and sprinkler systems. Sprinkler irrigation is suited to most crops. Use of this method permits the even, controlled application of water. Furrow irrigation is suited to row crops. Corrugation irrigation is well suited to pasture, alfalfa, and small grain.

The main management concerns in nonirrigated areas are controlling erosion, conserving moisture, and maintaining the fertility of the soil. Stubble mulching and returning crop residue to the soil reduce runoff and erosion. These practices also increase the water intake rate and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly Indian ricegrass, needleandthread, muttongrass, blue grama, big sagebrush, pinyon, Rocky Mountain juniper, serviceberry, Gambel oak, and bitterbrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the desirable rangeland vegetation. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. It is capable of producing about 16 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

This unit is used by wildlife such as mule deer, cottontail, coyote, squirrel, mourning dove, and various birds. They obtain their food from areas of irrigated cropland and native rangeland. Areas of pinyon and juniper woodland provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing, maintaining adequate plant cover, and maintaining areas of pinyon and juniper. Areas of rangeland and tall grasses in fence rows and ditches can be managed to improve or create wildlife habitat.

This unit is well suited to homesite and urban development. The rapidly permeable substratum is the main limitation for septic tank absorption fields and sewage lagoons. This limitation can be overcome by excavating the gravelly material and backfilling with finer textured material. Sewage lagoons can be lined to reduce seepage.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

73—Vernal-Sedillo complex, 3 to 12 percent slopes. This map unit is on narrow terrace breaks and slopes leading to breaks. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 13 to 16 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

This unit is 45 percent Vernal fine sandy loam and 30 percent Sedillo gravelly loam.

Included in this unit are about 15 percent uneroded Witt loam and 10 percent eroded Witt loam.

The Vernal soil is deep and well drained. It formed in medium textured loess and cobbly alluvial material. Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is reddish brown clay loam about 28 inches thick. The substratum is yellowish brown extremely cobbly sand that extends to a depth of 60 inches or more.

Permeability of this Vernal soil is moderate. Effective rooting depth is 20 to 40 inches because of the extremely cobbly substratum. Available water capacity is moderate. Runoff is moderate, and the hazard of erosion is slight.

The Sedillo soil is deep and well drained. It formed in medium textured loess and cobbly alluvial material. Typically, the surface layer is brown gravelly loam about 6 inches thick. The upper part of the subsoil is reddish brown very gravelly clay loam about 15 inches thick, and the lower part is brown very gravelly sandy clay loam about 6 inches thick. The substratum is pinkish white very cobbly or very gravelly sandy clay loam that extends to a depth of 60 inches or more.

Permeability of this Sedillo soil is moderately slow. Effective rooting depth is 60 inches or more. The available water capacity is moderate. Runoff is medium, and the hazard of erosion is slight.

Most areas of this unit are used as rangeland. Some areas of this unit that have few cobbles on the surface are sometimes used for nonirrigated crops.

The main management concerns in nonirrigated areas are controlling erosion and conserving moisture. Stubble mulching and returning crop residue to the soil reduce runoff and erosion. These practices also increase the water intake rate and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and increase the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly Indian ricegrass, western wheatgrass, muttongrass, blue grama, big sagebrush, cactus, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. It is capable of producing about 16 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

This unit is used by wildlife such as mule deer, cottontail, coyote, squirrel, and various birds. They obtain food from grasses, forbs, and shrubs in areas of rangeland and cropland. Nearby wooded areas provide shelter and nesting areas. Suitable management for wildlife includes protecting the unit from overgrazing by wildlife and maintaining adequate plant cover, including areas of pinyon and juniper. Areas of rangeland and tall grasses in fence rows can be managed to improve or create wildlife habitat.

The Vernal soil is well suited to homesite and urban development. The rapid permeability of the substratum is the main limitation for septic tank absorption fields and sewage lagoons. This limitation can be overcome by excavating the gravelly material and backfilling with finer textured material. Sewage lagoons can be lined to reduce seepage.

The Sedillo soil is moderately suited to homesite and urban development. Cobbles and gravel may make excavation for roads, utilities, and other development difficult. The restricted permeability of the soil limits use for septic tank absorption fields and sewage lagoons. Sewage lagoons can be lined to reduce seepage. Absorption fields may need to be made larger than normal.

This map unit is in capability subclass VIs, nonirrigated.

74—Vosburg fine sandy loam, 3 to 8 percent slopes. This deep, well drained soil is in swales and on foot slopes of uplands. It formed in medium textured alluvium derived from sandstone and shale. Elevation is 6,300 to 7,000 feet. The average annual precipitation is about 14 to 18 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is dark grayish brown fine sandy loam about 15 inches thick. The upper part of the subsoil is dark grayish brown clay loam about 3 inches thick, the next part is dark grayish brown sandy clay loam about 13 inches thick, and the lower part is brown sandy clay loam about 19 inches thick. The substratum is brown sandy clay loam that extends to a depth of 60 inches or more.

Included in this unit are 15 percent Umbarg loam and small areas of soils that do not have a thick, dark colored surface layer.

Permeability of this Vosburg soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated and nonirrigated crops and as wildlife habitat and rangeland. The main irrigated crops are alfalfa, pasture, and small grain. The main nonirrigated crop is wheat.

The main concerns on irrigated cropland are controlling water erosion, maintaining the organic matter in the surface layer, and properly using irrigation water. Returning crop residue to the soil increases the water intake rate, improves tilth, and helps to control erosion. The use of fertilizer helps to maintain the productivity and fertility of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus. Suitable irrigation methods are corrugation and sprinkler systems. These systems are suited to small grain, alfalfa, and irrigated pasture. Sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

In nonirrigated cropland areas, management is needed to conserve moisture, control erosion, and maintain the fertility of the soil. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and erosion and conserve moisture. Diversions and grassed waterways may be needed to reduce gully erosion. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation on this unit is mainly Indian ricegrass, junegrass, western wheatgrass, blue grama, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that support dense stands of sagebrush. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, cottontail, coyote, and various species of bird use this unit. Rangeland areas and nearby wooded areas provide shelter and nesting areas for wildlife. Areas of cropland and native plants provide food. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover.

This unit is suited to homesite and urban development. The moderate permeability of the soil should be considered when designing septic tank absorption fields or lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

75—Witt loam, 1 to 3 percent slopes. This deep, well drained soil is on uplands and mesas. It formed in silty, calcareous loess. Elevation is 6,200 to 7,500 feet. The average annual precipitation is about 14 to 17 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the upper part of the surface layer is brown loam about 7 inches thick and the lower part is reddish brown loam about 3 inches thick. The upper part of the subsoil is reddish brown silty clay loam about 9 inches thick, the next part is reddish brown silty clay loam about 15 inches thick, and the lower part is light reddish brown loam about 14 inches thick. The substratum to a depth of 60 inches or more is yellowish red loam.

Included in this unit is about 5 percent Pulpit loam. Also included are small areas of Vernal fine sandy loam and Simpatico loam.

Permeability of this Witt soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used for irrigated and nonirrigated crops and as rangeland. The main irrigated crops are alfalfa, pasture, barley, and oats. The main nonirrigated crops are wheat, pinto beans, and alfalfa (fig. 12).

This unit is well suited to irrigated crops. The main management concerns are reducing runoff and erosion, properly using irrigation water, and maintaining the organic matter content and fertility of the surface layer. Furrow, corrugation, and sprinkler irrigation systems are suited to this unit. Furrow irrigation is best suited to row crops, and corrugation irrigation is best suited to alfalfa, pasture, and small grain. Sprinkler irrigation is suited to most crops; use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Irrigation water should be applied at a rate that ensures optimum production without excessive runoff, deep percolation, and erosion. Land smoothing is needed in some areas to ensure a more nearly uniform distribution of irrigation water when using furrow or corrugation systems. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain the fertility and tilth of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus.

This unit is well suited to nonirrigated crops. The main concerns are reducing runoff and erosion, conserving moisture, and maintaining the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of terraces. Maintaining crop residue on or near the surface layer increases the water intake rate, reduces runoff and erosion, and helps to maintain soil tilth and organic matter content. Terraces reduce runoff and erosion and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus

Figure 12.—Pinto beans in an area of Witt loam, 1 to 3 percent slopes.

improve the water intake rate. Tillage should be kept to a minimum.

The native vegetation in most areas used as rangeland is mainly big sagebrush, western wheatgrass, pinyon, and Rocky Mountain juniper. Other important plants that characterize this unit are Indian ricegrass, blue grama, muttongrass, junegrass, needleandthread, Gambel oak, and serviceberry. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The production of forage is limited by low rainfall in summer. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that have dense stands of sagebrush. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Practices such as developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas in poor to fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by a lack of sufficient rainfall in summer. Supplemental irrigation may be needed when planting and during the early stages of growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from these areas. If all limbs larger than 2 inches in diameter are used, it is capable of producing about 18 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and

juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, coyote, cottontail, squirrel, and mourning dove use this unit. They obtain their food from areas of cropland and native vegetation. Areas of pinyon and juniper and rangeland provide cover and nesting areas. Suitable management for wildlife should include providing protection from overgrazing and wildfire and maintaining adequate plant cover, including areas of pinyon and juniper. In cropland areas favorable habitat can be developed by maintaining plant cover along fences and ditches and in corners of fields.

If this unit is used for homesite development, the main limitations are the low soil strength and moderate shrink-swell potential. Buildings should be designed to offset the effects of shrinking and swelling. Roads should be designed to overcome the limitations of low soil strength. The moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclasses IIIe, irrigated, and IIIc, nonirrigated.

76—Witt loam, 3 to 8 percent slopes. This deep, well drained soil is on uplands and mesas. It formed in calcareous loess. Elevation is 6,200 to 7,500 feet. The average annual precipitation is about 14 to 17 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the upper part of the surface layer is brown loam about 7 inches thick and the lower part is reddish brown loam about 3 inches thick. The upper part of the subsoil is reddish brown silty clay loam about 9 inches thick, the next part is reddish brown silty clay loam about 15 inches thick, and the lower part is light reddish brown loam about 14 inches thick. The substratum is yellowish red loam that extends to a depth of 60 inches or more.

Included in this unit is about 5 percent Pulpit loam. Also included are small areas of eroded Witt loam and of Simpatico loam.

Permeability of this Witt soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for irrigated and nonirrigated crops and as rangeland. The main irrigated crops are alfalfa, barley, and oats. The main nonirrigated crops are wheat, pinto beans, and alfalfa.

The main management concerns in irrigated areas are controlling water erosion, maintaining the organic matter content and fertility of the surface layer, and properly using irrigation water. Furrow, corrugation, and sprinkler irrigation systems are suited to this unit. Furrow irrigation is best suited to row crops, and corrugation irrigation is best suited to alfalfa, pasture, and small grain. Sprinkler irrigation is suited to most crops. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Irrigation water should be applied at a rate that ensures optimum production without excessive runoff, deep percolation, and erosion. Furrows should run across the slope. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain the fertility and tilth of the soil. Grain and grasses respond to nitrogen, and legumes respond to phosphorus.

This unit is well suited to nonirrigated crops. The main concerns are reducing runoff and erosion, conserving moisture, and maintaining the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of terraces, diversions, and grassed waterways. Maintaining crop residue on or near the surface layer increases the water intake rate, reduces runoff and erosion, and helps to maintain soil tilth and organic matter content. Terraces reduce runoff and erosion and conserve moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation in most areas used as rangeland is mainly big sagebrush, western wheatgrass, pinyon, and Rocky Mountain juniper. Other important plants that characterize this unit are Indian ricegrass, blue grama, muttongrass, junegrass, needleandthread, Gambel oak, and serviceberry. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The production of forage is limited by low rainfall in summer. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that support dense stands of sagebrush. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing help to improve the distribution of grazing and to maintain the condition of the rangeland. Contour furrowing and pitting increase the water intake rate and reduce runoff. These practices are especially effective in rangeland areas in poor to fair condition.

This unit generally is suited to windbreaks and environmental plantings. It is limited mainly by a lack of sufficient rainfall in summer. Supplemental irrigation may be needed when planting and during the early stages of

growth. Cultivation to reduce plant competition commonly is necessary, particularly while the plantings are young. Among the trees that are suitable for planting are ponderosa pine, Russian-olive, Colorado blue spruce, and eastern redcedar. Among the shrubs are caragana, lilac, honeysuckle, and sumac.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from these areas. The unit is capable of producing about 18 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, coyote, cottontail, squirrel, and mourning dove use this unit. They obtain their food from areas of cropland and native vegetation. Areas of pinyon and juniper and rangeland provide cover and nesting areas. Suitable management for wildlife should include providing protection from overgrazing and wildfire and maintaining adequate plant cover, including areas of pinyon and juniper. In cropland areas favorable habitat can be developed by maintaining plant cover along fences and ditches and in corners of fields.

If this unit is used for homesite development, the main limitations are the low soil strength and moderate shrink-swell potential. Buildings should be designed to offset the effects of shrinking and swelling. Roads should be designed to overcome the limitations of low soil strength. The moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

77—Witt loam, 3 to 12 percent slopes, eroded. This deep, well drained soil is on uplands and mesa tops, commonly along upland drainageways and swales. It formed in silty, calcareous loess. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 14 to 17 inches. The average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is reddish brown loam about 5 inches thick. The upper part of the subsoil is reddish brown silty clay loam about 11 inches thick, and the lower part is light reddish brown loam about 16 inches thick. The substratum is yellowish red loam that extends to a depth of 60 inches or more.

Included in this unit are about 25 percent Witt loam that has not been eroded, about 15 percent soils that have been eroded to the point that the parent material is exposed at the surface, and small areas of soils that are shallow or moderately deep over interbedded sandstone and silty shale.

Permeability of this Witt soil is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly for nonirrigated crops and as rangeland. Pinto beans and wheat are the main crops.

The main concerns of management in nonirrigated areas are conserving moisture, controlling erosion, and maintaining the productivity of the soil. Practices that can be used to control erosion include stubble mulch tillage, contour farming, and construction of terraces, diversions, and grassed waterways. Using stubble mulch tillage and returning crop residue to the soil reduce runoff and conserve moisture. Terracing reduces runoff and erosion and conserves moisture. Chiseling or subsoiling can be used to break up the tillage pan and thus improve the water intake rate. Tillage should be kept to a minimum. Diversions and grassed waterways may be needed to reduce gully erosion.

The native vegetation in most areas used as rangeland is western wheatgrass, Indian ricegrass, muttongrass, and big sagebrush. Other plants that characterize this unit are junegrass, pinyon, and Rocky Mountain juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that support dense stands of sagebrush. Seeding facilitates revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing help to improve the distribution of grazing and to maintain the condition of the rangeland.

Some areas of this unit support stands of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from these areas. The unit is capable of producing about 15 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitation for the production of pinyon and juniper is the moderate hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper

by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as mule deer, coyote, cottontail, squirrel, and mourning dove use this unit. They obtain their food from areas of cropland and native vegetation. Areas of pinyon and juniper and rangeland plants provide cover and nesting areas. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining adequate plant cover, including areas of pinyon and juniper. In cropland areas favorable habitat can be developed by maintaining plant cover along fences and ditches and in corners of fields.

Low soil strength and moderate shrink-swell potential are the main limitations for homesite and urban development. Buildings should be designed to offset the moderate shrink-swell potential. Roads should be designed to overcome the limitation of low soil strength. The moderately slow permeability should be considered when designing septic tank absorption fields or sewage lagoons. Absorption fields may need to be made larger than normal. Sewage lagoons can be sealed to reduce seepage.

This map unit is in capability subclass VIe, nonirrigated.

78—Yenlo-Florita sandy loams, 1 to 6 percent slopes. This map unit is in upland valleys (fig. 13). Elevation is 6,000 to 6,600 feet. The average annual precipitation is about 12 to 14 inches. The average annual air temperature is about 45 to 50 degrees F, and the average frost-free period is 120 to 140 days.

This unit is about 50 percent Yenlo sandy loam and about 35 percent Florita sandy loam. The Florita soil has

Figure 13.—Area of Yenlo-Florita sandy loams. Wooded areas of Dulce-Travessilla-Rock outcrop complex on hills along the sides of the valley.

slopes of 3 to 6 percent, and the Yenlo soil has slopes of 1 to 5 percent.

Included in this unit are about 10 percent Mikim loam and 5 percent Buckle loam.

The Yenlo soil is deep and well drained. It formed in alluvium derived from sandstone and shale. Typically, the surface layer is light brownish gray sandy loam about 3 inches thick. The upper part of the subsoil is grayish brown sandy clay loam about 4 inches thick, the next part is brown sandy clay loam about 6 inches thick, and the lower part is pale brown sandy loam about 6 inches thick. The substratum is pale brown or light brownish gray sandy loam or sandy clay loam that extends to a depth of 60 inches or more.

Permeability of this Yenlo soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is high. Runoff is medium, and the hazard of erosion is moderate.

The Florita soil is deep and well drained. It formed in alluvium derived from sandstone and shale. Typically, the surface layer is yellowish brown sandy loam about 3 inches thick. The next layer is yellowish brown sandy loam about 5 inches thick. The substratum is yellowish brown sandy loam that extends to a depth of 60 inches or more. In some places the surface layer is loamy sand.

Permeability of this Florita soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Runoff is slow, and the hazard of erosion is moderate.

This unit is used mainly for wildlife habitat and as rangeland.

The native vegetation on this unit is big sagebrush, rabbitbrush, western wheatgrass, Indian ricegrass, galleta, and scattered pinyon and juniper. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the desirable rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing, cultivation, and other disturbances. Mechanical or chemical brush control followed by seeding to adapted grasses improves areas that support dense stands of sagebrush. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, coyote, rabbit, and various birds use this unit for food and shelter. Nearby wooded areas also provide cover for wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire.

This unit is suited to homesite and urban development. Moderate permeability limits use of the Yenlo soil for septic tank absorption fields or sewage lagoons. The absorption field may need to be made larger than normal. Absorption fields work well on the Florita soil. If sewage lagoons are constructed on either soil, lining is needed to reduce seepage.

This map unit is in capability subclass VIe, nonirrigated.

79—Zau stony loam, 3 to 9 percent slopes. This moderately deep, well drained soil is on high mesas and mountainsides. It formed in residuum derived from shale and sandstone. Elevation is 7,600 to 8,000 feet. The average annual precipitation is about 20 to 22 inches. The average annual air temperature is about 40 to 44 degrees F, and the average frost-free period is 75 to 110 days.

Typically, the surface is covered with a layer of organic material 4 inches thick. The upper part of the surface layer is dark grayish brown stony loam about 8 inches thick, and the lower part is brown clay loam about 5 inches thick. The upper part of the subsoil is brown and light yellowish brown clay loam about 4 inches thick, and the lower part is brown and brownish yellow clay about 10 inches thick. The substratum is brown and yellowish brown clay loam about 5 inches thick over weathered sandstone and shale at a depth of 32 inches. Depth to bedrock ranges from 20 to 40 inches. In some areas the surface layer is loam.

Included in this unit are about 5 percent Coni loam, 10 percent Herm loam, 5 percent Fortwingate stony fine sandy loam, and small areas of soils that have a thicker, dark colored surface layer or more stones than does this Zau soil.

Permeability of this Zau soil is slow. Effective rooting depth is 20 to 40 inches because of the presence of soft bedrock. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as rangeland. Some areas are used for irrigated pasture, mainly mixtures of grasses and legumes.

If irrigated crops are grown, the main concerns of management are controlling water erosion, properly using irrigation water, and maintaining the organic matter content and fertility of the soil. Stones on the surface restrict the choice of crops to those that do not require yearly cultivation and planting. When the pasture is seeded, incorporating plant residue or green manure crops into the surface layer increases the water intake rate, improves tilth, reduces erosion, and helps to maintain the organic matter content. Irrigation methods suited to this unit are corrugation and sprinkler systems.

The native vegetation on this unit is snowberry, Oregon-grape, Gambel oak, mountainmahogany, bluegrasses, needleandthread, Arizona fescue, western wheatgrass, sedges, larkspur, lupine, and occasional ponderosa pine. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the preferred rangeland vegetation. Seeding facilitates the revegetation of areas depleted by heavy grazing and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the

distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, elk, cottontail, coyote, and squirrel use this unit. They obtain their food from areas of shrubs, grasses, and forbs. The unit also provides cover and nesting areas. Nearby wooded areas also provide cover. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and maintaining some of the shrubs.

Depth to bedrock, shrink-swell potential, and slope are the main limitations for homesite and urban development. Buildings should be designed to offset the effects of shrinking and swelling. Roads should be designed to overcome the limitations of low soil strength. The slow permeability and depth to bedrock should be considered when designing septic tank absorption fields or sewage lagoons. If sewage lagoons are excavated to bedrock, they should be lined to reduce seepage.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

80—Zau stony loam, 9 to 25 percent slopes. This moderately deep, well drained soil is on mountainsides and high mesas. It formed in residuum derived from shale and sandstone. Elevation is 7,600 to 8,000 feet. The average annual precipitation is about 20 to 22 inches. The average annual air temperature is about 40 to 44 degrees F, and the average frost-free period is 75 to 110 days.

Typically, the surface is covered with a layer of organic material 4 inches thick. The upper part of the surface layer is dark grayish brown stony loam about 8 inches thick, and the lower part is brown clay loam about 5 inches thick. The upper part of the subsoil is brown and light yellowish brown clay loam about 4 inches thick, and the lower part is brown and brownish yellow clay about 10 inches thick. The substratum is brown and yellowish brown clay loam about 5 inches thick over weathered sandstone and shale at a depth of 32 inches. Depth to bedrock ranges from 20 to 40 inches. In some areas the surface layer is loam.

Included in this unit are about 10 percent Coni loam, 10 percent Herm loam, 5 percent Fortwingate stony fine sandy loam, small areas of soils that have a thicker, dark colored surface layer or more stones than does this Zau soil, and small areas of Rock outcrop.

Permeability of this Zau soil is slow. Effective rooting depth is 20 to 40 inches because of the presence of soft bedrock. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is moderate.

This unit is used mainly as rangeland and for wildlife habitat.

The native vegetation on this unit is snowberry, Oregon-grape, Gambel oak, mountainmahogany, bluegrasses, needleandthread, Arizona fescue, western wheatgrass, sedges, larkspur, lupine, and occasional ponderosa pine. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the desirable rangeland vegetation. Seeding facilitates the revegetation of areas depleted by heavy grazing and other disturbances. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

Wildlife such as mule deer, elk, cottontail, coyote, and squirrel use this unit. They obtain their food from the shrubs, grasses, and forbs on the unit. The unit also provides cover and nesting areas. Nearby wooded areas also provide cover. Suitable management for wildlife includes protecting the unit from overgrazing and wildfire and maintaining some of the shrubs in the area.

Depth to bedrock, shrink-swell potential, and slopes are the main limitations for homesite and urban development. Buildings should be designed to offset the effects of shrinking and swelling. Roads should be designed to overcome the limitations of low soil strength. The slow permeability, depth to bedrock, and slope should be considered when designing septic tank absorption fields or sewage lagoons. If sewage lagoons are excavated to bedrock, they should be lined to reduce seepage. Alternative disposal systems may be more suitable.

This map unit is in capability subclass VIe, nonirrigated.

81—Zyme clay loam, 3 to 25 percent slopes. This shallow, well drained soil is on ridges and hills. It formed in residuum derived from shale. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 14 to 18 inches. The average annual air temperature is about 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is grayish brown clay loam about 4 inches thick. The underlying material is grayish brown clay loam over soft shale at a depth of 10 inches. Depth to bedrock ranges from 6 to 20 inches.

Included in this unit are about 15 percent Bodot clay, 10 percent Arboles silty clay loam, and small areas of Dulce sandy loam, Travessilla sandy loam, and Rock outcrop.

Permeability of this Zyme soil is slow. Effective rooting depth is only 6 to 20 inches because of the presence of soft bedrock. Available water capacity is low. Runoff is rapid, and the hazard of erosion is high.

This unit is used mainly for livestock grazing and wildlife habitat.

The native vegetation in most areas consists of Indian ricegrass, western wheatgrass, needleandthread, blue grama, pinyon, Rocky Mountain juniper, mountainmahogany, Gambel oak, bitterbrush, serviceberry, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas

Figure 14.—An area of Zyme-Rock outcrop complex, 12 to 65 percent slopes.

depleted by heavy grazing and other disturbances. Revegetation is important in these areas because of the susceptibility of the unit to erosion. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

This unit is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from the unit. It is capable of producing about 12 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitations for the production of pinyon and juniper are shallow depth to bedrock, low available water capacity, steepness of slope, and the high hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as elk, mule deer, cottontail, squirrel, coyote, and various species of bird use this unit. Rangeland and wooded areas provide food, shelter, and nesting areas for wildlife. Nearby areas of cropland also provide food for some of the wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining areas of pinyon and juniper.

Slope, shallow depth to bedrock, and high shrink-swell potential are the main limitations for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential. The depth to bedrock and slope should be considered when designing septic tank absorption fields or sewage lagoons. Community sewage systems are more satisfactory.

This map unit is in capability subclass VIe, nonirrigated.

82—Zyme-Rock outcrop complex, 12 to 65 percent slopes. This map unit is on hills and ridges (fig. 14). Elevation is 6,000 to 7,000 feet. The average annual

precipitation is 14 to 18 inches. The average annual air temperature is about 47 to 50 degrees F, and the average frost-free period is 110 to 130 days.

This unit is about 50 percent Zyme clay loam and 30 percent Rock outcrop.

Included in this unit are about 15 percent Bodot clay and 5 percent Arboles silty clay loam. Also included are small areas of Dulce sandy loam, Travessilla sandy loam, and soils that are coarser textured than this Zyme soil.

The Zyme soil is shallow and well drained. It formed in residual material derived from shale. Typically, the surface layer is grayish brown clay loam about 4 inches thick. The underlying material is grayish brown clay loam over soft shale at a depth of 10 inches. Depth to shale ranges from 6 to 20 inches.

Permeability of this Zyme soil is slow. Effective rooting depth is 6 to 20 inches because of the presence of soft bedrock. Available water capacity is low. Runoff is rapid, and the hazard of erosion is high.

Rock outcrop consists of areas of exposed shale. It supports little if any vegetation.

This unit is used mainly for livestock grazing and wildlife habitat.

The native vegetation in most areas consists of Indian ricegrass, western wheatgrass, needleandthread, blue grama, pinyon, Rocky Mountain juniper, mountainmahogany, Gambel oak, bitterbrush, serviceberry, and big sagebrush. Proper grazing use as part of a planned grazing system helps to maintain the quality and quantity of the rangeland vegetation. Seeding and deferring grazing facilitate revegetation of areas depleted by heavy grazing and other disturbances. Seeding should be done by hand broadcasting or aerial methods. Revegetation is important in depleted areas because of the susceptibility of the unit to erosion. Developing livestock watering facilities, fencing, and deferring grazing improve the distribution of grazing and help to maintain the condition of the rangeland.

The Zyme soil is suited to the production of pinyon and juniper. Woodland products such as firewood, fenceposts, Christmas trees, and pinyon nuts can be obtained from this soil. It is capable of producing about 10 cords of firewood per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot, if all limbs larger than 2 inches in diameter are used.

The main limitations for the production of pinyon and juniper are shallow depth to bedrock, low available water capacity, steepness of slope, the areas of Rock outcrop, and the high hazard of erosion. Limiting soil disturbance when harvesting trees helps to minimize erosion. Seeding to adapted grasses may be needed in some areas after harvesting. Low precipitation and the presence of brushy plants may influence seedling survival. Areas can be maintained in pinyon and juniper by selective cutting, leaving small trees and a few of the larger seed producing trees, and controlling livestock grazing so that seedlings can become established.

Wildlife such as elk, mule deer, cottontail, squirrel, coyote, and various species of bird use this unit. Rangeland and wooded areas provide food, shelter, and nesting areas for wildlife. Nearby cropland also provides food for some of the wildlife. Suitable management for wildlife should include protecting the unit from overgrazing and wildfire and maintaining areas of pinyon and juniper.

Shallow depth to bedrock, steepness of slope, and high shrink-swell potential are the main limitations of the Zyme soil for homesite and urban development. The foundations of buildings should be designed to compensate for the high shrink-swell potential. The depth to bedrock and steepness of slope should be considered when designing septic tank absorption fields or sewage lagoons. Community sewage systems are more satisfactory.

This map unit is in capability subclass VIIe, nonirrigated.

Prime Farmland

In this section, prime farmland is defined and discussed and the prime farmland soils in this survey area are listed.

Prime farmland is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, seed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. Adequate moisture and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal units of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils commonly get an adequate and dependable supply of moisture from precipitation or irrigation. Temperature and growing season are favorable, and level of acidity or alkalinity is acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not flooded during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to flooding, or are droughty may qualify as prime farmland soils if the limitations are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 132,732 acres, or nearly 16 percent of the survey area, would meet the requirements for prime farmland if an adequate and dependable supply of irrigation water were available.

The following map units meet the soil requirements for prime farmland when irrigated. An asterisk indicates that small areas of the unit have slopes of more than 6 percent and thus are not considered prime farmland. On some soils included in the list, measures should be used to overcome a hazard or limitation, such as flooding, wetness, or droughtiness. The location of each map unit is shown on the detailed soil maps at the back of this publication. Soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

1 Agua Fria loam
4 Arboles silty clay loam, 0 to 3 percent slopes
10 Bayfield silty clay loam, 1 to 3 percent slopes
16 Buckle loam
22 Corta loam, 1 to 3 percent slopes
23 Corta loam, 3 to 8 percent slopes
26 Falfa clay loam, 1 to 3 percent slopes
35 Hayness loam, 1 to 3 percent slopes
*38 Herm Variant clay loam, 2 to 8 percent slopes
39 Hesperus loam, 3 to 12 percent slopes
47 Nutrioso loam
60 Shalona loam
62 Sili clay loam, 1 to 3 percent slopes
63 Sili clay loam, 3 to 6 percent slopes
64 Simpatico loam
65 Sycle fine sandy loam
69 Umbarg loam
72 Vernal fine sandy loam, 1 to 3 percent slopes
75 Witt loam, 1 to 3 percent slopes
76 Witt loam, 3 to 8 percent slopes

The parts of the following map units that have slopes of less than 6 percent meet the requirements for prime farmland if adequate water is available and the problem of wetness is overcome if necessary. An asterisk indicates that drainage is needed.

5 Arboles clay, 3 to 12 percent slopes
8 Baca Variant loam, 3 to 12 percent slopes
*12 Bayfield silty clay loam, seeped, 1 to 3 percent slopes
19 Clayburn loam, 3 to 12 percent slopes

23 Corta loam, 3 to 8 percent slopes
27 Falfa clay loam, 3 to 8 percent slopes
36 Hayness loam, 3 to 12 percent slopes
39 Hesperus loam, 3 to 12 percent slopes
44 Mikim loam, 3 to 12 percent slopes
55 Plome fine sandy loam, 3 to 12 percent slopes
*66 Tefton loam
74 Vosburg fine sandy loam, 3 to 8 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation.of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and for hay and pasture is suggested in this section. The system of land capability classification used by the Soil Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants commonly grown are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 102,000 acres of the survey area is used for irrigated crops, hay, and pasture, and about 35,000 acres is used for nonirrigated crops. About 37,000 acres of the irrigated land is under some kind of a crop rotation or cropping system and the rest is under permanent pasture and hay. There is good potential for irrigating additional land, mainly in the southwestern part of the survey area.

The potential for increased crop production in many areas of the irrigated soils is good. Some of the management practices that can be used to increase crop production and prevent erosion are improving irrigation water management, maintaining soil tilth, applying fertilizer in sufficient amounts, timely planting and harvesting, minimum tillage, weed control, and crop rotation.

Irrigation water for the soils of the survey area comes from the Pine, Florida, Animas, and La Plata Rivers. Vallecito Reservoir, on the Pine River, and Lemon Reservoir, on the Florida River, are used to store water for irrigation. In most years adequate water is available to meet the needs of these ditch systems in summer. Irrigated land that is supplied by the La Plata River generally is short of water by mid-July. Water is stored in Mormon Reservoir for some of this land, and it is diverted directly into ditch systems for other areas. Irrigation water from all of these sources is of high quality. It has a low salt content and normally is clear, except during periods of rapid snowmelt or after heavy rains.

The Alamosa, Big Blue, Pescar, and Tefton soils and some areas of the Bayfield soils have a high water table or are seeped. These soils generally need to be drained for maximum crop production and efficient use of water. In most areas the slope of the soils is such that drainage systems can be established and outlets can be provided.

In much of the survey area, improved irrigation water management is needed. In some areas water percolates below the root zone or runs off the end of the field in excessive amounts. Most of the soils that are presently irrigated have a moderately fine textured or fine textured surface layer and have moderately slow to very slow permeability; therefore, water should be applied at a uniform, slow rate. Sprinkler systems are suited to these

soils. Ditch structures and measuring devices are needed in many places for better water control.

Good tilth and organic matter content should be maintained in cropland soils. This can be done by working crop residue into the soil surface and by using green manure crops. Barnyard manure, when available, can also be used to maintain tilth, organic matter content, and fertility. In nonirrigated areas, the amount of crop residue generally is small, especially on bean fields; therefore, very little organic matter is returned to the soil.

Soil fertility is important for crop production. In most areas of irrigated soils, applications of fertilizer are needed. Nitrogen and phosphorus are the nutrients most needed. The soils generally have adequate amounts of potassium. In a few areas used for corn silage, the trace element zinc is needed. Additions of fertilizer should be based on soil tests, needs of the crop grown and expected yields. The Cooperative Extension Service can give assistance in determining the kind and amount of fertilizer to apply.

Timely tillage, planting, and harvesting are important in producing a crop, maintaining soil tilth, and preventing erosion. Tillage operations should be carried out when moisture conditions are optional. Most of the irrigated soils become compacted if tilled when they are too wet and become extremely cloddy if tilled when very dry. Timely planting is necessary to take full advantage of the short growing season. Using minimum tillage and maintaining crop residue on the surface or in the soil help to prevent erosion, especially on nonirrigated soils.

Weed control is important on all cropland because of the competition for soil moisture and nutrients. Annual weeds are the most common and easiest to control. Noxious weeds such as Russian knapweed, Canadian thistle, and field bindweed grow mainly in the irrigated areas. These weeds are hard to eliminate once they become established, but they can be controlled by using clean cultivation, by spraying with chemicals, or by applying soil sterilants.

Use of a cropping system that maintains ground cover much of the time, either as a growing crop or as residue, helps to prevent erosion and maintain soil tilth and fertility. The cropping system in irrigated areas should include a legume in the rotation. In nonirrigated areas the cropping system should include a residue-producing crop. Crop rotations help to prevent infestations of insects, diseases, and weeds.

Irrigated crops suited to the area are alfalfa, wheat, barley, oats, and corn silage. Irrigated pasture and grass hay are also grown to a large extent. In nonirrigated areas the main crops grown are pinto beans, wheat, and alfalfa. Small amounts of barley and oats are also grown.

Irrigated pasture in the area consists of native grass along the river valleys, improved grass, and a mixture of grass and legumes. Some of the pastureland is used strictly for grazing, and some of it is used as hayland and for grazing. Most of this land is irrigated by flooding or through corrugations from a system of contour ditches. The important management concerns are managing irrigation water to prevent deep percolation and loss of soil nutrients, preventing excessive runoff and erosion, maintaining soil fertility, and proper grazing use.

Proper grazing practices may include delaying grazing in spring until plants are established, avoiding grazing when the soil is wet, rotation grazing, and managing grazing to leave stubble. Mowing some grasses helps to distribute grazing and stimulate growth. Spraying to control weeds improves some grass pasture.

Preventing water erosion is a management concern on all soils in the survey area. Most of the soils used for crops and pasture have a moderate hazard of water erosion. Use of a cropping system that maintains adequate ground cover most of the time helps to reduce the risk of erosion, maintain tilth, and improve water infiltration. Many of the farming operations may be on the contour. Some field crops can be planted on the contour or across the slope. Land smoothing or leveling is needed on some irrigated fields to insure uniform slopes and to help prevent runoff. Wind erosion is not a serious problem on the soils in the survey area.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*8*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. 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. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce the choice of plants or that 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.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Rangeland

By Noel H. Wellborn, range conservationist, Soil Conservation Service.

About 33 percent of the survey area is rangeland and is used for grazing. In addition, most woodland areas are also used for grazing to varying degrees. The size of the ranches varies.

On many ranches the forage produced on private rangeland is supplemented by such crops as hay, grain, and winter wheat. Some ranchers use Forest Service and Bureau of Land Management land to supplement their rangeland.

The native vegetation in many parts of the survey area has been severely depleted by continued heavy use. Much of the area that has had heavy use has now been invaded by pinyon and juniper. The production of usable forage under the pinyon and juniper is very limited. Productivity of the range can be increased if proper management practices are applied.

The survey area has two significantly different kinds of native plant communities or range sites—those of the foothills and those of the mountains.

The foothill plant communities support shrubs and grasses. Where the pinyon and juniper have invaded, the potential plant community is cool-season grasses, mainly muttongrass and Indian ricegrass.

The higher precipitation in some areas allows for the establishment of woodland communities as well as grassland communities. The grassland in these areas supports a variety of grasses, including Arizona fescue, mountain muhly, Parry oatgrass, and needlegrass.

Proper grazing use is the major management concern on the rangeland. Grazing should be controlled so that the kinds and amounts of plants that make up the potential plant community are maintained. To achieve this, 50 percent of the seasonal growth should remain at the end of the grazing period.

Deferment of grazing during the growing season of key forage plants helps to improve or maintain the condition of a range site by allowing the plants to produce seed.

Some areas under pinyon and juniper can be improved by clearing. This can be accomplished by firewood cuttings or chaining. Seeding may be required in areas

where grasses have been severely depleted or where nonirrigated cropland is converted to rangeland. Brush control is beneficial in some areas.

Gambel oak brush is very difficult to control because of its ability to resprout. Chaining, root plowing, and burning have been tried with little success.

Sound range management based on current soil information and rangeland inventories can result in increased productivity of the rangeland in the area.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Woodland Management and Productivity

Commercial woodland makes up about 22 percent of the survey area. It is in the northern part of the survey area and on Basin Mountain, in the central part of the area. The soils in these areas produce natural stands of ponderosa pine, spruce, fir, and aspen.

Noncommercial woodland makes up about 25 percent of the survey area. It consists of areas that support pinyon and juniper and occurs throughout the survey areas, except in the northern part. Many of these areas were converted from rangeland to woodland. The noncommercial woodland also includes the areas producing thick stands of cottonwood along the major river valleys.

In some areas the natural woodland vegetation was depleted by timber operations or by fire many years ago and has not been reforested. These areas now support thick stands of Gambel oak or other shrubs and grasses, which prevent the natural re-establishment of woodland. These areas are used for grazing and as wildlife habitat.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for

important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *X* indicates stoniness or rockiness; *W*, excessive water in or on the soil; *T*, toxic substances in the soil; *D*, restricted root depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, high content of coarse fragments in the soil profile; and *R*, steep slopes. The letter *O* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: X, W, T, D, C, S, F, and R.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Table 8 shows, for each soil suitable for woodland use, the potential for producing understory vegetation. The *total production* of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4 1/2 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 8 also lists the common names of the *characteristic vegetation* on each soil and the percentage *composition*, by air-dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely

spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Windbreaks and environmental plantings can be established on many of the soils in the survey area. Windbreaks can be beneficial on much of the farmland in the southern part of the area. Environmental plantings can be established around schools, parks, and homesites. Establishment of windbreaks is limited by the lack of moisture in summer and competition from weeds. They should be cultivated to eliminate the weeds, they should be protected from livestock and wildlife. It may be necessary to irrigate for the first few years until the root system is established.

Environmental plantings are easier to establish. They generally are planted around areas where water is available. They should be kept free of weeds and protected from livestock, wildlife, and people.

Many plants can be used for windbreaks and environmental plantings. Evergreen trees are desirable because they are long-lived and can withstand the various weather conditions once they are established; however, they are slow growing for the first few years. Some of the evergreen trees adapted to the area are ponderosa pine, Colorado blue spruce, Douglas-fir, Rocky Mountain juniper, and eastern redcedar. Deciduous trees grow faster than evergreens, and thus they provide shade and protection more quickly. Some of the deciduous trees adapted to the area are Russian-olive, honeylocust, Chinese elm, ash, cottonwood, and golden willow. Shrubs are usually established more easily, and they reach their full height in a very few years. Some of the shrubs adapted to the area are caragana, lilac, honeysuckle, native plum, and sumac. Native plants may be used for environmental plantings. They are adapted to the climatic conditions and are usually more resistant to diseases and drought. They may be transplanted, started from seed, or started from nursery stock. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Cooperative Extension Service, or from a nursery.

Recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in table 11 and interpretations for septic tank absorption fields in table 12.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have

moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

The survey area has a wide diversity of plant cover types, including irrigated and nonirrigated rangeland and woodland. The landscape ranges from foothills to mountains. This provides the habitat elements needed for a broad variety of wildlife.

Land use changes bring about changes in wildlife habitat. The rapid population growth in recent years and the resulting construction of subdivisions, homesites, and roads affect the migration routes and feeding areas for elk and deer. Some areas have been cultivated in recent years. This creates habitat for openland wildlife. Construction of ponds and lakes in the area has created additional habitat for wetland wildlife.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are timothy, orchardgrass, crested wheatgrass, smooth brome, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are Arizona fescue, prairie junegrass, goldenrod, sunflower, western wheatgrass, and blue grama.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, spruce, fir, pinyon pine, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, Gambel oak, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, redtop cattail, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with

grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include quail, pheasant, meadowlark, field sparrow, mourning dove, cottontail, elk, mule deer, and coyote.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, blue grouse, camp robber, thrushes, woodpeckers, squirrels, snowshoe rabbit, coyote, fox, raccoon, mule deer, elk, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include elk, mule deer, meadowlark, and lark bunting.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building Site Development, Sanitary Facilities, Construction Materials, and Water Management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps and soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the

susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper

functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a *probable* source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an *improbable* source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (*1*) and the Unified soil classification system (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest (*5*).

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the amount of stable aggregates 0.84 millimeters in size. These are represented idealistically by USDA textural classes. Soils containing rock fragments can occur in any group.

1. Sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay

deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in the table.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, nonacid, mesic Typic Haplaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*7*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*9*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Agua Fria Series

The Agua Fria series consists of fine, montmorillonitic, mesic Ustollic Haplargids. These deep, well drained soils formed in eolian material overlying gravelly and cobbly glacial outwash. They are on old river terraces. Slope is 1 to 3 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 63 to 65 degrees.

Typical pedon of Agua Fria loam, about 700 feet north and 1,500 feet west of the southeast corner of sec. 1, T. 33 N., R. 9 W., south of the Ute baseline.

A—0 to 4 inches; brown (7.5YR 5/3) loam, dark brown (7.5YR 4/3) moist; moderate medium platy structure parting to moderate fine granular; soft, very friable, slightly sticky and nonplastic; 3 percent gravel and 3 percent cobbles; mildly alkaline (pH 7.4); abrupt smooth boundary.

Bt1—4 to 17 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure and strong medium angular blocky; very hard, firm, sticky and plastic; 2 percent gravel and 2 percent cobbles; many moderately thick clay films on faces of peds; mildly alkaline (pH 7.6); clear smooth boundary.

Bt2—17 to 26 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/3) moist; strong medium subangular blocky structure and strong medium angular blocky; very hard, firm, sticky and plastic; 2 percent gravel and 2 percent cobbles; continuous moderately thick clay films on faces of peds; mildly alkaline (pH 7.6); gradual smooth boundary.

Bk—26 to 30 inches; light reddish brown (5YR 6/3) clay loam, reddish brown (5YR 5/3) moist; weak medium subangular blocky structure; very hard, friable, sticky and plastic; thin patchy clay films on faces of peds; visible lime in soft masses; 8 percent calcium carbonate equivalent; calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

2Bk—30 to 60 inches; reddish brown (5YR 5/3) extremely cobbly loam, reddish brown (5YR 4/3) moist; massive; hard, friable, nonsticky and nonplastic; 35 percent gravel and 40 percent cobbles; lime coatings on gravel and cobbles; 25 percent calcium carbonate equivalent; calcareous; moderately alkaline (pH 8.2).

Depth to the cobbly substratum ranges from 18 to 36 inches. Depth to calcareous material ranges from 20 to 30 inches.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 or 4.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 to 5. It typically is clay or clay loam, but clay content ranges from 35 to 50 percent, silt content from 10 to 40 percent, and sand content from 15 to 40 percent. It is mildly alkaline or moderately alkaline. The 2Bk horizon is 35 to 85 percent cobbles and gravel.

Alamosa Series

The Alamosa series consists of fine-loamy, mixed, frigid, Typic Argiaquolls. These deep, poorly drained soils formed in mixed alluvium. They are on alluvial valley floors, fans, and bottoms. Slope is 0 to 3 percent. The average annual precipitation ranges from 18 to 24 inches. The average annual soil temperature ranges from 43 to 46 degrees F, and the average annual soil temperature in summer is 59 to 62 degrees.

Typical pedon of Alamosa loam, along Wallace Gulch, about 1,800 feet south and 75 feet west of the northeast corner of sec. 34, T. 35 N., R. 7 W.

A—0 to 3 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; neutral (pH 7.0); clear smooth boundary.

BA—3 to 8 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, sticky and plastic; few thin clay films on faces of peds; common fine and very fine roots; neutral (pH 7.2); clear smooth boundary.

Btg1—8 to 14 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; common fine faint gray (N 5/0) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few thin clay films on faces of peds; common fine and very fine roots; mildly alkaline (pH 7.4); gradual smooth boundary.

Btg2—14 to 20 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; common fine faint gray (N 5/0) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few thin clay films on faces of peds; few fine and very fine roots; mildly alkaline (pH 7.4); gradual smooth boundary.

Bkg1—20 to 32 inches; gray (10YR 6/1) sandy clay loam, very dark gray (10YR 3/1) moist; common fine distinct gray (N 5/0) mottles; weak medium subangular blocky structure; hard, friable, sticky and plastic; few medium calcium nodules; calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

Bkg2—32 to 60 inches; light gray (N 7/0) sandy clay loam, gray (N 5/0) moist; massive; hard, friable, sticky and plastic; calcareous; moderately alkaline (pH 8.0).

Depth to the base of the argillic horizon ranges from 20 to 50 inches. Rock fragment content ranges from 0 to 15 percent in the solum and C horizon. Thickness of the solum ranges from 24 to 60 inches or more.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 or 2. It is neutral or mildly alkaline.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 1 or 2. It is silty clay loam, clay loam, or loam. Mottles in this horizon range from faint to prominent. The horizon is neutral or mildly alkaline. The Bkg1 horizon is gleyed

with blue and green hues of as much as 7.5YR, value of 6 or 7 when dry and 3 to 6 when moist, and chroma of 1 or 2. It is loam, clay loam, or sandy clay loam. It is mildly alkaline or moderately alkaline.

Anvik Series

The Anvik series consists of fine-loamy, mixed Boralfic Cryoborolls. These deep, well drained soils formed in colluvium and alluvium derived from shale and sandstone. They are on mountainsides. Slope is 12 to 45 percent. The average annual precipitation ranges from 20 to 28 inches. The average annual soil temperature ranges from 38 to 42 degrees F, and the average soil temperature in summer ranges from 40 to 46 degrees.

Typical pedon of Anvik loam, 12 to 45 percent slopes, along the road up Miller Mountain northeast of Lemon Reservoir, about 400 feet east of the northwest corner of sec. 29, T. 37 N., R. 7 W.

Oi—4 inches to 0; undecomposed leaves, needles, and twigs.

A—0 to 13 inches; dark brown (10YR 4/3) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; 10 percent gravel and 2 percent stones; neutral (pH 6.8); abrupt smooth boundary.

E—13 to 19 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; moderate medium granular structure; slightly hard, friable, nonsticky and nonplastic; 10 percent gravel and 2 percent stones; neutral (pH 6.8); clear smooth boundary.

E&B—19 to 23 inches; light yellowish brown (10YR 6/4) and brown (7.5YR 5/4) sandy clay loam, yellowish brown (10YR 5/4) and dark brown (7.5YR 4/3) moist; weak medium and moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; 10 percent stones; neutral (pH 6.8); clear smooth boundary.

Bt—23 to 46 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; 10 percent stones; thin patchy clay films on faces of peds; neutral (pH 7.0); clear smooth boundary.

Bk—46 to 60 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 10 percent stones; iron stains in some of the soil mass; calcareous; mildly alkaline (pH 7.8).

Thickness of the mollic epipedon ranges from 7 to 15 inches. Stone, cobble, and gravel content ranges from 10 to 25 percent. Depth to calcareous material ranges from 40 inches to more than 60 inches.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The E horizon has hue of 2.5Y to 7.5YR, value of 6 or 7 when dry and 4 to 6 when moist, and chroma of 2 to 4. It is neutral or slightly acid.

The Bt horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. In some pedons it is clay loam and has a clay content of 20 to 35 percent, a silt content of 10 to 40 percent, and a sand content of 30 to 60 percent with more than 15 percent sand that is fine or coarser. It is neutral or slightly acid.

Arboles Series

The Arboles series consists of fine, montmorillonitic, mesic Udorthentic Chromusterts. These deep, well drained soils formed in alluvium derived from shale. They are on valley filling side slopes, in valleys, and on terraces and alluvial fans. Slope is 0 to 12 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 47 to 50 degrees F, and the average summer soil temperature ranges from 65 to 68 degrees.

Typical pedon of Arboles clay, 3 to 12 percent slopes, about 100 feet north and 50 feet west of the southeast corner of sec. 9, T. 34 N., R. 8 W.

A1—0 to 1 inch; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; neutral (pH 7.1); clear smooth boundary.

A2—1 inch to 6 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine angular blocky; very hard, friable, sticky and plastic; neutral (pH 6.9); clear smooth boundary.

Bw1—6 to 12 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium angular blocky structure parting to moderate fine angular blocky; very hard, very friable, sticky and plastic; neutral (pH 7.2); gradual smooth boundary.

Bw2—12 to 23 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate coarse angular blocky structure parting to strong fine angular blocky; very hard, firm, very sticky and very plastic; neutral (pH 7.2); clear smooth boundary.

Bw3—23 to 30 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate coarse angular blocky structure parting to moderate medium angular blocky; very hard, firm, very sticky and very plastic; calcareous; mildly alkaline (pH 7.5); clear smooth boundary.

Bk—30 to 37 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; massive; hard, friable,

sticky and plastic; calcareous; mildly alkaline (pH 7.6); clear smooth boundary.
C1—37 to 46 inches; brown (7.5YR 5/4) clay loam, brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; calcareous; mildly alkaline (pH 7.6); clear smooth boundary.
C2—46 to 60 inches; reddish yellow (7.5YR 6/6) clay loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; calcareous in spots; mildly alkaline (pH 7.6).

The profile is calcareous below the upper part of the Bw horizon. The solum is 20 to 40 inches thick. Content of rock fragments typically is less than 5 percent but ranges from 0 to 15 percent throughout the profile. Content of clay in the control section ranges from 40 to 50 percent. When dry, the soil has cracks 0.5 to 1.0 inch wide and more than 20 inches deep and 12 inches long. The cracks remain open for 90 to 150 days (cumulative).

The A horizon has hue of 7.5YR to 2.5Y, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 2 to 4. It is clay or silty clay loam. It is neutral or mildly alkaline.

The Bw horizon has hue of 7.5YR to 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 5. It is silty clay or clay. It is neutral or mildly alkaline.

The C horizon has hue of 7.5YR to 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 6. It is clay loam, silty clay, or clay. It is mildly alkaline or moderately alkaline.

Archuleta Series

The Archuleta series consists of loamy, mixed, nonacid, frigid, shallow Typic Ustorthents. These shallow, well drained soils formed in residuum derived from sandstone and shale. They are on hills, ridges, and mountainsides. Slope is 12 to 65 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 42 to 47 degrees F, and the average soil temperature in summer ranges from 53 to 57 degrees.

Typical pedon of an Archuleta loam in an area of Archuleta-Sanchez complex, 12 to 65 percent slopes, along Wallace Gulch Road, about 1,500 feet north and 200 feet west of the southeast corner of sec. 19, T. 35 N., R. 7 W.

Oi—1 inch to 0; organic mat of pine needles and oak leaves.
A—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; neutral (pH 6.6); clear wavy boundary.
C—4 to 12 inches; pale brown (10YR 6/3) light clay loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; 5 percent stones and gravel; neutral (pH 6.8); clear wavy boundary.
Cr—12 inches; weathered sandstone and shale.

Depth to bedrock ranges from 10 to 20 inches. Rock fragment content ranges from 0 to 35 percent throughout the soil. Reaction ranges from slightly acid to mildly alkaline.

The A horizon has hue of 5Y to 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 4.

The C horizon has hue of 5Y to 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 4. It typically is loam, clay loam, or sandy clay loam; however, the control section has between 18 and 35 percent clay, less than 50 percent silt, and more than 20 percent sand.

Baca Variant

The Baca Variant consists of fine, montmorillonitic, mesic Ustollic Haplargids. These deep, well drained soils formed in alluvium derived from shale. They are in upland valleys and on mesas. Slope is 3 to 12 percent. The average annual precipitation ranges from 14 to 16 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Baca Variant loam, 3 to 12 percent slopes, about 1,300 feet west and 1,300 feet south of the northeast corner of sec. 24, T. 32 N., R. 9 W.

A1—0 to 4 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.6); clear smooth boundary.
A2—4 to 6 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.6); clear smooth boundary.
BA—6 to 12 inches; brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; neutral (pH 6.6); clear smooth boundary.
Bt—12 to 24 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to strong angular blocky; very hard, very friable, sticky and plastic; neutral (pH 7.2); clear smooth boundary.
Btk—24 to 32 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to strong angular blocky; very hard, friable, sticky and plastic; calcareous; mildly alkaline (pH 7.4); clear wavy boundary.
Bk—32 to 40 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) moist; moderate medium

subangular blocky structure; hard, friable, sticky and plastic; calcareous; mildly alkaline (pH 7.8); gradual wavy boundary.

C—40 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline (pH 8.0).

Depth to calcareous material ranges from 8 to 24 inches.

The A horizon has hue of 2.5Y to 10YR, value of 5 to 7 when dry and 3 or 4 when moist, and chroma of 1 to 3. It is neutral or mildly alkaline.

The Bt horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is clay, silty clay loam, or clay loam that is 35 to 50 percent clay. It is neutral to moderately alkaline.

The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Bayfield Series

The Bayfield series consists of fine, mixed (calcareous), mesic Ustertic Torriorthents. These deep, well drained soils formed in alluvium derived from shale. They are in broad valleys. Slope is 1 to 3 percent. The average annual precipitation ranges from 13 to 16 inches. The average annual soil temperature ranges from 48 to 53 degrees F, and the average soil temperature in summer ranges from about 64 to 70 degrees.

Typical pedon of Bayfield silty clay loam, 1 to 3 percent slopes, about 1,300 feet west and 100 feet south of the northeast corner of sec. 24, T. 34 N., R. 7 W.

A1—0 to 2 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 4/2) moist; weak thick platy structure; hard, friable, slightly sticky and slightly plastic; neutral (pH 6.7); abrupt smooth boundary.

A2—2 to 4 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; strong fine granular structure; hard, friable, sticky and plastic; cracks 0.75 inch wide; neutral (pH 6.6) clear smooth boundary.

AC—4 to 8 inches; pale brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; very hard, friable, very sticky and very plastic; cracks 0.75 inch wide; neutral (pH 7.0); gradual smooth boundary.

C1—8 to 15 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine subangular blocky structure; very hard, firm, very sticky and very plastic; cracks 0.75 inch wide; common pressure faces; calcareous; moderately alkaline (pH 7.9); gradual smooth boundary.

C2—15 to 20 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common pressure faces; calcareous; moderately alkaline (pH 8.0) gradual smooth boundary.

C3—20 to 35 inches; light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, very sticky and very plastic; calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

C4—35 to 48 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, sticky and plastic; calcareous; moderately alkaline (pH 8.1); gradual smooth boundary.

C5—48 to 60 inches; pale brown (10YR 6/3) silty clay loam, grayish brown (10YR 5/2) moist; massive; very hard, firm, sticky and plastic; calcareous; moderately alkaline (pH 8.2).

Depth to uniformly calcareous material is less than 10 inches. The base of the AC horizon is less than 10 inches below the soil surface. Rock fragment content ranges from 0 to 10 percent but is typically less than 2 percent. The particle-size control section has 35 to 50 percent clay, 35 to 60 percent silt, and 10 to 30 percent sand. Visible calcium carbonate is present in some pedons.

The A horizon has hue of 2.5Y to 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 or 3. It is neutral to moderately alkaline.

The AC horizon has hue of 2.5Y to 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 or 3. It typically is silty clay or silty clay loam. It is neutral to moderately alkaline.

The C horizon has hue of 2.5Y to 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 or 3. It typically is silty clay or silty clay loam but is clay or clay loam in some pedons. It is mildly alkaline or moderately alkaline.

Big Blue Series

The Big Blue series consists of fine, montmorillonitic (calcareous), frigid Fluvaquentic Haplaquolls. These deep, poorly drained soils formed in alluvium derived from shale. They are on low terraces, valley bottoms, and alluvial valley floors. Slope is 0 to 6 percent. The average annual precipitation ranges from 16 to 20 inches. The average annual soil temperature ranges from 40 to 45 degrees F, and the average soil temperature in summer ranges from 55 to 60 degrees.

Typical pedon of Big Blue clay loam, about 800 feet north of the southwest corner of sec. 4, T. 35 N., R. 11 W.

A—0 to 4 inches; very dark gray (2.5Y 3/0) clay loam, black (2.5Y 2/0) moist; moderate medium subangular blocky structure parting to moderate fine granular; very hard, firm, slightly sticky and plastic; moderately alkaline (pH 8.0); clear smooth boundary.

Ag—4 to 10 inches; very dark gray (2.5Y 3/0) silty clay, black (2.5Y 2/0) moist; few fine olive yellow (2.5Y 6/8) mottles; moderate medium subangular blocky structure; very hard, firm, slightly sticky and plastic; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

Cg1—10 to 24 inches; gray (2.5Y 5/0) silty clay, dark gray (2.5Y 4/0) moist; common fine olive yellow (2.5Y 6/8) mottles; weak coarse angular blocky structure; very hard, firm, slightly sticky and plastic; lime is disseminated throughout; calcareous; moderately alkaline (pH 8.4); gradual wavy boundary.

Cg2—24 to 60 inches; gray (2.5Y 5/0) silty clay, gray (2.5Y 5/0) moist; many fine and medium olive yellow (2.5Y 6/6, 6/8) and light olive brown (2.5Y 5/6) mottles; massive; very hard, firm, slightly sticky and plastic; lime is in seams and soft masses; calcareous; moderately alkaline (pH 8.4).

Thickness of the mollic epipedon is 10 to 23 inches. Mottling typically starts in the lower part of the mollic epipedon. The profile typically is calcareous throughout, but in some pedons it is noncalcareous to a depth of 6 inches. Rock fragment content ranges from 0 to 15 percent in the major part of the control section. The control section typically is silty clay, but in some pedons it is clay or clay loam and is 35 to 50 percent clay.

The A horizon has hue of 5Y to 7.5YR, value of 3 to 5 when dry and 2 or 3 moist, and chroma of 0 to 2.

The Cg1 horizon has hue of 5Y to 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 0 to 2. The Cg2 horizon has hue of 5Y to 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 0 to 2.

Bodot Series

The Bodot series consists of fine, montmorillonitic (calcareous), mesic Ustic Torriorthents. These moderately deep, well drained soils formed in residuum derived from shale. They are on hills. Slope is 3 to 10 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 48 to 51 degrees F, and the average soil temperature in summer ranges from 65 to 68 degrees.

Typical pedon of Bodot clay, 3 to 10 percent slopes, about 850 feet south of the northeast corner of sec. 7, T. 32 N., R. 6 W.

A—0 to 3 inches; gray (5YR 5/1) clay, dark gray (5YR 3/1) moist; strong fine granular structure; hard, firm, very sticky and very plastic; slightly calcareous; moderately alkaline (pH 8.3); abrupt smooth boundary.

AC—3 to 6 inches; gray (5YR 5/1) clay, dark gray (5YR 4/1) moist; weak medium and coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; slightly calcareous; moderately alkaline (pH 8.3); gradual smooth boundary.

C—6 to 33 inches; gray (5YR 5/1) clay, dark gray (5YR 4/1) moist; weak coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; slightly calcareous; moderately alkaline (pH 8.3); gradual wavy boundary.

Cr—33 inches; shale.

The profile commonly is calcareous at the surface, but in some areas it is leached in the upper few inches. Depth to the paralithic contact ranges from 20 to 40 inches. Content of rock fragments ranges from 0 to 10 percent but is commonly less than 2 percent. Visible secondary calcium carbonate and calcium sulfate are present in some pedons.

The A horizon has hue of 2.5Y to 2.5YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 4. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y to 2.5YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 4. It is heavy clay loam, clay, or silty clay. The control section is 35 to 50 percent clay, 20 to 40 percent silt, and 5 to 40 percent sand. It is moderately alkaline or strongly alkaline.

Buckle Series

The Buckle series consists of fine-loamy, mixed, mesic Ustollic Haplargids. These deep, well drained soils in upland valleys. These soils formed in alluvium derived from sandstone. Slope is 1 to 5 percent. The average annual precipitation is about 12 to 14 inches. The average annual soil temperature is 47 to 52 degrees F, and the average soil temperature in summer is 62 to 68 degrees.

Typical pedon of Buckle loam, in a gully about 600 feet east and 1,100 feet south of the northwest corner of sec. 24, T. 32 N., R. 9 W.

A—0 to 10 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; moderately alkaline (pH 8.0); clear smooth boundary.

BA—10 to 15 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; weak fine subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline (pH 8.0); clear smooth boundary.

Bt1—15 to 27 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; moderately alkaline (pH 8.0); clear smooth boundary.

Bt2—27 to 38 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; moderately alkaline (pH 8.1); clear smooth boundary.

Bk—38 to 60 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; weak coarse subangular blocky structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; calcareous; moderately alkaline (pH 8.2).

The thickness of the solum is 40 to 60 inches or more. The control section averages 28 to 35 percent clay.

The A horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 4.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 1 to 3. It is clay loam or silty clay loam. Thin strata of loam or silt loam are present in some pedons.

Chris Series

The Chris series consists of clayey-skeletal, montmorillonitic Glossic Cryoboralfs. These deep, well drained soils formed in stony colluvium and local alluvium. They are on mountainsides. Slope is 9 to 25 percent. The average annual precipitation ranges from 25 to 40 inches. The average annual soil temperature ranges from 40 to 44 degrees F, and the average soil temperature in summer ranges from 45 to 47 degrees.

Typical pedon of Chris very stony loam, 9 to 25 percent slopes, about 1,980 feet north of the southeast corner of sec. 35, T. 36 N., R. 6 W.

Oi—2 inches to 1 inch; undecomposed needles, twigs, and leaves.

Oe—1 inch to 0; partially decomposed needles, twigs, and leaves.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) very stony loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 25 percent stones and cobbles and 15 percent gravel; slightly acid (pH 6.5); clear smooth boundary.

E—4 to 11 inches; pink (7.5YR 7/4) gravelly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure parting to moderate medium granular; soft, very friable, nonsticky and nonplastic; 20 percent gravel; slightly acid (pH 6.4); gradual irregular boundary.

E/B—11 to 21 inches; mixed pink (7.5YR 7/4) and reddish yellow (5YR 6/8) very cobbly clay loam, brown (7.5YR 5/4) and yellowish red (5YR 5/6) moist; moderate medium subangular and angular blocky structure; very hard, very firm, sticky and plastic; 15 percent gravel, 15 percent cobbles, and 5 percent stones; slightly acid (pH 6.5); gradual wavy boundary.

Bt—21 to 40 inches; reddish yellow (5YR 6/6) very cobbly clay, yellowish red (5YR 5/6) moist; moderate medium subangular and angular blocky structure; very hard, very firm, very sticky and very plastic; thin nearly continuous clay films on faces of peds; 15 percent gravel, 20 percent cobbles, and 5 percent stones; slightly acid (pH 6.5); clear wavy boundary.

BC—40 to 47 inches; reddish yellow (5YR 6/6) very cobbly clay, yellowish red (5YR 5/6) moist; moderate medium subangular and angular blocky structure; very hard, very firm, very sticky and very plastic; 15 percent gravel, 20 percent cobbles, and 5 percent stones; medium acid (pH 5.8); clear wavy boundary.

C—47 to 60 inches; strong brown (7.5YR 5/6) very cobbly clay loam, strong brown (7.5YR 5/6) moist; massive; hard, firm, sticky and plastic; 15 percent gravel, 20 percent cobbles, and 5 percent stones; medium acid (pH 5.8).

The profile is slightly acid or medium acid. Rock fragment content ranges from 35 to 60 percent in a major part of the solum and in the C horizon.

The E horizon has hue of 10YR to 5YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 1 to 3. It is slightly acid or medium acid.

The Bt horizon has hue of 5YR to 10R, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 6. It is clay or clay loam. Clay content ranges from 35 to 50 percent.

The C horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 6.

Clark Fork Series

The Clark Fork series consists of sandy-skeletal, mixed, frigid Typic Ustorthents. These deep, somewhat excessively drained soils formed in very gravelly and cobbly alluvium. They are on river terraces, alluvial fans, and old flood plains. Slope is 1 to 6 percent. The average annual precipitation ranges from about 20 to 30

inches. The average annual soil temperature ranges from 44 to 47 degrees F, and the average soil temperature in summer ranges from 60 to 64 degrees.

Typical pedon of Clark Fork very cobbly sandy loam, north of Vallecito Reservoir, about 1,000 feet north and 400 feet east of the southwest corner of sec. 21, T. 37 N., R. 6 W.

A—0 to 5 inches; grayish brown (10YR 5/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine pores; 20 percent gravel, 30 percent cobbles, and 5 percent stones; neutral (pH 6.8); clear smooth boundary.

C1—5 to 20 inches; pale brown (10YR 6/3) extremely cobbly sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine pores; 20 percent gravel, 40 percent cobbles, and 10 percent stones; neutral (pH 6.8); gradual smooth boundary.

C2—20 to 60 inches; varicolored extremely cobbly sand; single grain; loose; few fine roots in upper part; 30 percent gravel, 40 percent cobbles, and 10 percent stones; neutral (pH 6.6).

Rock fragment content ranges from 35 to 80 percent in the control section. Rock fragments are mostly cobbles and gravel, but some stones are present. The profile is neutral or slightly acid throughout.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 to 4.

The C1 horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 3 to 5. It is extremely cobbly sandy loam, very cobbly sandy loam, or very gravelly sandy loam. The C2 horizon is extremely cobbly, very cobbly, or very gravelly sand or loamy sand.

Clayburn Series

The Clayburn series consists of fine-loamy, mixed Argic Pachic Cryoborolls. These deep, well drained soils formed in medium textured alluvium washed from nearby mountains. They are in narrow intermontane valleys and mountain toe slopes. Slope is 3 to 25 percent. The average annual precipitation ranges from 20 to 35 inches. The average annual soil temperature ranges from 38 to 41 degrees F, and the average soil temperature in summer ranges from 50 to 55 degrees.

Typical pedon of Clayburn loam, 3 to 12 percent slopes, about 750 feet east of the entrance to Hesperus ski area, near the south quarter corner of sec. 10, T. 35 N., R. 11 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; neutral (pH 6.6); clear smooth boundary.

A2—6 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable, nonsticky and nonplastic; neutral (pH 6.6); gradual smooth boundary.

Bt1—10 to 16 inches; dark grayish brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; thin nearly continuous clay films on faces of peds; neutral (pH 6.8); gradual smooth boundary.

Bt2—16 to 23 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine angular blocky structure; hard, friable, sticky and plastic; thin nearly continuous clay films on faces of peds; neutral (pH 6.8); gradual smooth boundary.

Bt3—23 to 31 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; thin nearly continuous clay films on the faces of peds; neutral (pH 6.8); clear wavy boundary.

C1—31 to 36 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; massive; hard, friable, nonsticky and nonplastic; neutral (pH 7.0); gradual smooth boundary.

C2—36 to 60 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable, nonsticky and nonplastic; neutral (pH 7.0).

The mollic epipedon is more than 16 inches thick. The upper boundary of the argillic horizon is within 24 inches of the surface. Content of rock fragments, mainly cobbles and stones, ranges from 0 to 20 percent.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 when dry and 1.5 or 2 when moist, and chroma of 2 or 3. It is neutral or slightly acid. The horizon is loam or cobbly loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 to 4. It clay loam or sandy clay loam and has a clay content of 25 to 35 percent, a silt content of 15 to 40 percent, and a sand content of 30 to 65 percent. It is neutral or slightly acid.

The C horizon is loam or fine sandy loam. It is neutral or slightly acid.

Coni Series

The Coni series consists of loamy, mixed Lithic Argiborolls. These shallow, well drained soils formed in

residuum derived from interbedded sandstone and shale. They are on mountainsides and parks. Slope is 4 to 25 percent. The average annual precipitation ranges from 20 to 28 inches. The average annual soil temperature ranges from 42 to 47 degrees F, and the average soil temperature in summer ranges from 59 to 63 degrees.

Typical pedon of Coni loam, 4 to 25 percent slopes, about 2,380 feet west and 400 feet south of the northeast corner of sec. 24, T. 35 N., R. 12 W.

A1—0 to 2 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; neutral (pH 7.2); clear smooth boundary.

A2—2 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 5 percent gravel; neutral (pH 7.0); clear smooth boundary.

BA—7 to 11 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; 5 percent gravel; neutral (pH 7.2); gradual smooth boundary.

Bt—11 to 17 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; 5 percent gravel; neutral (pH 7.0); abrupt smooth boundary.

R—17 inches; sandstone.

Thickness of the solum ranges from 10 to 20 inches. Rock fragment content ranges from 0 to 35 percent. Depth to bedrock ranges from 10 to 20 inches.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is neutral or slightly acid.

The Bt horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 to 4. It typically is loam or clay loam, but clay content ranges from 18 to 35 percent. The horizon is neutral or slightly acid.

Corta Series

The Corta series consists of fine, montmorillonitic, mesic Udertic Paleustalfs. These deep, well drained soils formed in alluvium derived from shale and mixed with loess. They are on mesa tops, ridgetops, and old pediment surfaces. Slope is 1 to 8 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 48 to 50 degrees F, and the average soil temperature in summer ranges from 60 to 63 degrees.

Typical pedon of Corta loam, 3 to 8 percent slopes, about 1,200 feet west and 1,100 feet south of the center of sec. 1, T. 34 N., R. 7 W.

A—0 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/2) moist; weak medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; neutral (pH 7.0); abrupt smooth boundary.

Bt1—6 to 18 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; common moderately thick clay films on faces of peds, in root channels, and in pores; slightly acid (pH 6.5); clear smooth boundary.

Bt2—18 to 28 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/2) moist; weak medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; common moderately thick clay films on faces of peds; common slickensides; neutral (pH 6.8); clear smooth boundary.

Bt3—28 to 39 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/2) moist; moderate fine angular blocky structure; very hard, firm, very sticky and very plastic; common moderately thick clay films on faces of peds; common slickensides; mildly alkaline (pH 7.6); clear smooth boundary.

Bk—39 to 60 inches; reddish yellow (7.5YR 7/6) clay loam, strong brown (7.5YR 5/4) moist; massive; very hard, firm, sticky and plastic; seams of visible lime; calcareous; mildly alkaline (pH 7.6).

Depth to uniformly calcareous material ranges from 40 inches to more than 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 4. It is neutral or slightly acid.

The Bt horizon has hue of 10YR to 5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 6. In some pedons it is silty clay or heavy clay loam. This horizon is slightly acid or neutral. The Bk horizon has hue of 2.5Y to 7.5YR. It is clay loam, clay, or silty clay loam. It is 35 to 50 percent clay. This horizon is neutral or mildly alkaline.

Dominguez Variant

The Dominguez Variant consists of fine, montmorillonitic, mesic Ustertic Camborthids. These deep, well drained soils formed in alluvium derived from shale and sandstone. They are along drainageways and on valley bottoms. Slope is 1 to 6 percent. The average annual precipitation is 13 to 15 inches, the average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of a Dominguez Variant silty clay loam in an area of Panitchen-Dominguez Variant silty clay

loams, about 1,300 feet east and 1,400 feet west of the southwest corner of sec. 2, T. 32 N., R. 11 W.

A1—0 to 1 inch; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak very fine granular structure; soft, very friable, sticky and plastic; calcareous; moderately alkaline (pH 8.4); clear smooth boundary.
A2—1 inch to 3 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate thin platy structure; soft, very friable, sticky and plastic; calcareous; moderately alkaline (pH 8.4); gradual wavy boundary.
Bw—3 to 25 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; calcareous; strongly alkaline (pH 8.8); gradual wavy boundary.
BC—25 to 35 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; strong medium subangular blocky structure; very hard, firm, sticky and plastic; calcareous; strongly alkaline (pH 8.6); gradual wavy boundary.
C—35 to 60 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; very hard, firm, sticky and plastic; calcareous; strongly alkaline (pH 8.6).

The profile is calcareous throughout. It is moderately alkaline or strongly alkaline. Cracks more than 0.4 inch wide and 12 inches long are in the upper 20 inches of the profile when it is dry, and they remain open for 90 to 240 days (cumulative) in most years. The exchangeable sodium percentage commonly is more than 15 but less than 45.

The A horizon has hue of 10YR to 7.5YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 4. It is silty clay loam or clay loam.

The B horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 4. It is clay, silty clay, or silty clay loam.

The C horizon has hue of 2.5Y to 7.5YR.

Dulce Series

The Dulce series consists of loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents. These shallow, well drained soils formed in residuum derived from calcareous sandstone. They are on foothill slopes and ridges. Slope is 6 to 50 percent. The average annual precipitation is 13 to 16 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of a Dulce sandy loam in an area of Dulce-Travessilla-Rock outcrop complex, 6 to 50 percent slopes, about 700 feet south and 300 feet west of the northeast corner of sec. 4, T. 32 N., R. 10 W.

A—0 to 4 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic, 2 percent stones; moderately alkaline (pH 8.0); clear smooth boundary.
AC—4 to 9 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; 2 percent stones; calcareous; moderately alkaline (pH 8.0); clear smooth boundary.
Ck—9 to 13 inches; very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonsticky and nonplastic; strongly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.
Cr—13 inches; soft sandstone and interbedded sandy shale that can be dug with an auger and a spade.

Depth to the paralithic contact ranges from 8 to 20 inches. In some pedons hard layers are present in the bedrock. Content of rock fragments ranges from 0 to 20 percent; fragments typically are sandstone and range in size from gravel to stones. The profile typically is calcareous throughout, but in some pedons the calcium carbonate is leached from the upper 5 inches. It is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3. It is sandy loam or loam, and the clay content ranges from 5 to 18 percent.

Durango Series

The Durango series consists of fine, mixed, mesic Aridic Haplustalfs. These deep, well drained soils formed in glacial outwash. They are on mesas and ridgetops. Slope is 3 to 20 percent. The average annual precipitation is about 15 to 18 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 60 to 65 degrees.

Typical pedon of Durango cobbly loam, 3 to 20 percent slopes, about 1,000 feet south and 900 feet east of the northwest corner of sec. 28, T. 33 N., R. 8 W.

A—0 to 3 inches; brown (7.5YR 4/2) cobbly loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine and medium roots; 20 percent cobbles and 5 percent gravel; neutral (pH 7.2); clear smooth boundary.
BA—3 to 8 inches; brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) moist; moderate medium subangular

blocky structure parting to moderate medium granular; hard, firm, sticky and plastic; many fine and medium roots; few thin clay films on faces of peds; 5 percent gravel and 5 percent cobbles; mildly alkaline (pH 7.4); clear smooth boundary.

Bt—8 to 25 inches; reddish brown (5YR 5/3) heavy clay loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure parting to moderate medium angular blocky; very hard, very firm, very sticky and plastic; many fine and medium roots; many thin clay films on faces of peds; 2 percent cobbles and 2 percent gravel; mildly alkaline (pH 7.4); clear smooth boundary.

Bk1—25 to 31 inches; light reddish brown (5YR 6/3) clay loam, reddish brown (5YR 5/3) moist; weak medium subangular blocky structure parting to moderate fine subangular blocky; very hard, very firm, sticky and plastic; few thin clay films on faces of peds; visible calcium carbonate in seams and masses; calcareous; 2 percent cobbles and 2 percent gravel; mildly alkaline (pH 7.6); clear smooth boundary.

Bk2—31 to 42 inches; brown (7.5YR 5/4) clay loam, brown (7.5YR 5/2) moist; massive; very hard, very firm, sticky and plastic; visible calcium carbonate in seams and masses; 2 percent cobbles and 2 percent gravel; calcareous; moderately alkaline (pH 7.8); gradual wavy boundary.

2C—42 to 60 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; massive; very hard, very firm, sticky and plastic; calcareous; mildly alkaline (pH 7.6).

Depth to calcareous material ranges from 18 to 36 inches. Depth to the base of the Bt horizon ranges from 22 to 46 inches. The control section is 2 to 15 percent rock fragments, mostly cobbles and gravel. Depth to the 2C horizon ranges from 30 to 60 inches or more.

The A horizon has hue of 7.5YR or 5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 4. Cobble and gravel content ranges from 15 to 50 percent. The profile is neutral or mildly alkaline.

The Bt horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. It is clay loam or clay. It is neutral or mildly alkaline.

The 2C horizon has hue of 10YR to 2.5YR. It is moderately alkaline or strongly alkaline.

Falfa Series

The Falfa series consists of fine, montmorillonitic, mesic Ustollic Haplargids. These deep, well drained soils formed in calcareous loess. They are on mesa tops. Slope is 1 to 8 percent. The average annual precipitation ranges from 15 to 18 inches. The average annual soil temperature ranges from 47 to 55 degrees F, and the average soil temperature in summer ranges from 64 to 69 degrees.

Typical pedon of Falfa clay loam, 1 to 3 percent slopes, about 2,000 feet south and 370 feet east of the northwest corner of sec. 29, T. 34 N., R. 9 W.

Ap—0 to 9 inches; reddish brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate medium granular structure; hard, firm, sticky and slightly plastic; neutral; (pH 7.0); clear smooth boundary.

BA—9 to 14 inches; reddish brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, firm, sticky and slightly plastic; common thin clay films on faces of peds; neutral (pH 7.0); clear smooth boundary.

Bt1—14 to 24 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; very hard, very firm, very sticky and plastic; thin continuous clay films on faces of peds and in pores; mildly alkaline (pH 7.4); clear smooth boundary.

Bt2—24 to 34 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; very hard, very firm, very sticky and plastic; thin continuous clay films on faces of peds and in pores; mildly alkaline (pH 7.6); clear smooth boundary.

Btk—34 to 57 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, very sticky and plastic; thin continuous clay films on faces of peds and in pores; visible secondary carbonate as concretions, as thin seams and streaks, and as coatings on peds; calcareous; moderately alkaline (pH 8.2); gradual smooth boundary.

Bk—57 to 60 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common thin clay films on faces of peds; calcareous in spots; moderately alkaline (pH 8.0).

Depth to calcareous material ranges from 20 to 40 inches. Thickness of the solum is more than 40 inches. Rock fragment content ranges from 0 to 10 percent throughout the profile, but it commonly is less than 1 percent.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is neutral or mildly alkaline.

The Bt horizon has hue of 5YR or 2.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6. It commonly is clay, clay loam, or silty clay and is 35 to 50 percent clay. It is neutral or mildly alkaline in the upper part and moderately alkaline in the lower part. The Bk horizon has hue of 5YR or 2.5YR, value of 5 to 7

when dry and 4 to 6 when moist, and chroma of 4 to 8. It typically is clay loam or loam and is 20 to 35 percent clay.

Florita Series

The Florita series consists of coarse-loamy, mixed, nonacid, mesic Ustic Torriorthents. These deep, well drained soils formed in alluvium derived from sandstone and shale. They are in upland valleys. Slope is 3 to 6 percent. The average annual precipitation ranges from 12 to 14 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of a Florita sandy loam in an area of Yenlo-Florita sandy loams, about 1,000 feet west and 200 feet north of the southeast corner of sec. 14, T. 32 N., R. 11 W.

A—0 to 3 inches; yellowish brown (10YR 5/4) sandy loam, brown (10YR 4/3) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; mildly alkaline: (pH 7.4); clear smooth boundary.

AC—3 to 8 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; mildly alkaline; (pH 7.4); gradual smooth boundary.

C—8 to 60 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; mildly alkaline; (pH 7.6).

The control section ranges from sandy loam to loamy sand, and the content of clay is 5 to 15 percent. Depth to calcium carbonate is more than 40 inches. Depth to bedrock is more than 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 6 when dry and 2 to 5 when moist, and chroma of 2 to 4.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 4.

Fortwingate Series

The Fortwingate series consists of fine, montmorillonitic Typic Eutroboralfs. These moderately deep, well drained soils formed in slope alluvium from sandstone and loess. They are on mountainsides. Slope is 3 to 25 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 44 to 47 degrees F, and the average soil temperature in summer ranges from 60 to 62 degrees.

Typical pedon of Fortwingate stony fine sandy loam, 3 to 12 percent slopes, in the southwest quarter of sec. 1, T. 35 N., R. 9 W.

Oi—1 inch to 0; undecomposed leaves, needles, and twigs.

A—0 to 1 inch; brown (7.5YR 5/2) stony fine sandy loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 10 percent stones; slightly acid (pH 6.3); clear smooth boundary.

E—1 inch to 7 inches; pinkish gray (7.5YR 7/2) stony fine sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 10 percent stones; slightly acid (pH 6.2); clear smooth boundary.

BE—7 to 12 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, nonsticky and nonplastic; thin patchy clay films on faces of peds; slightly acid (pH 6.2); clear smooth boundary.

Bt—12 to 25 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium angular and subangular blocky structure; very hard, firm, sticky and plastic; thin continuous clay films on faces of peds and in root channels; 5 percent stones; slightly acid (pH 6.3); gradual smooth boundary.

BC—25 to 32 inches; reddish yellow (7.5YR 6/6) stony sandy clay loam, strong brown (7.5YR 5/8) moist; weak medium subangular blocky structure; very hard, firm, sticky and plastic; thin patchy clay films on faces of peds; 30 percent stones and cobbles; slightly acid (pH 6.3); abrupt wavy boundary.

R—32 inches; sandstone.

Depth to the argillic horizon ranges from 6 to 17 inches. Depth to bedrock ranges from 20 to 40 inches. The content of sandstone fragments, mainly angular stones, cobbles, and gravel, ranges from 10 to 25 percent on the surface and from 0 to 15 percent in the Bt horizon.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The E horizon has hue of 5YR or 7.5YR, value of 5 to 7 when dry, and chroma of 2 to 4. It is slightly acid or neutral.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 or 5 when dry or moist, and chroma of 3 or 4. It ranges from sandy clay and clay loam to clay and is 35 to 45 percent clay, 15 to 40 percent silt, and 15 to 50 percent sand. It is slightly acid or neutral.

Goldvale Series

The Goldvale series consists of fine, montmorillonitic Typic Eutroboralfs. These deep, well drained soils formed in alluvium derived from interbedded sandstone and shale. They are on the side slopes of valleys and mountains. Slope is 15 to 65 percent. The average precipitation is 18 to 22 inches; the average annual soil temperature ranges from 42 to 46 degrees F, and the average soil temperature in summer ranges from 55 to 62 degrees.

Typical pedon of Goldvale very stony fine sandy loam, 15 to 65 percent slopes, in Durango Hills subdivision, on Sagebrush Trail, about 100 feet south of junction with Stagecoach Trail, in sec. 7, T. 35 N., R. 8 W.

Oi—1 inch to 0; undecomposed leaves, needles, and twigs.

A—0 to 3 inches; reddish gray (5YR 5/2) very stony fine sandy loam, dark reddish brown (5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 30 percent stones and 20 percent cobbles; neutral (pH 6.8); clear smooth boundary.

E—3 to 13 inches; pinkish gray (5YR 7/2) very stony fine sandy loam, reddish brown (5YR 5/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 25 percent stones and 20 percent cobbles; neutral (pH 6.6); clear smooth boundary.

B/E—13 to 21 inches; mixed light reddish brown (5YR 6/4) and pinkish gray (5YR 7/2) stony sandy clay loam, reddish brown (5YR 4/4, 5/4) moist; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; thin patchy clay films on faces of peds; 20 percent stones and 10 percent cobbles; neutral (pH 6.8); clear smooth boundary.

Bt—21 to 45 inches; reddish brown (5YR 5/4) stony clay, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; thin nearly continuous clay films; 10 percent stones and 5 percent cobbles; neutral (pH 6.8); gradual smooth boundary.

BC—45 to 60 inches; reddish brown (5YR 5/4) and yellowish brown (10YR 5/4) stony clay, dark reddish brown (5YR 4/4) and dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; very hard, very firm, sticky and plastic; thin patchy clay films; 15 percent stones and 10 percent cobbles; neutral (pH 6.8).

Rock fragment content of the particle-size control section ranges from 15 to 35 percent. The Oi and A horizons are absent in some pedons.

The E horizon has hue of 5YR or 2.5YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 2 to 6. It commonly is 30 to 50 percent cobbles and stones. It is slightly acid or neutral.

The Bt horizon has hue of 5YR or 2.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6. It is sandy clay or clay and is 35 to 50 percent clay. It is slightly acid or neutral.

The C horizon, where present, has hue of 5YR or 2.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6.

Harlan Series

The Harlan series consists of fine-loamy, mixed, mesic Aridic Argiustolls. These deep, well drained soils formed in glacial outwash and cobbly alluvium. They are on high terraces and in drainageways. Slope is 1 to 15 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature is 47 to 52 degrees F, and the average summer soil temperature is 63 to 68 degrees.

Typical pedon of Harlan cobbly loam, moist, 1 to 3 percent slopes, about 2,600 feet east of the northwest corner of sec. 20, T. 35 N., R. 9 W.

A—0 to 8 inches; reddish brown (5YR 5/3) cobbly loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 15 percent cobbles; mildly alkaline (pH 7.4); clear smooth boundary.

BA—8 to 12 inches; reddish brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; neutral (pH 7.2); clear smooth boundary.

Bt1—12 to 20 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 4/3) moist; moderate medium prismatic structure parting to strong fine subangular blocky; very hard, friable, sticky and plastic; neutral (pH 7.2); clear wavy boundary.

Bt2—20 to 34 inches; reddish brown (5YR 5/4) cobbly clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure parting to strong fine subangular blocky; very hard, friable, sticky and plastic, 20 percent cobbles, 10 percent gravel, and 1 percent stones; neutral (pH 7.2); clear wavy boundary.

Bk—34 to 44 inches; light reddish brown (5YR 6/4) cobbly sandy clay loam, reddish brown (5YR 4/4) moist; strong fine angular blocky structure; hard, friable, slightly sticky and slightly plastic; 20 percent cobbles, 5 percent gravel, and 5 percent stones; calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.

Ck—44 to 60 inches; light reddish brown (5YR 6/4) extremely cobbly sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable,

nonsticky and nonplastic; 40 percent cobbles, 10 percent stones, and 15 percent gravel; calcareous; moderately alkaline (pH 8.2).

Depth to carbonates ranges from 20 to 34 inches. Thickness of the solum is 15 to 44 inches. Thickness of the mollic epipedon ranges from 8 to 20 inches.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is neutral or mildly alkaline.

The Bt horizon has hue of 5YR or 2.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 5. It typically is clay loam, sandy clay loam, or loam. It is 18 to 35 percent clay and 10 to 35 percent cobbles and gravel. The horizon is neutral or mildly alkaline.

The Ck horizon has hue of 5YR or 2.5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 5. It typically is sandy loam or loam. It is 55 to 75 percent cobbles and gravel.

Hayness Series

The Hayness series consists of fine-loamy, mixed, mesic Entic Haplustolls. These deep, well drained soils formed in alluvium derived from red sandstone. They are on alluvial fans and valley side slopes. Slope is 1 to 12 percent. The average annual precipitation ranges from 18 to 20 inches. The average annual soil temperature ranges from 47 to 51 degrees F, and the average soil temperature in summer ranges from 63 to 67 degrees.

Typical pedon of Hayness loam, 1 to 3 percent slopes, about 900 feet west and 1,800 feet north of the southeast corner of sec. 28, T. 36 N., R. 9 W.

Ap—0 to 9 inches; weak red (2.5YR 5/2) loam, dusky red (2.5YR 3/2) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

AC—9 to 18 inches; weak red (2.5YR 5/2) loam, dusky red (2.5YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; soft, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

C1—18 to 29 inches; reddish brown (2.5YR 5/4) loam, dark reddish brown (2.5YR 3/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

C2—29 to 60 inches; reddish brown (2.5YR 5/4) silt loam, reddish brown (2.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.4).

Thickness of the mollic epipedon ranges from 7 to 20 inches. In some pedons the profile is noncalcareous to a depth of as much as 12 inches. The content of sandstone rock fragments, mainly gravel and cobbles, ranges from 0 to 15 percent throughout the profile.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 10R to 5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 4 to 6. Texture of the control section typically is silt loam or loam, but it is clay loam in some areas. The average content of clay ranges from 18 to 35 percent, the content of silt from 30 to 60 percent, and the content of sand from 20 to 40 percent. It is moderately alkaline or strongly alkaline.

Herm Series

The Herm series consists of fine, montmorillonitic Typic Argiborolls. These deep, well drained soils formed in a thin loess deposit superimposed over alluvium derived from shale. They are on mountainsides and valley floors. Slope is 6 to 25 percent. The average annual precipitation ranges from 16 to 25 inches. The average annual soil temperature ranges from 41 to 46 degrees F, and the average soil temperature in summer ranges from 50 to 55 degrees.

Typical pedon of Herm loam, 6 to 25 percent slopes, along Wallace Gulch Road and about 50 feet south of the road, about 2,100 feet south and 2,300 feet west of the northeast corner of sec. 12, T. 35 N., R. 7 W.

Oi—2 inches to 1 inch; pine needles, leaves, and bark.

Oe—1 inch to 0; partially decayed organic material.

A1—0 to 4 inches; dark reddish gray (5YR 4/2) loam, dark reddish brown (5YR 2/2) moist; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; neutral (pH 6.6); clear smooth boundary.

A2—4 to 7 inches; reddish gray (5YR 5/2) loam, dark reddish brown (5YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and nonplastic; neutral (pH 6.8); clear smooth boundary.

Bt1—7 to 14 inches; reddish gray (5YR 5/2) clay loam, dark reddish gray (5YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine angular blocky; hard, friable, sticky and plastic; thin patchy clay films on faces of peds; neutral (pH 7.0); clear smooth boundary.

Bt2—14 to 34 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to strong fine angular blocky; very hard, very firm, very sticky and

very plastic; thin continuous clay films on peds; neutral (pH 7.2); gradual smooth boundary.

BC—34 to 60 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; thin patchy clay films on peds; neutral; (pH 7.2).

Thickness of the mollic epipedon ranges from 10 to 16 inches. Thickness of the solum ranges from 40 to 60 inches or more. Rock fragment content ranges from 0 to 15 percent.

The A horizon has hue of 10YR to 5YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. This horizon is slightly acid or neutral.

The Bt1 horizon has hue of 10YR to 5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is clay loam or silty clay loam. The Bt2 horizon has hue of 7.5YR to 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 to 5. It is clay loam or clay and is 35 to 50 percent clay. It is neutral or mildly alkaline. The BC horizon commonly has hue of 10YR or 2.5Y, but in some pedons it has hue of 7.5YR. It is neutral or mildly alkaline.

Herm Variant

The Herm Variant consists of fine, montmorillonitic Typic Argiborolls. These deep, well drained soils are on alluvial fans and valley side slopes. They formed in alluvium derived from sandstone and shale. Slope is 2 to 8 percent. The average annual precipitation is 18 to 20 inches. The average annual soil temperature is 40 to 44 degrees F, and the average soil temperature in summer is 57 to 60 degrees.

Typical pedon of Herm Variant clay loam, 2 to 8 percent slopes, about 2,100 feet north and 1,700 feet west of the southeast corner of sec. 33, T. 36 N., R. 12 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and plastic; calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

Bt1—6 to 12 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and very plastic; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

Bt2—12 to 18 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; very hard, very firm, slightly sticky and very plastic; calcareous; moderately alkaline (pH 8.4); gradual smooth boundary.

Bt3—18 to 37 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and very plastic; calcareous; strongly alkaline (pH 8.6); gradual smooth boundary.

Bk—37 to 60 inches; light gray (10YR 7/2) clay loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and plastic; calcareous; strongly alkaline (pH 8.6).

Depth to bedrock is more than 60 inches. The mollic epipedon is 10 to 16 inches thick. Depth to visible secondary lime accumulation is 12 to 30 inches.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 when dry and 2 to 4 when moist, and chroma of 2 or 3.

The Bt horizon has hue of 2.5Y or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 or 3. It is clay loam or clay. It is 35 to 45 percent clay and more than 15 percent sand that is fine or coarser. It is moderately alkaline or strongly alkaline. The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 or 3. It is moderately alkaline or strongly alkaline.

Hesperus Series

The Hesperus series consists of fine-loamy, mixed Pachic Argiborolls. These deep, well drained soils formed in alluvium. They are on alluvial fans and valley bottoms. Slope is 3 to 12 percent. The average annual precipitation ranges from 18 to 24 inches. The average annual soil temperature ranges from 43 to 46 degrees F, and the average soil temperature in summer ranges from 57 to 62 degrees.

Typical pedon of Hesperus loam, 3 to 12 percent slopes, about 800 feet south and 1,000 feet west of the northeast corner of sec. 22, T. 35 N., R. 12 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.8); clear smooth boundary.

A2—5 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.8); gradual smooth boundary.

Bt1—14 to 27 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; neutral (pH 7.0); gradual smooth boundary.

Bt2—27 to 45 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; strong medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; neutral (pH 7.0); gradual smooth boundary.
BC—45 to 55 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, nonsticky and nonplastic; neutral (pH 7.2); gradual smooth boundary.
C—55 to 60 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; neutral (pH 7.2).

Depth to calcareous material is 40 inches or more. Thickness of the mollic epipedon is 17 to 50 inches. Rock fragment content ranges from 0 to 10 percent throughout the solum. The profile is slightly acid to mildly alkaline.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 to 3.

The Bt horizon has hue of 2.5Y or 10YR, value of 4 to 7 when dry and 2 to 6 when moist, and chroma of 1 to 4. Texture typically is loam or clay loam but clay ranges from 18 to 35 percent.

The C horizon has hue of 2.5Y or 10YR. It is loam, clay loam, or sandy clay loam. Clay content is 18 to 35 percent.

Horsethief Series

The Horsethief series consists of loamy-skeletal, mixed Typic Paleboralfs. These deep, well drained soils formed in stony colluvium and slope alluvium derived dominantly from sandstone and shale. They are on cuestas, hogbacks, and mountainsides. Slope is 20 to 65 percent. The average annual precipitation ranges from 18 to 30 inches. The average annual soil temperature ranges from 36 to 42 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of Horsethief stony fine sandy loam, 20 to 65 percent slopes, above Vallecito Reservoir, about 2,000 feet south and 1,800 feet west of the northeast corner of sec. 29, T. 36 N., R. 6 W.

Oi—2 inches to 0; litter of needles and partially decomposed organic material.
A—0 to 2 inches; grayish brown (10YR 5/2) very stony fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 15 percent cobbles, and 20 percent stones; neutral (pH 7.0); clear smooth boundary.
E—2 to 14 inches; very pale brown (10YR 7/3) stony fine sandy loam, brown (10YR 5/3) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 10 percent cobbles, and 15 percent stones; neutral (pH 6.8); gradual smooth boundary.
E/B—14 to 24 inches; 85 percent (E) light gray (10YR 7/2) very stony fine sandy loam, grayish brown (10YR 5/2) moist, and 15 percent (B) pale brown (10YR 6/3) very stony loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 5 percent gravel, 15 percent cobbles, and 25 percent stones; slightly acid (pH 6.5); gradual smooth boundary.
B/E—24 to 32 inches; 75 percent (B) pale brown (10YR 6/3) extremely stony clay loam, brown (10YR 5/3) moist, and 25 percent (E) light gray (10YR 7/2) extremely stony fine sandy loam, grayish brown (10YR 5/2) moist; weak fine subangular blocky structure; hard, firm, sticky and plastic; 5 percent gravel, 20 percent cobbles, and 60 percent stones; medium acid (pH 6.0); clear smooth boundary.
Bt—32 to 42 inches; brownish yellow (10YR 6/6) matrix color and pale brown (10YR 6/3) on pedexterous extremely stony clay loam, yellowish brown (10YR 5/6) matrix and brown (10YR 5/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and plastic; 5 percent gravel, 20 percent cobbles, and 60 percent stones; strongly acid (pH 5.4); clear smooth boundary.
C—42 to 50 inches; light brownish gray (10YR 6/2) very stony clay loam, brown (10YR 5/3) moist; massive; hard, firm, sticky and plastic; 5 percent gravel, 15 percent cobbles, and 30 percent stones; medium acid (pH 6.0); clear smooth boundary.
Cr—50 inches; weathered sandstone.

Depth to interbedded sandstone or shale ranges from 40 to 60 inches or more. Thickness of the solum ranges from 30 to 60 inches.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 or 2. It is slightly acid or neutral.

The E horizon has hue of 2.5Y to 7.5YR, value of 6 to 8 when dry and 5 or 6 when moist, and chroma of 2 or 3. It is slightly acid or neutral. The E/B and B/E horizons have hue of 2.5Y to 7.5YR, value of 5 to 8 when dry and 4 to 6 when moist, and chroma of 2 to 6. Rock fragment content ranges from 30 to 85 percent. These horizons are medium acid to neutral.

The Bt horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 3 to 6. Gravel content ranges from 5 to 25 percent, cobble content from 10 to 20 percent, and stone content from 20 to 40 percent. This horizon is strongly acid or medium acid.

Lazear Series

The Lazear series consists of loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents. These shallow, well drained soils formed in residuum and slope alluvium derived from sandstone. They are on mesas and breaks. Slope is 6 to 65 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of Lazear stony loam, 6 to 25 percent slopes, about 1,520 feet east and 1,220 feet north of the southwest corner of sec. 31, T. 34 N., R. 12 W., south of the Ute Baseline.

A—0 to 5 inches; brown (7.5YR 5/4) stony loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 15 percent stones and cobbles and 10 percent gravel; strongly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

AC—5 to 8 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 5/3) moist; weak fine subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; 5 percent gravel; strongly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C—8 to 15 inches; very pale brown (10YR 8/4) loam, light yellowish brown (10YR 6/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent gravel; strongly calcareous; moderately alkaline (pH 8.4); abrupt smooth boundary.

R—15 inches; fractured, calcareous sandstone.

Depth to lithic contact ranges from 10 to 20 inches. The control section is 18 to 35 percent clay, 15 to 50 percent silt, and 20 to 60 percent sand. Content of rock fragments throughout the solum ranges from 10 to 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4. It is mildly alkaline to strongly alkaline.

The C horizon has hue of 2.5Y to 7.5YR, value of 6 to 8 when dry and 5 to 7 when moist, and chroma of 2 to 4. It is loam or clay loam. It is is moderately alkaline or strongly alkaline.

Leadville Series

The Leadville series consists of loamy-skeletal, mixed Typic Cryoboralfs. These deep, well drained soils formed in glacial till and in alluvium and colluvium derived from sandstone. They are on mountainsides and toe slopes. Slope is 15 to 55 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 36 to 40 degrees F, and the average soil temperature in summer ranges from 45 to 47 degrees.

Typical pedon of Leadville very stony sandy loam, 15 to 55 percent slopes, about 1,700 feet north and 1,260 feet east of the southwest corner of sec. 32, T. 37 N., R. 7 W.

Oi—2 inches to 0; undecomposed leaves, needles, and twigs.

A—0 to 2 inches; brown (7.5YR 5/2) very stony sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 10 percent gravel, 15 percent cobbles, and 25 percent stones; neutral (pH 7.0); clear smooth boundary.

E—2 to 19 inches; pinkish gray (7.5YR 6/2) very stony sandy loam, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 10 percent cobbles, and 25 percent stones; neutral (pH 7.0); clear smooth boundary.

E/B—19 to 23 inches; mixed pinkish gray (7.5YR 6/2) and reddish brown (5YR 5/3) very stony sandy clay loam, brown (7.5YR 4/4) and reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; thin continuous clay films on faces of peds; 5 percent gravel, 10 percent cobbles, and 25 percent stones; neutral (pH 7.0); clear smooth boundary.

Bt—23 to 53 inches; reddish brown (5YR 5/3) very stony sandy clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; thin nearly continuous clay films on faces of peds; 10 percent gravel, 10 percent cobbles, and 20 percent stones; neutral (pH 6.6); clear smooth boundary.

C—53 to 60 inches; reddish brown (5YR 5/3) very stony sandy loam, reddish brown (5YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 10 percent cobbles, and 20 percent stones; neutral; (pH 6.6).

Depth to the top of the argillic horizon is less than 24 inches. Rock fragment content ranges from 35 to 65 percent in the major part of the profile.

The A horizon has hue of 10YR to 5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 to 3. It is medium acid to neutral.

The E horizon has hue of 10YR to 5YR, value of 5 to 8 when dry and 4 to 7 when moist, and chroma of 1 to 4. It is medium acid to neutral.

The Bt horizon has hue of 10R to 5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 6. It typically is very stony loam, very stony clay loam, or

very stony sandy clay loam and is 18 to 35 percent clay. It is medium acid to neutral.

The C horizon has hue of 5YR to 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It typically is very stony loam, very stony clay loam, or very stony sandy loam.

Mikim Series

The Mikim series consists of fine-loamy, mixed (calcareous), mesic Ustic Torriorthents. These deep, well drained soils formed in alluvium. They are on alluvial fans and in foothill valleys. Slope is 3 to 12 percent. The average annual precipitation ranges from 13 to 16 inches. The average annual soil temperature ranges from 48 to 53 degrees F, and the average soil temperature in summer ranges from 61 to 66 degrees.

Typical pedon of Mikim loam, 3 to 12 percent slopes, about 1,650 feet north and 650 feet east of the southwest corner of sec. 24, T. 34 N., R. 10 W., south of the Ute Baseline.

A1—0 to 3 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 7.2); clear smooth boundary.

A2—3 to 9 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak coarse granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 7.2); clear smooth boundary.

C1—9 to 30 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; calcareous; mildly alkaline (pH 7.8); gradual smooth boundary.

C2—30 to 60 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline (pH 8.0).

The control section is loam or clay loam. In many areas the profile is weakly stratified with layers of sandy loam. The control section is 18 to 35 percent clay, 20 to 50 percent silt, and 20 to 50 percent sand. Content of rock fragments, mostly gravel, ranges from 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 2 to 4. Reaction ranges from neutral to mildly alkaline.

The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 2 to 4. It is mildly alkaline or moderately alkaline. Some soft masses and streaks of visible calcium carbonate are present in some pedons.

Nehar Series

The Nehar series consists of clayey-skeletal, mixed, mesic Ustollic Haplargids. These deep, well drained soils formed in cobbly and stony glacial outwash. They are on terraces along major drainageways. Slope is 1 to 6 percent. The average annual precipitation ranges from 13 to 16 inches. The average annual soil temperature ranges from 48 to 53 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Nehar stony sandy loam, in the SE1/4NE1/4 of sec. 24, T. 34 N., R. 10 W.

A1—0 to 4 inches; light brown (7.5YR 6/4) stony sandy loam, dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 5 percent cobbles, and 10 percent stones; neutral (pH 7.0); abrupt smooth boundary.

A2—4 to 9 inches; reddish brown (5YR 5/4) stony loam, reddish brown (5YR 4/4) moist; moderate thin platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; 5 percent gravel, 5 percent cobbles, and 10 percent stones; neutral (pH 7.0); clear smooth boundary.

BA—9 to 13 inches; reddish brown (5YR 5/3) stony clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; 10 percent gravel, 5 percent cobbles, and 10 percent stones; neutral (pH 7.1); clear smooth boundary.

Bt1—13 to 21 inches; reddish brown (5YR 5/4) very cobbly clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; 10 percent gravel, 30 percent cobbles, and 10 percent stones; neutral (pH 7.2); gradual wavy boundary.

Bt2—21 to 31 inches; reddish brown (5YR 5/4) extremely stony clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; 10 percent gravel, 30 percent cobbles, and 25 percent stones; neutral (pH 7.2); clear smooth boundary.

BC—31 to 42 inches; yellowish red (5YR 5/6) very stony clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; 10 percent gravel, 30 percent cobbles, and 20 percent stones; mildly alkaline (pH 7.4); gradual wavy boundary.

C—42 to 60 inches; light reddish brown (5YR 6/4) extremely stony sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; 20 percent gravel, 30 percent cobbles, and 20 percent stones; mildly alkaline (pH 7.6).

Thickness of the solum ranges from 40 to 50 inches. Rock fragment content ranges from 35 to 60 percent in

the B horizon and from 50 to 80 percent in the C horizon.

The A horizon has hue of 5YR to 10YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is neutral or mildly alkaline.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 to 6. It is extremely stony clay loam or very cobbly clay loam. Clay content ranges from 35 to 40 percent, silt content from 20 to 40 percent, and sand content from 25 to 45 percent. It is mildly alkaline to slightly acid.

The C horizon is very cobbly, extremely stony, or very gravelly sandy loam or loamy sand. It is mildly alkaline to slightly acid.

Nordicol Series

The Nordicol series consists of loamy-skeletal, mixed Cryic Paleborolls. These deep, well drained soils formed in colluvium and alluvium derived from sandstone. They are on mountainsides. Slope is 6 to 25 percent. The average annual precipitation ranges from 20 to 25 inches. The average annual soil temperature ranges from 39 to 43 degrees F, and the average soil temperature in summer ranges from 43 to 47 degrees.

Typical pedon of Nordicol very stony sandy loam, 6 to 25 percent slopes, at the *S* curve on the main road to the microwave tower, about 2,300 feet south of the northeast corner of sec. 1, T. 35 N., R. 9 W.

Oi—1 inch to 0; undecomposed needles, leaves, and twigs.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 10 percent cobbles, and 15 percent stones; neutral (pH 6.8); clear smooth boundary.

A2—8 to 12 inches; brown (10YR 4/3) very stony sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 10 percent cobbles, and 25 percent stones; neutral (pH 6.7); clear smooth boundary.

E—12 to 24 inches; light brownish gray (7.5YR 6/4) very stony sandy loam, brown (7.5YR 5/4) moist; weak coarse subangular blocky structure parting to moderate fine granular; soft, very friable, nonsticky and nonplastic; 10 percent gravel, 10 percent cobbles, and 20 percent stones; neutral (pH 6.6); gradual smooth boundary.

E/B—24 to 36 inches; mixed light brown (7.5YR 6/4) and brown (7.5YR 5/4) very stony sandy clay loam, brown (7.5YR 5/4) in matrix and dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; 15 percent gravel, 10 percent cobbles, and 15 percent stones; neutral (pH 6.6); gradual smooth boundary.

Bt—36 to 60 inches; brown (7.5YR 5/4) very stony sandy clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 15 percent gravel, 10 percent cobbles, and 15 percent stones; thin patchy clay films on faces of peds; neutral (pH 6.8).

The content of rock fragments ranges from 35 to 65 percent. The depth to the upper boundary of the argillic horizon ranges from 26 to 45 inches. Thickness of the mollic epipedon ranges from 10 to 19 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is slightly acid or neutral.

The E horizon has hue of 10YR or 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is slightly acid or neutral.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 4 to 6. This horizon is very stony or stony clay loam or very stony or stony sandy clay loam. It is medium acid to neutral.

Nutrioso Series

The Nutrioso series consists of fine-loamy, mixed Cumulic Haploborolls. These deep, well drained soils formed in alluvium. They are on valley bottoms and alluvial fans. Slope is 1 to 3 percent. The average annual precipitation ranges from 18 to 24 inches. The average annual soil temperature is 45 or 46 degrees F, and the average soil temperature in summer ranges from 60 to 62 degrees.

Typical pedon of Nutrioso loam, about 600 feet east and 400 feet north of the southwest corner of sec. 20, T. 35 N., R. 10 W.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.8); gradual smooth boundary.

A2—10 to 25 inches; dark grayish brown (10YR 4/2) stratified loam and fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, very friable, nonsticky and nonplastic; neutral (pH 7.0); gradual smooth boundary.

A3—25 to 45 inches; dark grayish brown (10YR 4/2) stratified loam and fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; neutral (pH 6.8); gradual smooth boundary.

C—45 to 60 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; neutral (pH 7.0).

Thickness of the mollic epipedon ranges from 40 inches to more than 60 inches. Thickness of individual strata below a depth of 15 inches in some pedons varies from a few inches to a foot or more in thickness. Depth to uniformly calcareous material is 10 to 40 inches or more. The control section typically is stratified. Average clay content in the control section is 18 to 35 percent. The profile is neutral or mildly alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is loam, fine sandy loam, or clay loam. It is neutral or mildly alkaline.

Panitchen Series

The Panitchen series consists of fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents. These deep, well drained soils formed in alluvium derived from shale and sandstone. They are along drainageways and on valley bottoms. Slope is 1 to 6 percent. The average annual precipitation is 13 to 15 inches. The average annual soil temperature ranges from 49 to 54 degrees F, and the average soil temperature in summer ranges from 62 to 66 degrees.

Typical pedon of a Panitchen silty clay loam in an area of Panitchen-Dominguez Variant silty clay loams, about 2,600 feet east and 1,600 feet south of the northwest corner of sec. 1, T. 32 N., R. 12 W.

A—0 to 6 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5YR 4/2) moist; weak very thin platy structure; soft, very friable, nonsticky and slightly plastic; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

AC—6 to 15 inches; grayish brown (2.5YR 5/2) silty clay loam stratified with thin layers of sandy loam, dark grayish brown (2.5Y 4/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

Cy1—15 to 34 inches; grayish brown (2.5Y 5/2) silty clay loam stratified with thin layers of sandy loam, loamy sand, and gravelly sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; calcareous; visible small and medium gypsum crystal seams; moderately alkaline (pH 8.2); clear wavy boundary.

Cy2—34 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam stratified with thin layers of sandy loam, loamy sand, and gravelly sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, nonsticky and slightly plastic; calcareous; visible gypsum occurring as small crystals on faces of peds; moderately alkaline (pH 8.4).

The profile is slightly saline or moderately saline. It is moderately alkaline or strongly alkaline. Content of rock fragments, mainly very fine and fine gravel, ranges from 0 to 15 percent. The 10- to 40-inch control section is 18 to 35 percent clay and is more than 15 percent sand that is fine or coarser.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 or 3.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 or 3. It typically is silty clay loam or clay loam that is stratified with thin layers of sandy loam, loamy sand, and gravelly sandy loam.

Pastorius Series

The Pastorius series consists of loamy-skeletal, mixed Pachic Argiborolls. These deep, well drained soils formed in cobbly alluvium. They are on river terraces. Slope is 1 to 3 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 42 to 46 degrees F, and the average soil temperature in summer ranges from 60 to 64 degrees.

Typical pedon of Pastorius cobbly loam, along La Plata Canyon Road, about 50 feet west of the road near the northwest corner of sec. 3, T. 35 N., R. 11 W.

A1—0 to 7 inches; brown (7.5YR 4/2) cobbly loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; 15 percent cobbles; slightly acid (pH 6.3); gradual smooth boundary.

A2—7 to 20 inches; brown (7.5YR 4/2) cobbly loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; 5 percent gravel and 20 percent cobbles; slightly acid (pH 6.4); clear smooth boundary.

BA—20 to 24 inches; reddish brown (5YR 5/4) very cobbly clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; thin patchy clay films on faces of peds; 25 percent gravel and 25 percent cobbles; neutral (pH 6.8); clear smooth boundary.

Bt—24 to 39 inches; reddish brown (5YR 4/4) extremely cobbly clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure;

hard, firm, sticky and plastic; thin nearly continuous clay films on peds and as patches on rock fragments; 20 percent gravel and 50 percent cobbles; neutral (pH 6.8); gradual smooth boundary.

BC—39 to 56 inches; reddish brown (5YR 5/4) extremely cobbly sandy clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; thin patchy clay films on peds and on rock fragments; 15 percent gravel and 65 percent cobbles; neutral (pH 7.0); gradual smooth boundary.

C—56 to 60 inches; extremely cobbly sand; 50 percent cobbles and 15 percent gravel.

Thickness of the mollic epipedon ranges from 17 to 24 inches. A few stones as much as 2.5 feet in diameter are present throughout the profile.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 to 3. It is 10 to 35 percent cobbles.

The Bt horizon has hue of 5YR or 2.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 to 6. It typically is extremely cobbly clay loam or extremely cobbly sandy clay loam. Cobble content ranges from 35 to 60 percent, and gravel content from 15 to 35 percent. The horizon is neutral or mildly alkaline.

Pescar Series

The Pescar series consists of coarse-loamy over sandy or sandy-skeletal, mixed (calcareous), frigid Aquic Ustifluvents. These deep, somewhat poorly drained soils formed in calcareous alluvium. They are on flood plains and terraces. Slope is 0 to 2 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 45 to 47 degrees F, and the average soil temperature in summer ranges from 60 to 63 degrees.

Typical pedon of Pescar fine sandy loam, about 1,800 feet west and 1,400 feet south of the northeast corner of sec. 1, T. 35 N., R. 8 W.

A—0 to 8 inches; light brownish gray (10YR 6/2) fine sandy loam, dark brown (10YR 4/3) moist; common medium distinct yellowish brown (10YR 5/4) mottles; weak fine granular structure; soft, very friable, nonsticky and nonplastic; calcareous; mildly alkaline (pH 7.8); clear smooth boundary.

C—8 to 20 inches; light brownish gray (10YR 6/2) fine sandy loam stratified with loam and loamy fine sand, dark brown (10YR 4/3) moist; common medium distinct yellowish brown (10YR 5/4) mottles and few fine faint dark gray (10YR 4/1) mottles; massive; soft, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

2C—20 to 60 inches; light brownish gray (10YR 6/2) very gravelly sand, dark brown (10YR 4/3) moist; few fine faint dark gray (10YR 4/1) mottles; massive; soft, very friable, nonsticky and nonplastic; 45 percent gravel; calcareous; mildly alkaline (pH 7.8).

Depth to uniformly calcareous material ranges from 0 to 10 inches. Depth to the 2C horizon ranges from 18 inches to about 30 inches. Rock fragment content ranges from 0 to 10 percent in the major part of the upper part of the control section and from 35 to 70 percent in the lower part. The profile is neutral to moderately alkaline.

The A horizon has hue of 5Y to 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 1 to 4.

The C horizon has hue of 5Y to 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 or 3.

Picante Series

The Picante series consists of loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents. These shallow, well drained soils are on cuestas and hills. The soils formed in residuum derived from siltstone and shale. Slope is 10 to 45 percent. The average annual precipitation is about 12 to 14 inches. The average annual soil temperature ranges from 48 to 53 degrees F, and the average soil temperature in summer ranges from 63 to 69 degrees.

Typical pedon of a Picante clay loam in an area of Picante-Rock outcrop complex, 10 to 45 percent slopes, about 2,600 feet north and 900 feet east of the southwest corner of sec. 18, T. 32 N., R. 11 W.

A—0 to 3 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; 10 percent gravel; calcareous; moderately alkaline (pH 7.9); clear smooth boundary.

C—3 to 14 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; calcareous; moderately alkaline (pH 8.0); clear wavy boundary.

Cr—14 inches; grayish yellow, calcareous, soft siltstone and shale.

Depth to soft bedrock is 10 to 20 inches. The profile typically is calcareous throughout, but some pedons are leached in the upper few inches. The particle-size control section is clay loam, silty clay loam, or loam and is 18 to 35 percent clay and more than 15 percent sand that is fine or coarser. It is mildly alkaline or moderately alkaline.

The A horizon has hue of 5Y to 10YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 6.

It is 0 to 20 percent rock fragments, mainly gravel and cobbles.

The C horizon has hue of 5Y to 10YR, value of 5 to 7 when dry and 3 to 6 when moist, and chroma of 1 to 6.

Pinata Series

The Pinata series consists of clayey-skeletal, mixed Typic Eutroboralfs. These deep, well drained soils formed in glacial till and glacial outwash mixed with eolian material. They are on mountainsides and mesa tops. Slope is 1 to 40 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 43 to 47 degrees F, and the average soil temperature in summer ranges from 59 to 64 degrees.

Typical pedon of Pinata loam, 1 to 12 percent slopes, along U.S. Highway 160, 0.5 mile east of Hesperus, about 400 feet east and 800 feet north of the southwest corner of sec. 13, T. 35 N., R. 11 W.

A—0 to 7 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 4/2) moist; weak fine and medium medium granular structure; soft, very friable, nonsticky and nonplastic; 5 percent cobbles and 5 percent gravel; mildly alkaline (pH 7.4); clear smooth boundary.

BA—7 to 11 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; thin patchy clay films on faces of peds; 5 percent gravel; mildly alkaline (pH 7.4); clear smooth boundary.

Bt1—11 to 21 inches; reddish brown (5YR 5/4) gravelly clay, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; 20 percent gravel and 10 percent cobbles; thin continuous clay films on faces of peds; neutral (pH 7.0); gradual smooth boundary.

Bt2—21 to 31 inches; reddish brown (5YR 5/4) very cobbly clay, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; thin continuous clay films on faces of peds; 15 percent gravel and 40 percent cobbles; neutral (pH 6.8); gradual smooth boundary.

BC—31 to 38 inches; reddish brown (5YR 5/4) extremely cobbly clay, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; thin patchy clay films in root channels and on faces of peds; 15 percent gravel and 45 percent cobbles; neutral (pH 6.8); gradual smooth boundary.

C—38 to 60 inches; mixed strong brown (7.5YR 5/6) and pinkish gray (7.5YR 6/2) extremely cobbly sandy clay loam, brown (7.5YR 5/4) and dark brown (7.5YR 4/4) moist; massive; hard, friable, slightly sticky and nonplastic; 20 percent gravel and 50 percent cobbles; mildly alkaline (pH 7.6).

Thickness of the solum ranges from 30 to 50 inches. Rock fragment content ranges from 30 to 80 percent throughout the particle-size control section. Some pedons have an E horizon below the A horizon.

The A horizon, where present, has hue of 7.5YR or 10YR, value of 4 or 5 when dry or moist, and chroma of 2 to 4. It is neutral or mildly alkaline.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4. It is clay loam, clay, or sandy clay and is 40 to 80 percent rock fragments. This horizon is slightly acid to mildly alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 6. It is sandy clay loam, sandy clay, or clay loam and is 40 to 80 percent rock fragments. It is neutral or mildly alkaline.

Plome Series

The Plome series consists of fine-loamy, mixed Typic Eutroboralfs. These deep, well drained soils formed in eolian material. They are on mountainsides and mesa tops. Slope is 3 to 12 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 43 to 47 degrees F, and the average soil temperature in summer ranges from 59 to 64 degrees.

Typical pedon of Plome fine sandy loam, 1 to 12 percent slopes, about 1,500 feet west and 1,700 feet north of the southeast corner of sec. 20, T. 35 N., R. 10 W.

Oi—2 inches to 0; organic mat of partially decomposed pine needles and leaves.

E—0 to 6 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/2) moist; weak thick platy structure; soft, very friable, plastic and nonsticky; neutral (pH 6.8); clear smooth boundary.

B/E—6 to 9 inches; light brown (7.5YR 6/4) and yellowish red (5YR 5/6) clay loam, brown (7.5YR 4/2) and yellowish red (5YR 4/6) moist; weak medium subangular blocky structure parting to moderate coarse granular; slightly hard, friable, slightly plastic and slightly sticky; thin common clay films of faces of peds; neutral (pH 6.8); clear smooth boundary.

Bt1—9 to 20 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to strong medium angular blocky; very hard, firm, plastic and sticky; many thin clay films on faces of peds; neutral (pH 7.0); gradual smooth boundary.

Bt2—20 to 29 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; strong medium angular blocky structure; hard, firm, sticky and plastic; many thin clay films on faces of peds; neutral (pH 7.2); clear smooth boundary.
BC—29 to 60 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few thin clay films lining tubular and interstitial pores; mildly alkaline (pH 7.9).

The solum ranges from 24 to 60 inches in thickness. Some pedons have an A horizon. In some pedons the lower part of the profile is as much as 15 percent cobbles and gravel. It is neutral or slightly acid.

The A horizon, where present, has hue of 5YR to 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3.

The E horizon has hue of 10YR to 5YR, value of 6 or 7 when dry and 4 to 6 when moist, and chroma of 2 to 4.

The Bt horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 3 to 6. It typically is clay loam, but content of clay in some pedons ranges from 18 to 35 percent, content of sand from 15 to 45 percent, and content of silt from 25 to 45 percent.

Pulpit Series

The Pulpit series consists of fine-silty, mixed, mesic Ustollic Haplargids. These moderately deep, well drained soils formed in loess deposits overlying sandstone. They are on mesas. Slope is 3 to 12 percent. The average annual precipitation ranges from 14 to 17 inches. The average annual soil temperature ranges from 50 to 53 degrees F, and the average soil temperature in summer ranges from 64 to 69 degrees.

Typical pedon of Pulpit loam, 3 to 12 percent slopes, about 2,640 feet east and 1,050 feet south of the northwest corner of sec. 5, T. 33 N., R. 12 W.

Ap1—0 to 1 inch; reddish gray (5YR 5/2) loam, dark reddish gray (5YR 4/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.6); abrupt smooth boundary.
Ap2—1 inch to 5 inches; reddish gray (5YR 5/2) loam, dark reddish gray (5YR 4/2) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.4); clear smooth boundary.
Bt1—5 to 10 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure parting to moderate medium granular; hard, friable, sticky and plastic; thin nearly continuous clay films on faces of peds; mildly alkaline (pH 7.6); clear smooth boundary.
Bt2—10 to 21 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, sticky and plastic; thin patchy clay films on faces of peds; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.
Bk1—21 to 29 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many lime spots; moderately alkaline (pH 8.2); clear smooth boundary.
Bk2—29 to 35 inches; very pale brown (7.5YR 6/4) loam, very pale brown (7.5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; moderately alkaline (pH 8.2); abrupt smooth boundary.
R—35 inches; hard sandstone.

Depth to uniformly calcareous material ranges from 6 to 20 inches, and depth to continuous horizons of visible secondary calcium carbonate ranges from 10 to 36 inches. Content of sandstone rock fragments ranges from 0 to 10 percent. Depth to the lithic contact ranges from 20 to 40 inches.

The A horizon has hue of 7.5YR or 5YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4. It is neutral or mildly alkaline.

The Bt horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 3 to 5. It is silty clay loam, clay loam, or loam, and the clay content may range from 18 to 35 percent, silt from 30 to 60 percent, and sand from 5 to 40 percent with less than 15 percent fine sand or coarser. The horizon is mildly alkaline or moderately alkaline. The Bk horizon has hue of 7.5YR or 10YR and typically is loam or fine sandy loam. It is mildly alkaline or moderately alkaline.

Sanchez Series

The Sanchez series consists of loamy-skeletal, mixed Lithic Eutroboralfs. These shallow, well drained soils formed in residuum overlying sandstone. They are on hills, ridges, and mountainsides. Slope is 12 to 45 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 43 to 47 degrees F, and the average soil temperature in summer ranges from 56 to 61 degrees.

Typical pedon of a Sanchez very stony sandy clay loam in an area of Archuleta-Sanchez complex, 12 to 65 percent slopes, about 450 feet north of Wallace Gulch Road, about 1,150 feet west and 850 feet south of the northeast corner of sec. 24, T. 35 N., R. 8 W.

E—0 to 5 inches; pale brown (10YR 6/3) very stony sandy clay loam, brown (10YR 5/3) moist; weak

medium granular structure; hard, friable, slightly sticky and nonplastic; 10 percent stones, 10 percent cobbles, and 10 percent gravel; neutral (pH 7.0); clear smooth boundary.

Bt—5 to 11 inches; light brownish gray (10YR 6/2) very stony clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; thin nearly continuous clay films on faces of peds; 20 percent stones and 10 percent gravel; neutral (pH 7.0); clear smooth boundary.

BC—11 to 15 inches; light brownish gray (10YR 6/2) stony sandy clay loam, grayish brown (10YR 5/2) moist; weak medium granular structure; hard, firm, sticky and slightly plastic; 10 percent stones, 10 percent cobbles, and 10 percent gravel; neutral (pH 7.0); abrupt smooth boundary.

R—15 inches; hard sandstone.

Depth to bedrock ranges from 11 to 20 inches. Content of rock fragments in the control section ranges from 35 to 55 percent. Depth to the base of the Bt horizon ranges from 10 to 14 inches. The profile is neutral or slightly acid.

The E horizon has hue of 10YR or 7.5YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 or 3.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. It typically is clay loam or sandy clay loam content may range from 20 to 35 percent, clay silt from 15 to 40 percent, and sand from 20 to 60 percent.

Sedillo Series

The Sedillo series consists of loamy-skeletal, mixed, mesic Ustollic Haplargids. These deep, well drained soils formed in cobbly glacial outwash or alluvium. They are on old high terraces of major river valleys. Slope is 0 to 12 percent. The average annual precipitation ranges from 13 to 16 inches. The average annual soil temperature ranges from 52 to 54 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Sedillo gravelly loam, 0 to 3 percent slopes (fig. 15), about 1,900 feet west and 350 feet south of the northeast corner of sec. 8, T. 32 N., R. 11 W.

A—0 to 6 inches; brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 20 percent gravel; mildly alkaline (pH 7.8); clear wavy boundary.

Bt1—6 to 12 inches; reddish brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 30 percent gravel and 5 percent cobbles; moderately alkaline (pH 8.0); clear wavy boundary.

Figure 15.—Profile of Sedillo gravelly loam, 0 to 3 percent slopes.

Bt2—12 to 21 inches; reddish brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; slightly

hard, friable, slightly sticky and slightly plastic; 40 percent gravel and 10 percent cobbles; moderately alkaline (pH 8.0); clear wavy boundary.

Bk—21 to 27 inches; brown (7.5YR 5/4) very gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; 40 percent gravel and 10 percent cobbles; calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

2Bk1—27 to 35 inches; pinkish white (7.5YR 8/2) very gravelly sandy clay loam, pinkish gray (7.5YR 7/2) moist; massive; hard, firm, slightly sticky and nonplastic; 35 percent gravel and 10 percent cobbles; 20 percent calcium carbonate equivalent; calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

2Bk2—35 to 60 inches; pinkish white (7.5YR 8/2) very cobbly sandy clay loam, pinkish gray (7.5YR 7/2) moist; massive; very hard, firm, slightly sticky and nonplastic; 35 percent gravel and 20 percent cobbles; 30 percent calcium carbonate equivalent; calcareous; moderately alkaline (pH 8.2).

Depth to visible calcium carbonate ranges from 15 to 30 inches. Rock fragment content ranges from 35 to 50 percent throughout the solum. Thickness of the solum is 9 to 32 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 4.

The Bt horizon has hue of 5YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is very gravelly clay loam or very gravelly sandy clay loam that is 20 to 35 percent clay. The 2Bk horizon has hue of 5YR or 7.5YR, value of 6 to 8 when dry and 5 to 7 when moist, and chroma of 2 to 6. It is very gravelly sandy clay loam or very cobbly sandy clay loam. It is moderately alkaline or strongly alkaline.

Shalona Series

The Shalona series consists of fine-loamy, mixed, mesic Aridic Argiustolls. These deep, well drained soils formed in alluvium derived from sandstone and shale. They are on old high river terraces. Slope is 1 to 6 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature is 47 to 55 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of Shalona loam, 600 feet west and 350 feet north of the southeast corner of sec. 24, T. 34 N., R. 10 W.

A1—0 to 2 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; weak thick platy structure; soft, very friable, nonsticky and nonplastic; neutral (pH 6.8); abrupt smooth boundary.

A2—2 to 7 inches; brown (7.5YR 5/2) light clay loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; neutral (pH 7.0); clear smooth boundary.

BA—7 to 14 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure parting to strong medium granular; slightly hard, friable, sticky and plastic; thin nearly continuous clay films on faces of peds; neutral (pH 7.0); clear smooth boundary.

Bt—14 to 35 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; thin nearly continuous clay films on faces of peds; neutral (pH 7.2); gradual smooth boundary.

Bk—35 to 43 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; thin patchy clay films on faces of peds; mildly alkaline (pH 7.8); gradual smooth boundary.

C—43 to 60 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline (pH 8.0).

Thickness of the solum ranges from 25 to 50 inches. Depth to calcareous material ranges from 20 to 40 inches. Content of rock fragments, mainly gravel and cobbles, ranges from 0 to 10 percent.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is neutral or mildly alkaline.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 2 to 4. Texture is typically is clay loam or silty clay loam, but clay content ranges from 18 to 35 percent, silt from 15 to 55 percent, and sand from 15 to 40 percent. It is neutral or mildly alkaline.

The C horizon has hue of 7.5YR to 2.5Y. It is loam, clay loam, or silt loam. It is mildly alkaline or moderately alkaline.

Shawa Variant

The Shawa Variant series consists of fine-loamy, mixed Pachic Haploborolls. These deep, well drained soils formed in alluvium and colluvium. They are on mountainsides. Slope is 5 to 20 percent. The average annual precipitation ranges from 18 to 22 inches. The average annual soil temperature ranges from 45 to 47 degrees F, and the average soil temperature in summer ranges from 60 to 63 degrees.

Typical pedon of Shawa Variant loam, 5 to 20 percent slopes, about 400 feet east and 400 feet south of the northwest corner of sec. 13, T. 37 N., R. 9 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, nonsticky and nonplastic; calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

A2—6 to 13 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine prismatic structure parting to moderate fine subangular blocky; slightly hard, very friable, nonsticky and nonplastic; calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

A3—13 to 23 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

AC—23 to 40 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; calcareous; moderately alkaline; (pH 8.3); gradual smooth boundary.

C—40 to 60 inches; light brownish gray (10YR 6/2) cobbly loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 20 percent cobbles; calcareous; moderately alkaline; (pH 8.4).

Depth to uniformly calcareous material ranges from 0 to 10 inches. Content of rock fragments ranges from 0 to 15 percent in the control section.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 to 3. It is neutral or mildly alkaline.

The C horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. Texture typically is loam or clay loam but ranges from 18 to 35 percent clay, 20 to 50 percent silt, and 20 to 50 percent sand. It is moderately alkaline or strongly alkaline.

Sili Series

The Sili series consists of fine, montmorillonitic, mesic Ustollic Camborthids. These deep, well drained soils formed in alluvium derived from shale. They are on upland valley bottoms and alluvial fans. Slope is 1 to 6 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 48 to 52 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Sili clay loam, 3 to 6 percent slopes, about 300 feet north and 130 feet west of the southeast corner of sec. 19. T. 33 N., R. 6 W.

Ap—0 to 7 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, firm, sticky and plastic; mildly alkaline (pH 7.4); clear smooth boundary.

Bw—7 to 22 inches; light brownish gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate medium angular and subangular blocky structure; hard, firm, sticky and plastic; few thin patchy clay films on faces of peds; calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

C—22 to 60 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, sticky and plastic; calcareous; moderately alkaline (pH 8.0).

Thickness of the solum ranges from 14 to 40 inches. Depth to calcareous material ranges from 0 to 30 inches. Minor cracking occurs in some pedons, but cracks are less than 0.5 inch wide and commonly do not remain open for more than 90 days (cumulative).

The A horizon has hue of 7.5YR to 2.5Y, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is neutral or mildly alkaline.

The Bw horizon has hue of 7.5YR to 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. It typically is clay loam, but clay content ranges from 35 to 50 percent, silt content from 15 to 50 percent, and sand content from 15 to 45 percent. It is mildly alkaline or moderately alkaline.

The C horizon ranges from sandy clay loam to clay. It is mildly alkaline or moderately alkaline.

Simpatico Series

The Simpatico series consists of fine-silty, mixed, mesic Pachic Argiustolls. These deep, well drained soils formed in alluvium derived from surrounding loess deposits. They are on swales on mesas. Slope is 1 to 3 percent. The average annual precipitation ranges from 15 to 18 inches. The average annual soil temperature ranges from 48 to 53 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Simpatico loam, about 2,560 feet south and 1,000 feet east of the northwest corner of sec. 12, T. 34 N., R. 9 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure parting to moderate medium granular; soft, very friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.4); clear smooth boundary.

AB—6 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; soft, very friable, slightly

sticky and slightly plastic; neutral (pH 7.0); gradual smooth boundary.

Bt1—12 to 24 inches; brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; neutral (pH 7.0); clear smooth boundary.

Bt2—24 to 34 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; mildly alkaline (pH 7.4); clear smooth boundary.

BC—34 to 45 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; mildly alkaline (pH 7.4); abrupt irregular boundary.

2C—45 to 60 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, sticky and slightly plastic; 35 percent cobbles and 10 percent gravel; calcareous; moderately alkaline (pH 8.0).

The profile is noncalcareous to a depth of 40 to 50 inches. Thickness of the mollic epipedon, which includes all or part of the Bt horizon, ranges from 20 to 34 inches. Depth to the contrasting 2C horizon ranges from 40 to 60 inches or more. Glacial outwash is at a depth of 40 to 60 inches in some pedons.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 when dry and 2 or 3 when moist, and chroma of 1 or 2. It is neutral or mildly alkaline.

The Bt horizon has hue of 5YR or 7.5YR, value of 3 to 5 when dry and 2 to 4 when moist, and chroma of 2 to 4. It is silty clay loam or clay loam, but clay content may range from 27 to 35 percent, silt content from 35 to 70 percent, and sand content from 5 to 35 percent, of which less than 15 percent is fine or coarser. The horizon is neutral or mildly alkaline.

The 2C horizon has hue of 5YR to 10YR. The horizon is mildly alkaline or moderately alkaline.

Sycle Series

The Sycle series consists of fine-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Haplustolls. These deep, well drained soils formed in alluvium overlying river-deposited cobbles and gravel. The soils are on terraces of major drainageways. Slope is 1 to 3 percent. The average annual precipitation ranges from 15 to 19 inches. The average annual soil temperature ranges from 48 to 52 degrees F, and the average soil temperature in summer ranges from 65 to 68 degrees.

Typical pedon of Sycle fine sandy loam, about 100 feet north and 100 feet east of the southwest corner of sec. 33, T. 34 N., R. 9 W.

Ap—0 to 10 inches; brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; moderate medium and fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 5 percent gravel; mildly alkaline (pH 7.8); clear smooth boundary.

BA—10 to 14 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable, nonsticky and nonplastic; 5 percent gravel; mildly alkaline (pH 7.8); clear smooth boundary.

Bw—14 to 22 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; 5 percent gravel; slightly calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

Bk—22 to 26 inches; light reddish brown (5YR 6/3) gravelly sandy loam, reddish brown (5YR 5/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; 20 percent gravel; calcareous; moderately alkaline (pH 8.2); gradual smooth boundary.

2C—26 to 60 inches; extremely cobbly sand; 25 percent gravel and 45 percent cobbles; calcareous; moderately alkaline (pH 8.2).

Depth to the contrasting 2C horizon ranges from 20 to 40 inches. Thickness of the mollic epipedon ranges from 7 to 15 inches. Depth to calcium carbonate commonly ranges from 20 to 30 inches, but in some pedons the profile is calcareous to the surface.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 to 3. It is mildly alkaline or moderately alkaline.

The Bw horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 3 or 4. It is sandy clay loam or clay loam. It is mildly alkaline or moderately alkaline. The Bk horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 1 to 3. It is loam, sandy loam, or gravelly sandy loam. It is mildly alkaline or moderately alkaline.

Tefton Series

The Tefton series consists of fine-loamy, mixed (calcareous), mesic Aquic Ustifluvents. These deep, somewhat poorly drained soils formed in alluvium. They are on flood plains and alluvial valley floors. Slope is 1 to 3 percent. The average annual precipitation ranges from 16 to 19 inches. The average annual soil temperature ranges from 47 to 55 degrees F, and the average soil temperature in summer ranges from 60 to 66 degrees.

Typical pedon of Tefton loam in the northeast quarter of sec. 15, T. 36 N., R. 9 W.

A—0 to 5 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; calcareous; mildly alkaline (pH 7.8); clear smooth boundary.
AC—5 to 17 inches; pale brown (10YR 6/3) loam and very fine sandy loam, brown (7.5YR 4/3) moist; weak coarse subangular blocky structure parting to moderate fine granular; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; calcareous; mildly alkaline (pH 7.8); clear smooth boundary.
C—17 to 56 inches; pinkish gray (7.5YR 6/2) loam stratified with fine sandy loam and very fine sandy loam, brown (7.5YR 4/2) moist; common fine distinct yellowish brown (10YR 5/6, moist) mottles; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; calcareous; moderately alkaline (pH 8.0); clear smooth boundary.
2C—56 to 60 inches; stratified sand and gravel.

Depth to sand and gravel ranges from 40 to 60 inches or more. Clay content averages 18 to 35 percent in the control section. A fluctuating water table rises to a depth of 2 to 3 feet during spring and summer.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 or 3. It is stratified loam, clay loam, fine sandy loam, or very fine sandy loam. It is mildly alkaline or moderately alkaline.

Travessilla Series

The Travessilla series consists of loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents. These shallow, well drained soils formed in slope alluvium and residuum derived from calcareous sandstone. They are on foothill slopes and ridges. Slope is 6 to 50 percent. The average annual precipitation is 13 to 16 inches. The average annual soil temperature ranges from 47 to 56 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of a Travessilla sandy loam in an area of Dulce-Travessilla-Rock outcrop complex, 6 to 50 percent slopes, about 1,450 feet west and 800 feet south of the northeast corner of sec. 21, T. 32 N., R. 10 W.

A—0 to 5 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; mildly alkaline (pH 7.2); clear smooth boundary.
AC—5 to 11 inches; light yellowish brown (10YR 6/4) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; calcareous; mildly alkaline (pH 7.8); clear smooth boundary.
Cr—11 to 14 inches; weathered sandstone.
R—14 inches; hard, calcareous sandstone.

Depth to the lithic contact ranges from 6 to 20 inches. Rock fragment content ranges from 0 to 35 percent in the control section.

The A horizon has hue of 2.5YR to 7.5YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4. It is neutral to moderately alkaline.

The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4. The control section is 5 to 18 percent clay, 15 to 50 percent silt, and 40 to 80 percent sand. It is mildly alkaline or moderately alkaline.

Uinta Series

The Uinta series consists of fine-loamy, mixed Typic Cryoboralfs. These deep, well drained soils formed in alluvium derived from interbedded red sandstone and shale. They are on mountainsides and alluvial fans. Slope is 5 to 60 percent. The average annual precipitation ranges from 20 to 28 inches. The average annual soil temperature ranges from 39 to 41 degrees F, and the average soil temperature in summer ranges from 44 to 46 degrees.

Typical pedon of Uinta loam, 15 to 60 percent slopes, about 1,400 feet south and 4,100 feet east of the northwest corner of sec. 19, T. 36 N., R. 6 W.

Oi—4 to 2 inches; undecomposed forest litter consisting primarily of needles, bark, and twigs.
Oe—2 inches to 0; partially decomposed organic material.
A—0 to 4 inches; reddish brown (2.5YR 5/4) loam, dark reddish brown (2.5YR 3/4) moist; weak very thin platy structure parting to moderate very fine granular; soft, very friable, nonsticky and nonplastic; neutral (pH 7.0); clear wavy boundary.
E—4 to 15 inches; reddish brown (2.5YR 5/4) loam, dark reddish brown (2.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; neutral (pH 7.0); clear wavy boundary.
E/B—15 to 23 inches; mixed reddish brown (2.5YR 4/4) and reddish brown (2.5YR 5/4) sandy clay loam, dark reddish brown (2.5YR 3/4) and red (2.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and plastic; neutral (pH 7.2); clear wavy boundary.
Bt1—23 to 32 inches; reddish brown (2.5YR 5/4) sandy clay loam, red (2.5YR 4/6) moist; weak medium

prismatic structure parting to moderate medium angular blocky; slightly hard, very friable, slightly sticky and plastic; thin nearly continuous clay films on faces of peds and in pores; neutral (pH 7.3); clear wavy boundary.

Bt2—32 to 45 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; weak medium prismatic structure parting to moderate medium and coarse angular blocky; hard, friable, slightly sticky and plastic; thin nearly continuous clay films on faces of peds and in pores; neutral (pH 7.3); gradual wavy boundary.

C—45 to 60 inches; red (2.5YR 4/6) loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral (pH 7.3).

Thickness of the solum ranges from 24 to 50 inches. Content of rock fragments, mainly sandstone, ranges from 0 to 35 percent throughout the major part of the solum.

The A horizon, where present, has hue of 2.5YR or 5YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is slightly acid or neutral.

The E horizon has hue of 2.5YR or 5YR, value of 5 to 7 when dry and 4 or 5 moist, and chroma of 2 to 4. It is slightly acid or neutral.

The Bt horizon has hue of 5YR or 2.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 4 to 6. It is sandy clay loam or clay loam and is 20 to 35 percent clay, 10 to 35 percent silt, and 30 to 70 percent sand, of which less than 35 percent is fine or coarser. It is mildly acid or neutral.

The C horizon has hue of 2.5YR or 5YR. It is loam or sandy clay loam. It is slightly acid to mildly alkaline.

Umbarg Series

The Umbarg series consists of fine-loamy, mixed, mesic Cumulic Haplustolls. These deep, moderately well drained soils formed in alluvium. They are on alluvial fans and upland valley bottoms. Slope is 3 to 6 percent. The average annual precipitation ranges from 15 to 20 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 60 to 65 degrees.

Typical pedon of Umbarg loam, about 2,000 feet west and 600 feet north of the southeast corner of sec. 5, T. 33 N., R. 12 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; calcareous; 5 percent gravel; mildly alkaline (pH 7.4); clear smooth boundary.

A2—7 to 17 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; calcareous; 5 percent gravel; moderately alkaline (pH 8.2); clear wavy boundary.

AC—17 to 29 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; calcareous; moderately alkaline (pH 8.2); gradual smooth boundary.

C—29 to 60 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable, slightly sticky and slightly plastic; common distinct mottles; calcareous; moderately alkaline (pH 7.6).

The mollic epipedon is 20 to 40 inches thick or more. Organic matter content decreases regularly with depth. Mottles commonly are in the lower part of the C horizon.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 to 3. It is loam or light clay loam and is weakly stratified. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5YR or 10YR, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 or 3. It typically is clay loam or loam with clay content ranging from 18 to 35 percent, sand content from 15 to 50 percent, and silt content from 15 to 50 percent. The horizon is mildly alkaline or moderately alkaline.

Valto Series

The Valto series consists of loamy-skeletal, mixed, nonacid, frigid Lithic Ustorthents. These shallow, well drained soils formed in slope alluvium and residuum derived mainly from sandstone. They are on mountainsides, ridges, and breaks. Slope is 12 to 65 percent. The average annual precipitation is about 20 to 30 inches. The average annual soil temperature ranges from 43 to 47 degrees F, and the average soil temperature in summer is 60 to 65 degrees.

Typical pedon of a Valto very stony fine sandy loam in an area of Valto-Rock outcrop complex, 12 to 65 percent slopes, in Durango Hills subdivision, about 0.5 mile on Sagebrush Trail from junction with Stagecoach Road, about 2,000 feet east of the northwest corner of sec. 7, T. 35 N., R. 8 W.

Oi—2 inches to 0; forest litter of pine needles and leaves.

A—0 to 2 inches; dark reddish gray (5YR 4/2) very stony fine sandy loam, dark reddish brown (5YR 2/2) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; 15 percent stones, 20 percent cobbles, and 10 percent gravel; neutral (pH 7.0); abrupt smooth boundary.

C—2 to 12 inches; light reddish brown (5YR 6/3) very stony fine sandy loam, reddish brown (5YR 5/3)

moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 20 percent stones, 30 percent cobbles, and 10 percent gravel; neutral (pH 7.0); clear smooth boundary.
R—12 inches; sandstone.

Depth to bedrock ranges from 6 to 20 inches. Stone and cobble content ranges from 30 to 70 percent, and gravel content ranges from 5 to 20 percent. The control section is 5 to 18 percent clay, 5 to 50 percent silt, and 40 to 80 percent sand.

The A horizon has hue of 7.5YR to 2.5YR, value of 4 to 6 when dry and 2 to 4 when moist, and chroma of 2 or 3. It is slightly acid or neutral.

The C horizon has hue of 7.5YR to 2.5YR, value of 5 to 7 when dry and 4 to 6 when moist, and chroma of 2 to 4. The texture is typically fine sandy loam. It is slightly acid or neutral.

Vernal Series

The Vernal series consists of fine-loamy over sandy or sandy-skeletal, mixed, mesic Ustollic Haplargids. These deep, well drained soils are on terraces. They formed in loess overlying unconsolidated cobbly alluvium. Slope is 1 to 3 percent. The average annual precipitation is 13 to 16 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Vernal fine sandy loam, 1 to 3 percent slopes, about 1,300 feet south and 300 feet east of the northwest corner of sec. 34, T. 34 N., R. 12 W.

Ap—0 to 5 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; mildly alkaline (pH 7.4); clear smooth boundary.
Bt1—5 to 15 inches; reddish brown (5YR 5/3) clay loam, brown (5YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many thin clay films on faces of peds; mildly alkaline (pH 7.6); gradual smooth boundary.
Bt2—15 to 26 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many thin clay films on faces of peds; mildly alkaline (pH 7.6); clear smooth boundary.
Bk1—26 to 33 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; thin seams and soft masses of secondary calcium carbonate; calcareous; moderately alkaline (pH 8.0); clear smooth boundary.
2Bk1—33 to 48 inches; light yellowish brown (10YR 6/4) extremely cobbly sand, yellowish brown (10YR 5/4) moist; single grained; loose; 30 percent gravel and 35 percent cobbles; visible secondary calcium carbonate on surfaces of rock fragments; calcareous; moderately alkaline (pH 8.4); gradual smooth boundary.
2Bk2—48 to 72 inches; yellowish brown (10YR 5/4) extremely cobbly sand, brown (10YR 4/4) moist; single grained; loose; 25 percent gravel and 45 percent cobbles; calcareous; moderately alkaline (pH 8.2).

Depth to uniformly calcareous material ranges from 15 to 30 inches. Rock fragment content is 0 to 15 percent in the A and B horizons and 65 percent or more in the 2Bk horizon. Depth to the contrasting 2Bk horizon is 20 to 40 inches.

The A horizon has hue of 7.5YR or 5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 to 4.

The Bt horizon has hue of 5YR or 2.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 to 4. In some pedons the Bt horizon has hue of 7.5YR. It typically is clay loam or loam, but in some pedons it is 18 to 35 percent clay, 15 to 55 percent silt, and 20 to 50 percent sand, of which less than 35 percent is fine or coarser. The 2Bk horizon has hue of 10YR to 2.5YR. It is very gravelly to extremely cobbly loamy sand or sand. It is mildly alkaline or moderately alkaline.

Vosburg Series

The Vosburg series consists of fine-loamy, mixed, mesic Pachic Argiustolls. These deep, well drained soils formed in mixed alluvium derived from sandstone and shale. They are in upland swales and on mountain foot slopes. Slope is 3 to 8 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 48 to 53 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Vosburg fine sandy loam, in Hay Gulch, about 1,700 feet east and 600 feet north of the southwest corner of sec. 15, T. 34 N., R. 12 W.

A—0 to 15 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; neutral (pH 7.2); clear smooth boundary.
BA—15 to 18 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; mildly alkaline (pH 7.4); clear smooth boundary.
Bt—18 to 31 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky

structure parting to moderate medium granular; hard, friable, sticky and plastic; mildly alkaline (pH 7.6); gradual smooth boundary.

Bk—31 to 50 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, sticky and plastic; calcareous; mildly alkaline (pH 7.8); gradual smooth boundary.

Ck—50 to 60 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; calcareous; mildly alkaline (pH 7.8).

Thickness of the mollic epipedon ranges from 20 to 50 inches. Depth to uniformly calcareous material ranges from 15 to 50 inches. Content of rock fragments, mostly gravel, ranges from 0 to 15 percent in the solum and in the part of the C horizon above a depth of 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 1 to 3. It is slightly acid to mildly alkaline.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry and 2 to 5 when moist, and chroma of 1 to 4. It is sandy clay loam or clay loam. It is neutral to moderately alkaline.

The C horizon has hue of 10YR or 7.5YR. It is sandy loam or sandy clay loam. It is mildly alkaline to strongly alkaline.

Witt Series

The Witt series consists of fine-silty, mixed, mesic Ustollic Haplargids. These deep, well drained soils formed in silty calcareous loess derived from red-bed sediment. They are on uplands and mesas. Slope is 1 to 8 percent. The average annual precipitation ranges from 14 to 17 inches. The average annual soil temperature ranges from 47 to 55 degrees F, and the average soil temperature in summer ranges from 63 to 68 degrees.

Typical pedon of Witt loam, 1 to 3 percent slopes, about 400 feet east and 50 feet south of the northwest corner of sec. 3, T. 33 N., R. 12 W.

Ap1—0 to 7 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/3) moist; weak medium granular structure; soft, very friable, slightly sticky and nonplastic; neutral (pH 7.0); clear smooth boundary.

Ap2—7 to 10 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak thick platy structure parting to moderate medium granular; hard, firm, slightly sticky and nonplastic; neutral (pH 7.0); clear smooth boundary.

Bt1—10 to 19 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; hard, firm, sticky and plastic; thin continuous clay films on faces of peds; mildly alkaline (pH 7.6); clear smooth boundary.

Bt2—19 to 34 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; thin continuous clay films on faces of peds; calcareous; small lime mycelia; mildly alkaline (pH 7.6); gradual smooth boundary.

Bk—34 to 48 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak medium or coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; thin nearly continuous clay films on faces of peds; strongly calcareous; many lime mycelia; moderately alkaline (pH 8.0); gradual smooth boundary.

C—48 to 60 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; massive; soft, very friable, nonsticky and nonplastic; slightly calcareous; moderately alkaline (pH 8.2).

The thickness of the solum ranges from 30 to 48 inches. Depth to the Bk horizon is more than 30 inches.

The A horizon has hue of 7.5YR or 5YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 2 to 4. It is neutral or mildly alkaline.

The Bt horizon has value of 5 or 6 when dry and 3 to 5 when moist, and it has chroma of 3 or 4. It is clay loam or silty clay loam and is 18 to 35 percent clay and less than 15 percent sand that is coarser than very fine sand. The horizon is mildly alkaline or moderately alkaline.

The C horizon has hue of 5YR or 7.5YR, value of 5 to 7 when dry and 3 to 5 when moist, and chroma of 3 to 6. It loam or silt loam.

Yenlo Series

The Yenlo series consists of fine-loamy, mixed, mesic Ustollic Haplargids. These deep, well drained soils formed in alluvium derived from sandstone and shale. They are in upland valleys. Slope is 1 to 5 percent. The average annual precipitation ranges from 12 to 14 inches. The average annual soil temperature ranges from 47 to 52 degrees F, and the average soil temperature in summer ranges from 62 to 68 degrees.

Typical pedon of a Yenlo sandy loam in an area of Yenlo-Florita sandy loams, about 3,600 feet south and 2,400 feet west of the northeast corner of sec. 22, T. 32 N., R. 10 W.

A—0 to 3 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; neutral; (pH 7.2); clear smooth boundary.

Bt1—3 to 7 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to

moderate medium granular; hard, friable, slightly sticky and nonplastic; mildly alkaline (pH 7.4); clear smooth boundary.

Bt2—7 to 13 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable, slightly sticky and slightly plastic; mildly alkaline (pH 7.4); clear smooth boundary.

BC—13 to 19 inches; pale brown (10YR 6/3) sandy loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline (pH 7.6); clear smooth boundary.

C1—19 to 28 inches; pale brown (10YR 6/3) sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; calcareous; mildly alkaline (pH 7.8); gradual smooth boundary.

C2—28 to 44 inches; pale brown (10YR 6/3) sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

Ck—44 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; calcareous; moderately alkaline (pH 8.2).

Depth to calcareous material ranges from 10 to 24 inches. Thickness of the solum is 15 to 30 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 2 or 3. It is neutral or mildly alkaline.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. It typically is sandy clay loam but but in some pedons it is 18 to 35 percent clay, 5 to 35 percent silt, and 40 to 75 percent sand, of which more than 35 percent is fine or coarser.

The C horizon has hue of 10YR or 2.5Y. It is loam, sandy loam, or sandy clay loam.

Zau Series

The Zau series consists of fine, mixed Typic Argiborolls. These moderately deep, well drained soils formed in residuum derived from sandstone and shale. They are on mesas and mountainsides. Slope is 3 to 25 percent. The average annual precipitation is about 20 to 22 inches. The average annual soil temperature ranges from 42 to 47 degrees F, and the average soil temperature in summer ranges from 53 to 57 degrees.

Typical pedon of Zau stony loam, 9 to 25 percent slopes, about 175 feet east and 190 feet south of the northwest corner of sec. 22, T. 35 N., R. 11 W.

Oi—4 to 2 inches; undecomposed leaves and bark.

Oe—2 inches to 0; partially decomposed plant material.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many medium and fine roots; common fine pores; 2 percent stones and cobbles and 5 percent gravel; neutral (pH 7.2); clear smooth boundary.

A2—8 to 13 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many medium and fine roots; few fine pores; 5 percent gravel; neutral (pH 7.2); gradual wavy boundary.

Bt1—13 to 17 inches; brown (10YR 5/3) and light yellowish brown (10YR 6/4) on ped exteriors clay loam, brown (10YR 4/3) moist and yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, firm, slightly sticky and slightly plastic; thin nearly continuous clay films on faces of peds; few fine roots; few fine discontinuous pores; 5 percent gravel; neutral (pH 7.0); gradual wavy boundary.

Bt2—17 to 27 inches; brown (10YR 5/3) and brownish yellow (10YR 6/6) on ped exteriors clay, dark brown (10YR 4/3) moist and yellowish brown (10YR 5/6) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky and plastic; thin nearly continuous clay films on faces of peds; few very fine roots; few very fine pores; 5 percent gravel; neutral (pH 6.8); clear smooth boundary.

C—27 to 32 inches; brown (10YR 5/3) and brownish yellow (10YR 6/6) on ped exteriors clay loam, dark brown (10YR 4/3) moist in matrix and yellowish brown (10YR 5/6) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; 15 percent gravel; neutral (pH 7.2); clear smooth boundary.

Cr—32 to 40 inches; weathered sandstone.

Depth to weathered interbedded sandstone and shale is 20 to 40 inches. Thickness of the mollic epipedon is 7 to 16 inches. Rock fragment content ranges from 5 to 35 percent throughout the solum and the C horizon.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is neutral or mildly alkaline.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 to 5. Colors commonly are variegated because of the nature of the parent material. The horizon is clay loam or clay and is 35 to 45 percent clay, 20 to 50 percent silt, and 10 to 45 percent sand, of which less than 35 percent is fine or coarser. The horizon is slightly acid or neutral.

The C horizon has hue of 7.5YR to 2.5Y. It is clay loam or sandy clay loam. It is slightly acid to mildly alkaline. In some pedons segregated calcium carbonate is present.

Zyme Series

The Zyme series consists of clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents. These shallow, well drained soils formed in residuum derived from shale. They are on foothills and ridges. Slope is 3 to 65 percent. The average annual precipitation ranges from 14 to 18 inches. The average annual soil temperature ranges from 48 to 51 degrees F, and the average soil temperature in summer ranges from 65 to 68 degrees.

Typical pedon of Zyme clay loam, 3 to 25 percent slopes, west of the cemetery on the west side of Durango, about 2,700 feet west and 300 feet north of the southeast corner of sec. 19, T. 35 N., R. 9 W.

A1—0 to 1 inch; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable, sticky and plastic; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

A2—1 inch to 4 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, sticky and plastic; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C—4 to 10 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; 10 percent shale chips; calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

Cr—10 inches; gray, calcareous shale.

Depth to shale is 6 to 20 inches. The profile ranges from 0 to 15 percent rock fragments. The particle-size control section is 35 to 45 percent clay, 20 to 50 percent silt, and 5 to 45 percent sand.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 5Y to 10YR, value of 5 to 7 when dry and 4 or 5 when moist, and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Formation of the Soils

The characteristics of any given soil are determined by the interaction of five factors of soil formation—the physical and mineralogical composition of the parent material; the climate under which the soil material accumulated and weathered; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rock or that has been deposited by wind and water and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The kind of parent material also affects the kind of profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into soil that has distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. The factors of soil formation are not equal in their effect on soil formation, nor is any one factor equal under different conditions. In some places any one factor may have a major influence on soil formation, while in another place it may be of little importance. For example, in areas on sandhills that are subject to semi-arid climatic conditions, relief has little effect and parent material has much effect on soil formation. The five main factors of soil formation and the geology of the area are discussed in the following paragraphs.

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; however, such factors as wind velocity and humidity have a significant influence on soil climate. Generally, soil-forming processes are more active when temperatures are warm and moisture is adequate but not excessive. The high water table that exists in part of the survey area has a profound effect on soil climate.

The climate of the survey area ranges from warm, semi-arid continental to cold, subhumid mountain. The area is warmest and driest in the southern part, and it becomes moister and cooler to the north. The average annual temperature is about 47 degrees F at Durango, 45 degrees at Ignacio, and 43 degrees at Vallecito Dam. The average annual precipitation is about 18 inches at Durango, 14 inches at Ignacio, and 25 inches at Vallecito Dam. These differences are reflected in the degree of weathering of the parent material, the development of the soils, and the plant cover on the soils.

Moisture moving down through the soil influences soil formation by leaching calcium carbonate and other soluble salts out of the surface layer and depositing them in the lower lying horizons and by transporting finely divided clay particles from the upper layers to the lower layers. Thus, the low amount of rainfall in the southern part of the survey area is reflected in the lack of soil formation in soils such as those of the Mikim, Florita, Bayfield, and Bodot series and in the weakly developed profiles of soils in the Sili, Yenlo, and Arboles series. In the moister part of the area, carbonates have been leached from many of the soils, the argillic horizon is well developed, and, in many of the soils, an albic horizon has formed. In addition, many of these soils have lower reaction and lower base saturation than do the soils in low rainfall areas. Examples are soils of the Chris, Goldvale, Herm, and Nordicol series.

The soil moisture also influences soil formation indirectly by controlling the amount and type of vegetation and, subsequently, the amount of organic matter returned to the soil. In part of the survey area where soil moisture is limited, plant growth is also limited and annual amounts of organic matter returned to the soil are small. Consequently, soils such as those of the Arboles, Bayfield, and Yenlo series are relatively low in content of organic matter. In the areas of higher precipitation, many of the soils support a denser stand of grasses and shrubs and have a much higher content of organic matter. Examples are soils in the Clayburn, Hesperus, and Nordicol series.

Relief

Relief modifies the effects of climate and vegetation mainly by controlling the amount of runoff and the degree of soil erosion and drainage. The survey area has extremely varied relief, ranging from nearly level areas on river valley floors and gently sloping or sloping

areas on mesas and in upland valleys to steep areas on mountainsides.

Relief affects the amount of runoff, but other factors must also be considered. Surface runoff is also affected by soil texture, vegetation, and a high water table. Soils that have a fine textured or moderately fine textured surface layer, such as the Arboles and Bayfield soils, have medium or rapid runoff in some areas because water penetrates them slowly.

Surface drainage on many of the nearly level to gently sloping soils is slow, especially if the soil is medium textured to coarse textured. Rainfall and runoff from adjacent, more sloping areas penetrate the soil to a greater depth and thus promote more plant growth. These soils generally have more organic matter in the surface layer and are leached to a greater depth. Simpatico soils are an example.

Relief also affects soil drainage, which in turn affects plant cover and microbial activity. Some of the soils on the valley floors, such as the Alamosa, Big Blue, and Pescar soils, have restricted subsurface drainage. The periodic poor drainage affects the processes of soil formation. For example, oxidation and reduction take place alternately in these soils and thus the soils are highly mottled.

The amount of runoff and the amount of water that penetrates the soil are also affected by the kind and amount of vegetation on the soil. Soils that have moderately steep slopes, such as the Nordicol soils, commonly have slow runoff if the plant cover is dense. The vegetation generally adds much organic matter to the surface layer, which increases water infiltration. The vegetation also acts to break up raindrops so that water is applied more gently to the soil, and thus runoff and erosion are reduced.

Relief affects the way some parent material is deposited. On the nearly level or gently sloping valley bottoms, alluvial material is deposited by streams. It typically is stratified and has layers of sand, gravel, and finer textured soil material. In the gently sloping areas in upland valleys, some soils have developed a thick, dark-colored surface layer. This can either be the result of organic matter being returned to the soil or a combination of soil deposition and soil formation. Soil material may be eroded from higher lying areas and deposited in more gently sloping areas or in valleys. On steep mountainsides, stones, boulders, and soil material commonly are moved down the slope by colluvial or alluvial action, or both.

Aspect is extremely important in the survey area. Aspect and steepness of slope influence soil formation by their effect on the microclimate and thus on the soil temperature and moisture content. In much of the area, south aspects are warmer and drier than north aspects. Soils on north aspects produce much more vegetation than those on south aspects.

On steep soils, where runoff is rapid, geologic erosion commonly occurs at the same rate as soil formation. Under these conditions, genetic horizons may never form because the mechanical removal of soil may keep pace with the alteration of parent material. The Dulce, Picante, and Zyme soils are examples.

Plant and Animal Life

Plants, micro-organisms, earthworms, and other forms of plant and animal life on or in the soil influence soil formation. The kinds of plant cover and micro-organisms at any location are controlled mainly by soil temperature, soil moisture, and the physical and chemical characteristics of the parent material.

In the southern part of the survey area, soil moisture is the greatest factor controlling the growth of plants. The soils in the southern part of the survey area formed under a sparse cover of shrubs, grasses, and pinyon and juniper. In the northern part of the area, the soils formed under a dense stand of grasses and shrubs or stands of ponderosa pine, spruce, fir, and aspen.

In the poorly drained areas, the soil moisture is greater and the soils formed under a dense cover of sedges, rushes, and water-tolerant grasses. These soils are high in organic matter content, and the organic matter extends to a greater depth than it does in the arid soils.

Soil micro-organisms affect soil formation in many ways. One of the most important effects is the breakdown of plant residue. In this survey area, this occurs rapidly in the well drained soils if soil temperature is favorable and moisture supplies are adequate. Because precipitation in summer generally occurs as small, infrequent showers, the activity of soil micro-organisms fluctuates greatly during this period, reaching a maximum after each shower and decreasing during the intervening dry periods.

Even though microbiologic activity occurs sporadically, it is sufficient to account for the thorough breakdown of the small annual amount of plant residue returned to the soil in the drier parts of the area. Consequently, the well drained, aridic soils are characterized by low organic matter content, highly stable residual organic compounds, and concentrations of organic matter in the upper few inches of the profile. The maximum amount of organic matter coincides with the greatest concentration of plant roots. The well drained, ustic soils under a denser stand of grasses and shrubs in the more moist areas have a mollic horizon and contain more organic matter than do soils in the drier areas. In some soils the mollic horizon is very thick. In most of the soils that formed under good stands of coniferous trees, an O horizon consisting of needles, leaves, bark, and other organic material in various stages of decay is on the surface. These soils typically have a light-colored E horizon that has been leached of silicate clay, do not have organic carbon, and are neutral or acidic.

In areas where the water table keeps the soil moist for a longer period of time, microbiologic activity occurs more uniformly throughout the warm season. In these areas, vegetation is more abundant and greater amounts of plant residue are returned to the soil annually. Consequently, there is a greater accumulation of organic matter and it extends to a greater depth in the soil. Such soils are darker colored to a greater depth than are well drained, aridic soils.

In some very poorly drained areas where the soil is wet most of the time, microbiologic activity is dominantly anaerobic. Under such conditions, decomposition is often incomplete and undecomposed organic matter may accumulate on the soil surface.

Time

Time, or age of the soil, refers to the length of time the processes of soil formation have been active. Time is needed for the other factors of soil formation to occur. The amount of time needed is related to the amount of influence the other factors of soil formation have on soil development.

The soils in the survey area vary widely in age, or in the length of time the soil-forming factors have been active. The older soils, such as the Durango, Falfa, and Pinata soils have developed A, B, and C horizons. These soils have a well expressed argillic horizon and have zones of calcium carbonate accumulation or have been leached entirely of calcium carbonate. These soils formed on old stable landforms. The younger soils generally have developed an A and C or A, C, and R sequence of horizons. The Tefton, Umbarg, Bayfield, and Zyme soils are young soils. These soils have little soil development and typically are calcareous throughout. The Tefton soils are flooded occasionally and receive deposits of new material.

The Umbarg soils are on alluvial fans or upland valley bottoms; they have received an accumulation of soil material from higher lying areas. The Bayfield soils have slow permeability; therefore, soil-forming processes are very slow. The Zyme soils are shallow over shale because erosion removes the soil as fast as it is formed.

Soils of flood plains where frequent deposition of material occurs may have differences in the horizons that develop. They are considered young soils because the differences are not genetic but are normal characteristics of the unaltered, stratified parent material. Fluvaquents, sandy, frequently flooded, are an example.

A distinction must be made between chronologic age of landscapes and the age of a soil as interpreted from the degree of genetic horizon formation. In some areas normal geologic erosion allows little if any formation of genetic horizons because soil is removed as rapidly as it is formed. Chronologically, such areas may be as old as those where the soils have well formed genetic horizons.

Parent Material

The soils in the survey area formed in many different kinds of parent material. The major kinds are loess, alluvium, glacial outwash, and material weathered from many kinds of sandstone and shale. These different kinds of parent material affect the mineralogy, color, texture, consistence, chemical makeup, reaction, and natural fertility of the soils.

Loess.—Many of the soils on mesa tops in the central, southern, and western parts of the area formed in silty, calcareous loess. It is of early Wisconsin age, but some additional reworking and deposition have occurred in late Wisconsin and Recent time. This loess layer generally is no more than about 15 feet thick. It has hue of 5YR and has a high content of silt and very fine sand. It generally is less than 15 percent sand that is coarser than very fine sand. This material weathered from red sandstone and siltstone in northeastern Arizona and southeastern Utah, and it has been deposited in the area by the prevailing winds from the southwest. The loess layer overlies Upper Cretaceous Cliffhouse Sandstone and Quaternary glacial outwash and gravelly terrace deposits (*3*). It also overlies other geologic formations in some places. The loess has had some influence over most of the area. In some places it either was eroded away as soon as it was deposited or has been subsequently eroded away. The Falfa, Pulpit, and Witt soils formed in loess.

Alluvium.—Soils that formed in alluvial parent material are throughout the survey area. Alluvium is on the flood plains, fans, terraces, piedmont slopes, valley bottoms, and side slopes, which are mostly of Recent or Pleistocene age.

The Recent flood plains and low terraces of the major river valleys consist of stratified sand, gravel, and cobbles with layers of finer textured material from various sources. The gravel and cobbles are rounded and are mostly granite, schist, or quartzite. The material in these areas weathered from geologic formations high in the mountains and was transported a great distance by water. Some material is still being deposited. The soils forming in this material exhibit little horizonation. The differences exhibited in the soils are mostly those of stratification rather than of soil development. These soils typically have an A and C or an A, AC, and C sequence of horizons. The Clark Fork, Pescar, and Tefton soils formed in recent alluvium.

Most upland valleys are made up of alluvial material of Recent age. This material has weathered from nearby sandstone and shale and generally has not been moved far. The material commonly is deep, calcareous, and moderately coarse textured to fine textured. It has very few coarse fragments. The soils that formed in this material vary greatly in the degree of development, depending largely on the length of time the material has been in place. In some areas deposition of new material

is taking place annually, but other areas are more stable. Some of the soils, such as those of the Nutrioso, Umbarg, and Vosburg series, have formed a thick, dark colored A horizon as a result of gradual accumulation of soil material. These soils may have A and C horizons or A, B, and C horizons. Other soils that formed in upland valley alluvium are those of the Arboles, Bayfield, Buckle, Florita, and Yenlo series.

Alluvial fans occur throughout the survey area and are of Recent age. The material in these areas weathered from sandstone and shale in the uplands. It has been washed down drainageways and deposited at the mouth of the drainageways. Some of the material has been washed from Pleistocene alluvium and then mixed with material derived from sandstone and shale. In many places the fans extend out over terraces of older age, and in many places the fans blend into terraces or valley bottoms. The parent material on the fans commonly is mixed or stratified, is moderately coarse textured to fine textured, and contains varying amounts of gravel, cobbles, and stones. Some of the soils that formed on these alluvial fans are those of the Mikim, Hesperus, and Sili series.

Some of the soils in the area formed in alluvial and colluvial material on the sides of mountains and foothills. This material varies in texture and content of gravel, cobbles, and stones, depending on the geologic formation it weathered from, the steepness of slope, and the distance the material has moved downslope. The material ranges from medium textured to fine textured. It is calcareous in some areas and noncalcareous in others, depending on the geologic formation it weathered from and the degree of weathering. Some of the soils that formed in alluvial and colluvial material on mountainsides are those of the Anvik, Herm, and Nordicol series and the Shawa Variant. The Horsethief soils formed mainly in stony colluvial material on mountainsides.

Glacial outwash.—Many of the soils in the survey area formed in old alluvium, glacial outwash, or till on terraces or piedmont slopes of Pleistocene age. These are stable landforms where the parent material has been in place for centuries. The material was deposited mainly by ancient rivers and by outwash from melting glaciers. It typically contains a high percentage of gravel, cobbles, stones, and boulders, which are mostly igneous or metamorphic rock but are sedimentary rock in places. The soils that formed in this material have a well developed argillic horizon and are commonly leached of carbonates to a considerable depth. Examples are the Durango, Harlan, Nehar, Pinata, and Sedillo soils. The Leadville soils formed in glacial till and alluvial and colluvial material on mountainsides.

Sandstone and shale.—Many of the soils in the area formed in material weathered from sandstone or shale. Some formed in residuum or in material that remained in place as it weathered, and others formed in material that was transported only a short distance. Most of the soils formed in material from more than one geologic formation.

The soils that formed in residual material derived from sandstone are mainly medium textured or moderately coarse textured. They are stony in most places, and in this survey area they are shallow. Some are calcareous, and some have been leached of carbonates. The soils typically have an A, C, and R horizon sequence. Examples of these soils are those of the Dulce, Lazear, Travessilla, and Valto series.

The soils that formed in material weathered from shale commonly are moderately fine textured or fine textured. They have very few rock fragments. They are shallow to deep and generally are calcareous. Examples are the soils of the Arboles, Bodot, and Zyme series.

A large number of the soils in the survey area formed in material weathered from interbedded sandstone, shale, and, in some places, siltstone. Soils that formed in this material have a wide range of properties. They are moderately coarse textured to fine textured, are calcareous or noncalcareous, and have coarse fragments in some places. Some are well developed and some are not. Examples of well developed soils that formed in material derived from sandstone and shale are those of the Fortwingate, Sanchez, and Zau series. Some soils, such as those of the Goldvale and Uinta series, formed in material weathered from sandstone and shale but have been moved a short distance by alluvial action. Examples of soils that have little horizon development are those of the Archuleta and Picante series.

Geology

Alex D. Elkin, geologist, Soil Conservation Service, assisted in the preparation of this section.

The geology of the survey area has been important in producing a wide variety of parent materials. Most have had some effect on the formation of the soils, either as individual formations or as sources of mixed mineralogy. The geologic formations have been important in controlling the degree of geologic erosion and, in turn, the landforms that have developed.

Rocks ranging in age from Precambrian to Quaternary are exposed in this survey area. They consist of crystalline igneous and metamorphic rock of Precambrian age, a thick sequence of sedimentary rock of Paleozoic, Mesozoic, and Cenozoic age, and a variety of unconsolidated alluvial, glacial, and eolian deposits of Quaternary age. Distribution of these rocks is controlled by two major structural features—the San Juan structural basin, in the southern part of the area, and the Needle Mountains, in the northern part of the area. The older rocks generally are exposed in the mountainous areas, and the younger rocks occur mainly in the central part of the San Juan Basin (*4*).

The oldest rocks in the survey area are in the northern part of the county, along the Animas River Valley. They consist of a variety of rocks of Precambrian age. These include Twilight Gneiss; the Irving Formation, consisting of amphibolite, gneiss, quartzite, and schist; the Electra Lake Gabbro; and the Bakers Bridge Granite (*10*).

Paleozoic rocks of Cambrian to Permian age crop out on the southern flanks of the Needle Mountains, mainly along the upper Animas River Valley and around Vallecito Reservoir. These rocks include quartzite, limestone, and shale overlain by red arkosic sandstone and conglomerate with beds of red mudstone and siltstone in the upper part. The Ignacio Quartzite is the older sedimentary formation; it consists of light gray quartzitic sandstone and siltstone. The Elbert Formation consists of calcareous shale, limestone, quartzitic sandstone, and siltstone. The Ouray Limestone is light gray and dense. The Leadville Limestone is light to dark gray limestone and dolomitic limestone. The Molas Formation is mostly nonmarine shale, siltstone, sandstone, and conglomerate. The Hermosa Formation is about 2,200 feet thick and consists largely of dark gray marine shale, limestone, and sandstone. Soils of the Shawa Variant formed mainly in material weathered from the Hermosa Formation. The Rico Formation consists of nonmarine red-bed shale, siltstone, and arkosic sandstone. It is a transitional formation between the Hermosa Formation and the overlying Cutler Formation. The Cutler Formation is mostly nonmarine red-bed shale, siltstone, and arkosic sandstone. It is as much as 2,000 feet thick. Soils of the Uinta series formed in material weathered mainly from the Cutler and Rico Formations.

Mesozoic rocks crop out extensively in the survey area. They consist of several thousand feet of alternating beds of sandstone, siltstone, and shale. These rocks are of Triassic, Jurassic, or Cretaceous age. Rocks of Triassic age consist of the nonmarine, reddish brown sandstone, siltstone, and shale of the Dolores Formation. Rocks of Jurassic age include the Entrada Sandstone, a prominent light gray to white massive sandstone about 200 feet thick; the Wanakah Formation, which consists of red shale and sandstone and a thin bed of dense, dark gray limestone; and the Morrison Formation, which is about 800 feet thick and consists mainly of sandstone with interbedded, varicolored claystone and mudstone. The Burro Canyon Formation and the Dakota Sandstone of Lower and Upper Cretaceous age consist of light gray to brown sandstone with interbedded green and gray claystone in the Burro Canyon Formation and interbedded gray siltstone and carbonaceous shale in the Dakota Sandstone.

Rocks of Upper Cretaceous age are exposed across the central part of the area. The lower part of this area consists of Mancos Shale, which is mostly dark gray marine shale about 2,000 feet thick. Above the Mancos Shale is a thick sequence of alternating shale and sandstone layers with some prominent coalbeds. The formations include the Point Lookout Sandstone; the Menefee Formation, consisting of light gray sandstone, siltstone, and shale with coalbeds; the Cliff House Sandstone; the Lewis Shale, consisting of dark gray marine shale; the Pictured Cliffs Sandstone; the Fruitland Formation, consisting of lenticular beds of sandstone, gray shale, and coal; and the Kirtland Shale, consisting of gray and greenish gray shale and light gray sandstone.

The Animas Formation of Upper Cretaceous and Paleocene age is in large areas in the southeastern part of the area. It is as much as 2,700 feet thick and consists of dark, varicolored sandstone, shale, and conglomerate. The Nacimiento Formation is of Paleocene age and consists of gray and varicolored shale and gray to yellow sandstone about 500 feet thick. The San Jose Formation and Blanco Basin Formation are across much of the southern part of the area. The San Jose Formation consists of light gray to brown arkosic sandstone and conglomerate interbedded with red, brown, and light gray claystone and is as much as 2,500 feet thick. The Blanco Basin Formation is mainly arkosic sandstone and conglomerate with red, yellow, and white claystone.

Quaternary deposits of Pleistocene to Recent age are widespread in the survey area. Glacial moraines and gravelly alluvial deposits representing several intervals of glaciation are present along the major valleys, as well as on some high level surfaces in the southern part of the survey area. The oldest alluvial deposits are the Bridgetimber Gravel. These deposits are about 2,000 feet above the Animas River, on Bridgetimber Mountain. Other high-lying deposits of gravel, cobbles, and boulders of slightly younger age occur on Bridgetimber Mountain and in large areas on Mesa Mountain. Glacial moraines of three distinct glacial advances occur along the Animas River Valley, in the vicinity of Durango. The oldest of these is of the Illinoian Glaciation, and the gravel on Florida Mesa is outwash deposits from this glaciation. The other two glacial moraines are of Wisconsin age, and outwash gravel from them are on two terrace levels along the Animas River, downstream from Durango. Terrace deposits of gravel, cobbles, and boulders from these three glacial advances also occur along the valleys of the Florida, the Los Pinos, and La Plata Rivers (*6*).

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vol., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Haynes, D.D., J.D. Vogel, and W.D. Wyant, 1972. Geology, structure and uranium deposits of the Cortez Quadrangle, Colorado and Utah. U.S. Geol. Surv. Misc. Invest. Ser. Map I-629.

(4) Larson, E.S., Jr., and W. Cross. 1956. Geology and petrology of the San Juan Region, Southwestern Colorado. U.S. Geol. Surv. Prof. Pap. No. 258, 303 pp., illus.

(5) Portland Cement Association. 1962. PCA soil primer. 52 pp., illus.

(6) Richmond, G.M. 1965. Quarternary stratigraphy of the Durango Area, San Juan Mountains, Colorado. U.S. Geol. Surv. Prof. Pap. No. 525-C, pp. C137-C143.

(7) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(8) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(9) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(10) United States Department of the Interior. 1974. Geologic map of the Durango Quadrangle, Southwest Colorado. U.S. Geol. Surv. Misc. Invest. Ser. May I-764.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having 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 plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal-unit-month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semi-arid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep to very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4 1/2 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Brush management. Use of mechanical, chemical, or biological methods to reduce or eliminate competition of woody vegetation to allow understory grasses and forbs to recover, or to make conditions favorable for reseeding. It increases production of forage, which reduces erosion. Brush management may improve the habitat for some species of wildlife.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation by use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter, in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conglomerate. A coarse grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. If soil improving crops and practices used in the system more than offset the soil depleting crops and deteriorating practices, then it is a good conservation cropping system. Cropping systems are needed on all tilled soils. Soil improving practices in a conservation cropping system include

the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

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.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops using a planned system of rotation and management practices.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cuesta. An asymmetric, homoclinal ridge capped by resistant rock layers of slight to moderate dip.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming with the dip of underlying bedded rock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited to crop production unless irrigated.
Somewhat excessively drained.—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.
Well drained.—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.
Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.
Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is

provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. They are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and produced by erosion or faulting. Synonym: scarp.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of men and equipment in fire fighting. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (or 300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors

responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Crops such as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well-defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of

the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit

widths that are more than the heights of bounding erosional scarps.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded 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 of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color in hue of 10YR, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Observed rooting depth. Depth to which roots have been observed to penetrate.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial meltwater.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

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.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential native plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed. (See climax plant community.)

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. The application of fire to land under such conditions of weather, soil moisture, and time of day as presumably will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This increases the vigor and reproduction of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Red beds. Sedimentary strata mainly red in color and composed largely of sandstone and shale.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site class. A grouping of site indexes into 5 to 7 production capability levels. Each level can be represented by a site curve.

Site curve (50-year). A set of related curves on a graph that shows the average height of dominant trees for the range of ages on soils that differ in productivity. each level is represented by a curve. The basis of the curves is the height of dominant trees that are 50 years old or are 50 years old at breast height.

Site curve (100-year). A set of related curves on a graph that show the average height of dominant and codominant trees for a range of ages on soils that differ in productivity. Each level is represented by a curve. The basis of the curves is the height of dominant and codominant trees that are 100 years old or are 100 years old at breast height.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

	Percent
Nearly level	0 to 1
Gently sloping	1 to 6
Sloping	6 to 12
Moderately steep	12 to 25
Steep	25 to 65
Very steep	65 and higher

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft rock. Rock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The action of uprooting and tipping over trees by the wind.