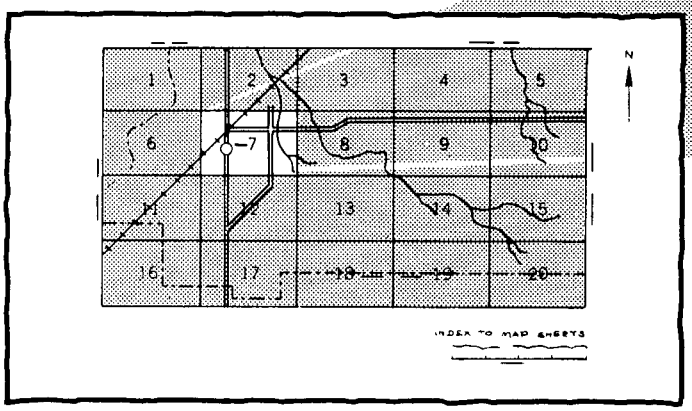
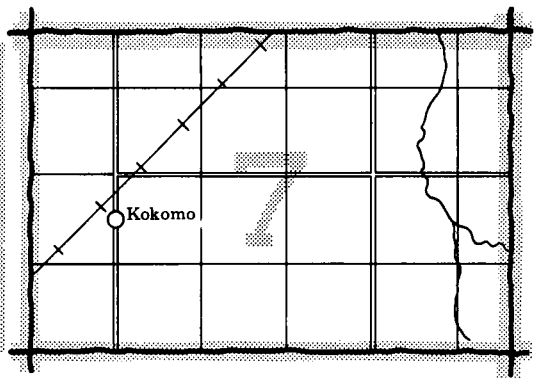
Soil survey of
Piedra Area, Colorado
Parts of Archuleta, Hinsdale, La Plata, Mineral, and Rio Grande Counties

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

HOW TO USE

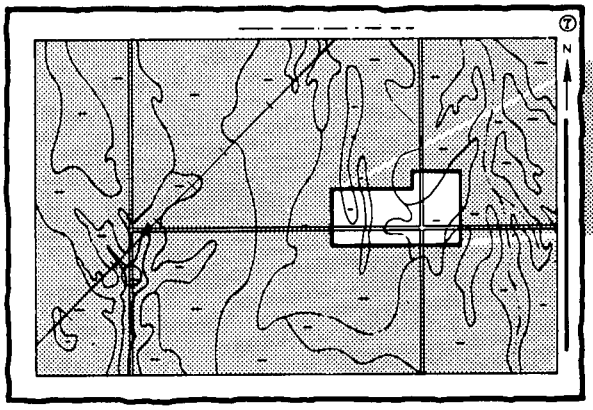
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

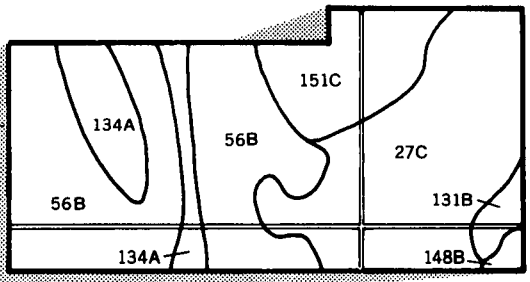




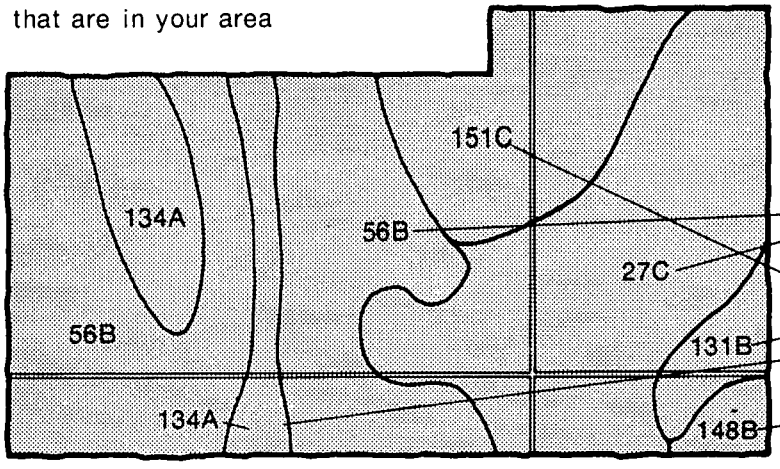
2. Note the number of the map sheet and turn to that sheet.

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





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



Symbols

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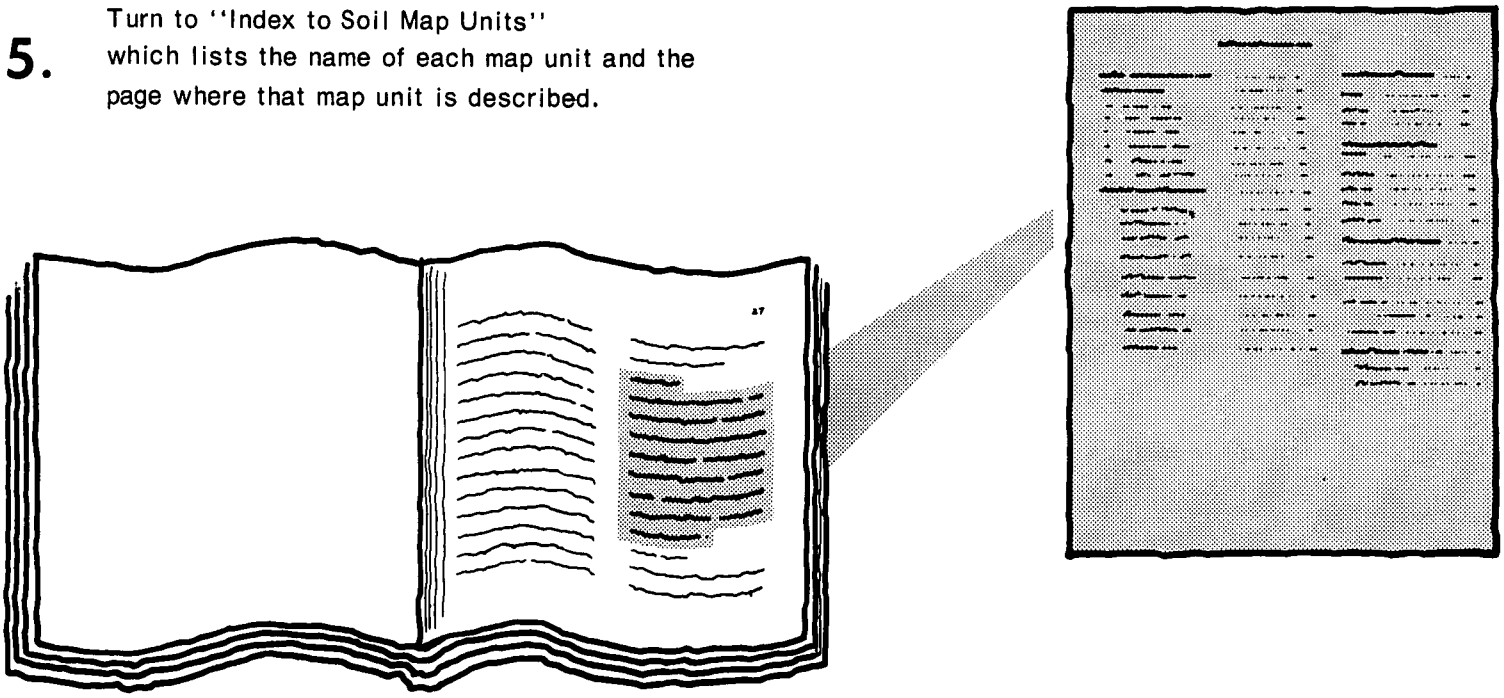
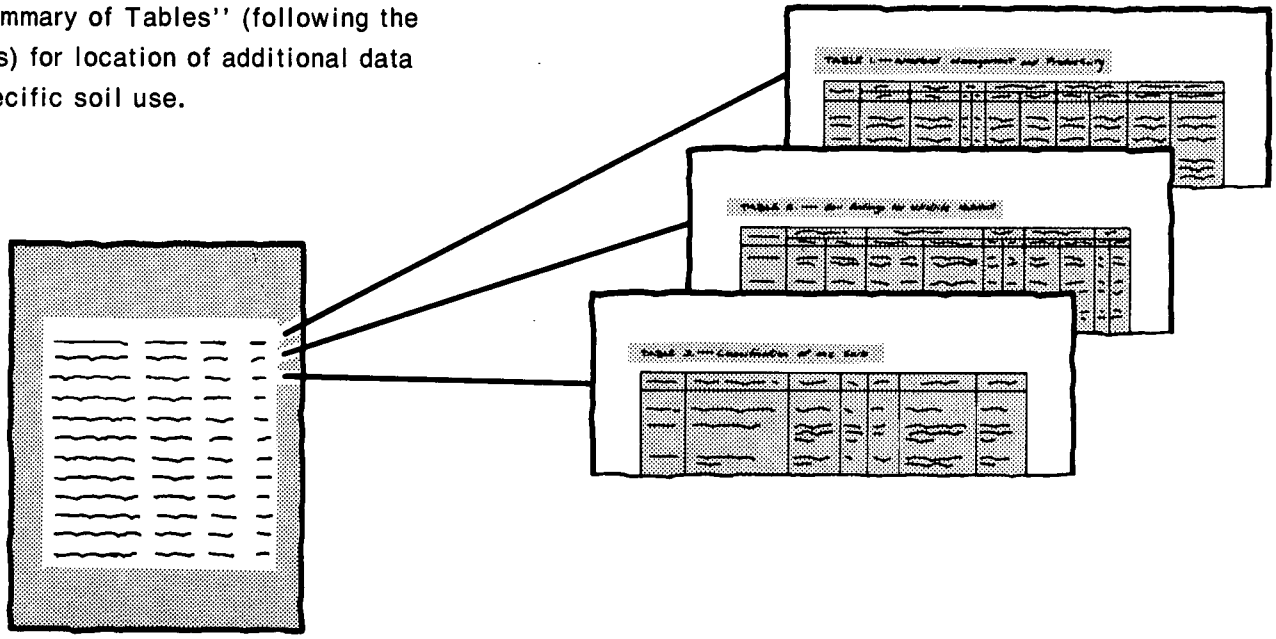
THIS SOIL SURVEY

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; for specialists in wildlife management, waste disposal, or pollution control.

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

Major fieldwork for this soil survey was completed in the period 1964-72. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1972. This survey was made cooperatively by the Soil Conservation Service and Forest Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the National Forest System Administration.

Cover: Typical landscape in the Piedra Area. In foreground is area of Skyway soils that support grasses and Castelleia soils that support trees. Navajo Peak in background.

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foreword

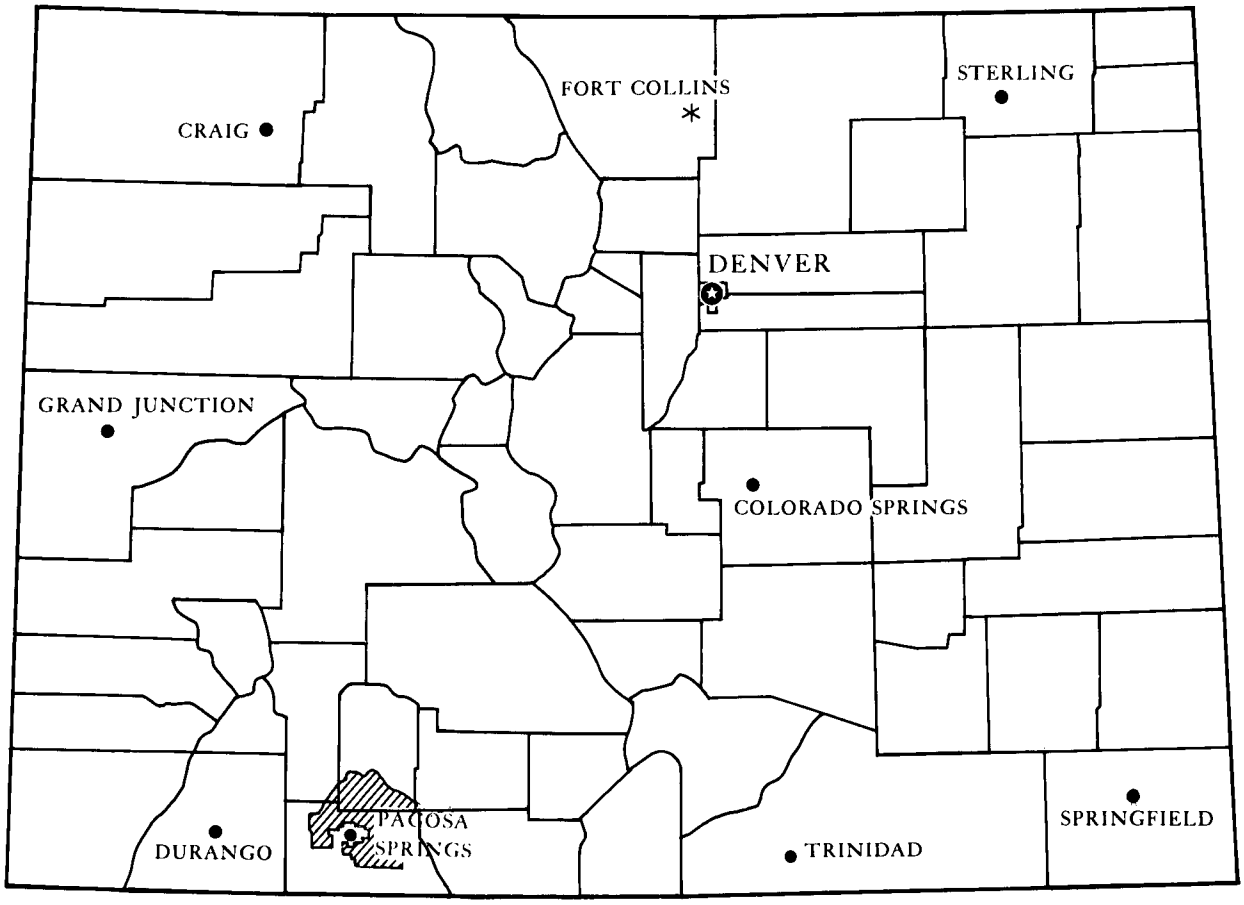
This soil survey contains information that can be used in land-planning programs in Piedra Area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact that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

This soil survey has been prepared 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 homebuyers 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 even within short distances. Soils may be 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 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 kind of soil is shown on 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 Forest Service, the Soil Conservation Service, or the Cooperative Extension Service.

Sheldon G. Boone
State Conservationist
Soil Conservation Service



* State Agricultural Experiment Station

Location of Piedra Area in Colorado.

Soil survey of

Piedra Area, Colorado

Parts of Archuleta, Hinsdale, La Plata, Mineral, and Rio Grande Counties

By Ronald F. Bauer, Forest Service
Fieldwork by Ronald F. Bauer, Cecil R. Armstrong, W. David Loggy, and Richard A. Thompson, Forest Service

United States Department of Agriculture
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PIEDRA AREA is in the San Juan National Forest. The survey area includes parts of Archuleta, Conejos, Hinsdale, La Plata, Mineral, and Rio Grande Counties. The total area is 848,219 acres, or about 1,325 square miles. There are no towns in the area, but Pagosa Springs, Bayfield, and Ignacio are nearby. The Forest supervisor is located in Durango.

Approximately 84 percent of the area is under the administration of the Forest Service. It is used for recreation, livestock grazing, timber production, watershed, and wildlife habitat. Mining and mineral exploration are also permitted by federal law. Most of the rest of the area is used for privately owned ranches and for recreation.

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.

general nature of the survey area

This section provides general information about the survey area. It discusses physiography and relief, climate, and vegetation.

physiography and relief

Piedra Area is in the San Juan Mountains of the Southern Rocky Mountains province and in the Navajo section of the Colorado Plateau province (*3*).

The San Juan Mountains are made up of nearly horizontal sheets of lava and tuff. They are maturely dissected. Total relief is about 5,900 feet. Peaks commonly are more than 13,000 feet high, and valleys are 2,000 to 4,000 feet deep. Glaciation has sculptured the mountains, and troughs, cirques, horns, cols, and serrate ridges are common. Terminal and lateral moraines and areas of outwash are at the edges of the mountain.

The small part of the survey area in the northwestern part of the Navajo section is underlain mainly by sandstone, shale, and some limestone. The beds vary

from nearly level to steeply dipped and folded. Mesas, cuestas, hogbacks, rock terraces, retreating escarpments, canyons, anticlines, and synclines are common in this area.

Elevations of Piedra Area ranges from 6,280 feet, where the Piedra River leaves the area, to 13,300 feet, at the top of Summit Peak.

climate

The climate of Piedra Area varies greatly because of the rugged topography. The average annual temperature is less than 32 degrees F on mountaintops and in cirque basins. Summers are cool in the mountains. Precipitation is fairly evenly distributed throughout the year. The amount of precipitation generally increases as elevation increases. Snow is on the ground in most areas during the winter, and it remains as late as June or early in July at the higher elevations.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Vallecito Dam and Wolf Creek Pass, Colorado, for the period of 1951-74. Vallecito Dam is at an elevation of 7,520 feet, and Wolf Creek Pass is at an elevation of 10,850 feet. Both of these locations are just outside the survey area, but the data recorded there is typical of that in the area. 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.

At the lower elevations, the average temperature in winter is 23.9 degrees F, and the average daily minimum is 8.5 degrees. The lowest temperature on record, which occurred at Vallecito Dam on January 12, 1963, is -35 degrees. In summer the average temperature is 61.6 degrees, and the average daily maximum temperature is 78.7 degrees. The highest recorded temperature, which occurred on June 22, 1954, was 92 degrees.

At the higher elevations, the average temperature in winter is 18 degrees F, and the average daily minimum is 6 degrees. The lowest temperature on record, which occurred at Wolf Creek Pass on January 12, 1963, is -30 degrees. In summer the average temperature is 51 degrees, and the average daily maximum is 63 degrees. The highest recorded temperature, which occurred on July 11, 1958, is 79 degrees.

Growing degrees days are shown in table 1. They 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 F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 12 inches at the lower elevations and about 18 inches at the higher elevations. Of this, about 45 percent usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 9 inches at the lower elevations and less than 14 inches at the higher elevations. The heaviest 1-day rainfall during the period of record was 3.89 inches at Wolf Creek Pass on September 6, 1970. Thunderstorms occur on about 44 days each year, and about 30 occur in summer.

Average seasonal snowfall is 125 inches at the lower elevations and 438 inches at the higher elevations. The greatest snow depth at any one time during the period of record was 161 inches at Wolf Creek Pass. On an average of 30 days at the lower elevations and 76 days at the higher elevations, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 35 percent in spring and about 45 percent during the rest of the year. Humidity is higher at night, and the average at dawn is about 77 percent. The sun shines 77 percent of the time possible in summer and 73 percent in winter.

vegetation

The types of vegetation in Piedra Area depend on factors such as the kinds of soil, climate, slope, and elevation. There are six broad types of vegetation in the survey area that include many kinds of trees, shrubs, forbs, grasses, and grasslike plants. These types of vegetation are foothill shrub, ponderosa pine-bunchgrass, spruce-fir and mountain bunchgrass, meadow, aspen-forb-grass, and alpine.

Foothill shrub vegetation is at the lower elevations in the area. It includes sagebrush and other brush, grasses, pinyon, and juniper. Sagebrush and grasses are on the Nunn soils on valley bottoms. Pinyon, juniper, and brush are on the Carracas and Corta soils on ridgetops and steep side slopes.

Ponderosa pine-bunchgrass vegetation is on the Dunton, Chris, Pagosa, and Greenough soils on mesas and cuestas. These areas are used for timber and forage production.

Spruce-fir and mountain bunchgrass vegetation is in mountainous areas. Spruce and fir are on the Leal, Grenadier, Limber, and Woodrock soils. Bunchgrass is on the Coni, Judy, Molas, Rogert, Skyway, and Winifred soils. These areas are used for timber and forage production and as watershed.

Meadow vegetation is on the Hunchback soils and some Histic Cryaquepts in swales and other low-lying areas. These areas are used for forage production and as watershed.

Aspen-forb-grass vegetation is on the Castelleia and Miracle soils in mountainous areas. These areas are used for forage production and as watershed.

Alpine vegetation is on the Hossick and Vasquez soils and Typic Cryohemists in areas above 11,800 feet. It includes turf, meadow, and willows and other bog vegetation. These areas are used as watershed and for recreation.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

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 and some minor soils. It is named for the major soils. The soils 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 can be identified on the map. Likewise, areas where the soils 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.

soil descriptions

1. Corta-Carracas-Nunn

Shallow to deep, well drained, fine textured to medium textured soils that formed in material derived from interbedded shale and sandstone

This map unit is on mesas, canyons, and hogbacks. It extends from Highway 160 south to the boundary of the San Juan National Forest and from Pine River to east of Highway 84, excluding Eightmile Mesa. Elevation ranges from 6,000 to 8,500 feet.

This unit makes up about 24 percent of the survey area. It is 42 percent Corta soils, 26 percent Carracas soils, and 12 percent Nunn soils. The remaining 20 percent is components of minor extent.

The deep Corta soils are on ridgetops and some north-facing slopes. The subsoil is more than 45 percent clay. These soils support ponderosa pine in the moister areas and pinyon and juniper in the drier areas.

The shallow Carracas soils are on steep, south-facing slopes and some ridgetops. Weathered bedrock is at a depth of less than 20 inches. These soils support brushy plants such as yucca, squaw-apple, and mountainmahogany. Ponderosa pine, pinyon, and juniper grow in some of the more gently sloping areas.

The deep Nunn soils are on canyon and valley bottoms. These soils formed in colluvium and alluvium. The subsoil is clay. Vegetation is mainly big sagebrush and grasses. The hazards of gully erosion and piping are high on these soils.

Of minor extent in this unit are Greenough, Heflin, Hunchback, Mayoworth, and Pescar soils, Sandstone outcrop, and Badland. Greenough soils formed in eolian material randomly deposited on the unit. Heflin soils are between the Carracas soils on the steep slopes and the Nunn soils on the valley bottoms. Heflin soils formed in colluvium and alluvium that are coarser textured than the parent material of the Nunn soils. Greenough and Heflin soils support ponderosa pine. The somewhat poorly drained Hunchback soils are in swales and along minor drainageways. These soils support dry meadow vegetation. Mayoworth soils are on north- and east-facing slopes. They support ponderosa pine and Douglas-fir. Pescar soils are on terraces along major drainageways.

This unit is used mainly as winter range for game animals, as summer range for livestock, and for wildlife habitat. It is also used for some timber production. Some areas of the Nunn soils outside the San Juan National Forest are used for small grain.

Precipitation on this unit is lower than that on most other units in the survey area. The hazard of erosion is high. Revegetation is extremely difficult on the Carracas soils because of the shallow depth to bedrock, and it is moderately difficult on the Nunn and Corta soils because of the clayey subsoil.

2. Dunton-Chris

Moderately deep and deep, moderately well drained and well drained, moderately fine textured and fine textured soils that formed in material derived from sandstone

This map unit is on cuestas and mesas and in canyons. It extends from Slide and Indian Mountains southeast to Eightmile Mesa. Elevation ranges from 7,000 to 10,000 feet.

This unit makes up about 25 percent of the survey area. It is 39 percent Dunton soils and 33 percent Chris soils. The remaining 28 percent is components of minor extent.

The Dunton soils are on mesas and dip slopes of cuestas. These soils are moderately deep to hard sandstone and are moderately well drained. The subsurface layer is loam, and the subsoil is clay loam. The vegetation is mainly ponderosa pine and oak brush with an understory of wyethia and grasses. Landslides may occur on the steeper slopes.

The Chris soils are on canyonsides. These soils are deep to hard sandstone and are well drained. The subsurface layer is gravelly loam or stony loam, and the subsoil is very gravelly clay or very stony clay. The vegetation is mainly ponderosa pine and oak brush with an understory of forbs and grasses.

Of minor extent in this unit are small areas of Adel, Carracas, Coni, Hunchback, Judy, Limber, and Miracle soils and Sandstone outcrop. The deep Adel soils are on toe slopes in the valleys. These soils have a thick surface layer. The shallow Carracas and Coni soils are scattered throughout the unit. The deep, somewhat poorly drained Hunchback soils are in swales. Judy, Limber, and Miracle soils are moderately deep. Miracle soils are scattered throughout the unit. Sandstone outcrop is on escarpments at the edges of mesas and dip slopes, where they break into canyons.

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

Ponderosa pine is the main species of tree on this unit (fig. 1). Some Douglas-fir is on the north-facing slopes, and some spruce and fir are at the higher elevations.

Precipitation on this unit is adequate for timber production. Revegetation is difficult on the Chris soils, however, because of steepness of slope, and reforestation is difficult on the Dunton soils because of competition from grass. The clay loam subsoil of the Dunton soils should not be left exposed during planting because of the slow water intake rate. It is a good practice to scarify the surface of the Dunton soils to facilitate infiltration and increase the rate of seedling survival. The hazard of soil blowing on this unit is high.

Figure 1. Typical area of the Dunton-Chris general map unit.

3. Pagosa-Winifred

Deep and moderately deep, moderately well drained and well drained, fine textured soils that formed in material weathered from shale and till and underlain by shale

This map unit extends from O'Neal Park to Williams Reservoir. Elevation ranges from 7,500 to 9,500 feet.

This unit makes up about 6 percent of the survey area. It is 53 percent Pagosa soils and 24 percent Winifred soils. The remaining 23 percent is components of minor extent.

The deep, moderately well drained Pagosa soils are on the gently sloping tops of interfluves. These soils formed in till overlying impervious shale. The subsurface layer is loam, and the subsoil is clay loam. The vegetation is mainly ponderosa pine and oak brush with an understory of forbs and grasses. The hazard of erosion is slight.

The moderately deep, well drained Winifred soils are on rolling hills. These soils have a clay subsoil underlain by soft shale. The vegetation is mainly grasses. The hazard of erosion is high.

Of minor extent in this unit are small areas of Hunchback and Molas soils. The deep, somewhat poorly drained Hunchback and Molas soils are in swales and along streams. The moderately deep, poorly drained Molas soils are underlain by shale.

This unit is used mainly for timber production and livestock grazing. Areas that are privately owned are used as rangeland and for hay and some small grain. Some areas are irrigated.

4. Castelleia-Animas

Deep and moderately deep, well drained and somewhat poorly drained, moderately fine textured soils that formed in landslide material derived from volcanic rock.

This map unit is in the landslide area of Leche Creek and Harris and Buckles Lakes in the southeastern part of the survey area. The soils formed in landslide material derived from igneous rock, principally andesite and quartz latite. The soils are hummocky, and the drainage pattern is not well developed. Elevation ranges from 8,000 to 10,500 feet.

This unit makes up about 4 percent of the survey area. It is 85 percent Castelleia soils, 8 percent Animas soils, and the remaining 7 percent is components of minor extent.

The deep, well drained Castelleia soils are on the higher positions of the landscape. The thin surface layer and the subsurface layer are loam. The subsoil is clay loam. These soils support white fir and aspen.

The moderately deep and somewhat poorly drained Animas soils are in depressional areas. Drainage is limited by the moderate depth to impervious shale. These soils support birch, willow, and carex.

Of minor extent in this unit are areas of Hunchback soils and Igneous outcrop. The somewhat poorly drained Hunchback soils are in swales and along drainageways.

This unit is used mainly as watershed and for timber production. Some areas are also used for livestock grazing.

The main concern for road construction on this unit is providing drainage on the Animas soils. Undercutting the toes of the hummocks generally initiates landslides.

5. Woodrock-Muggins

Moderately deep and deep, well drained, moderately fine textured and fine textured soils that formed in material derived from igneous rock and glacial deposits

This map unit is in an area below the palisades that extend from the upper reaches of the Weminuche Valley to Jackson Mountain. Elevation ranges from 7,000 to 10,000 feet.

This unit makes up about 6 percent of the survey area. It is 56 percent Woodrock soils and 16 percent Muggins soils. The remaining 28 percent is components of minor extent.

The moderately deep Woodrock soils formed in material derived from igneous rock on mountainsides. The thin surface layer and the subsurface layer are silt loam. The subsoil is gravelly clay loam underlain by hard quartz latite. These soils support Engelmann spruce and white fir.

The deep Muggins soils are on moraines in valleys. The thin surface layer and the subsurface layer are loam. The subsoil is clay loam. These soils support Engelmann spruce and white fir.

Of minor extent in this unit are Rogert soils that are mainly on south-facing slopes, Cryorthents, and Igneous outcrop. The shallow Rogert soils have a dark-colored surface layer. They support grasses. The shallow Cryorthents have a light-colored surface layer.

This unit is used for timber production and wildlife habitat and as watershed.

Rock outcrop and the shallow depth of the minor soils limit the production of vegetation.

6. Grenadier-Rogert-Skyway

Shallow to deep, well drained, medium textured and moderately coarse textured soils that formed in material derived from andesite and quartz latite

This map unit is in mountainous areas below the timberline (fig. 2). It extends from Wolf Creek south to Navajo Peak. Elevation ranges from 8,500 to 11,500 feet. Valleys are *V*-shaped, and ridges that divide drainageways are narrow and well defined.

This unit makes up about 13 percent of the survey area. it is 40 percent Grenadier soils, 5 percent Rogert soils, and 5 percent Skyway soils. The remaining 50 percent is components of minor extent.

Figure 2. Area of the Grenadier-Rogert-Skyway general map unit. Grenadier soils are on the valley bottoms, Rogert soils are on the steeper side slopes, and Skyway soils are on the less sloping side slopes.

This deep Grenadier soils are on valley sides and ridgetops. The thin subsurface layer is loam, and the subsoil is very stony loam. These soils support Engelmann spruce and subalpine fir. The understory is very sparse.

The shallow Rogert soils are on south- and west-facing slopes. These soils are gravelly loam. Andesite is at a depth of less than 20 inches. The vegetation is mainly grasses.

The Skyway soils are moderately deep. The very thick surface layer is loam. Quartz latite is at a depth of 30 to 40 inches. The vegetation is mainly grasses.

Of minor extent in this unit are Leal and Woodrock soils, Typic Ustorthents, and Igneous outcrop. The deep Leal soils have fewer coarse fragments than the rest of the unit. They support an understory of polemonium, vaccinium, and ribes. Woodrock soils are at the lower elevations of the unit. The subsoil is gravelly clay loam. Typic Ustorthents are deep soils that formed on alluvial cones at the base of steep drainageways. Igneous outcrop is throughout the unit.

This unit is used as watershed and for timber production and wildlife habitat.

Steepness of slope and depth to hard bedrock are special concerns for road construction and timber harvesting.

7. Leal-Endlich-Sambrito

Deep and moderately deep, well drained, moderately coarse textured soils that formed in material derived from igneous rock

This map unit is in mountainous areas below the timberline. It extends from Wolf Creek west to the Pine-Piedra divide. Valleys are *U*-shaped, and valley divides are commonly broad and rounded. Elevation ranges from 8,500 to 11,500 feet.

This unit makes up about 11 percent of the survey area. It is 82 percent Leal soils, 6 percent Endlich soils, and 4 percent Sambrito soils. The remaining 8 percent is components of minor extent.

The deep Leal soils are on valley sides and ridgetops. The thin surface layer and the subsurface layer are sandy loam. The subsoil is weak sandy loam. Bedrock is

at a depth of 40 to 60 inches. These soils support Engelmann spruce and subalpine fir with an understory of polemonium, vaccinium, and ribes.

The moderately deep Endlich soils are in the area of Granite Peak, Graham Peak, and the upper part of Coldwater Creek basin. The thin subsurface layer is stony loam, and the subsoil is weak very stony loam. Bedrock is at a depth of 20 to 36 inches. The amount of precipitation is high on these soils; however, the available water capacity is limited by the moderate depth to bedrock.

The deep Sambrito soils are on toe slopes at the base of valley sides. The thin surface layer is loam, and the subsoil is weak gravelly coarse sandy loam. These soils support Engelmann spruce and subalpine fir with an understory of shrubs and forbs. The Sambrito soils are permeable.

Of minor extent in this unit are small areas of Grenadier soils and Igneous outcrop.

This unit is used mainly as watershed. Areas outside the Weminuche Wilderness Area are also used for timber production.

Timber production on the Endlich soils is limited by moderate depth to bedrock.

8. Igneous outcrop-Hossick

Rock outcrop, and moderately deep, well drained, moderately coarse textured soils that formed in material derived from igneous rock

This map unit is in subalpine and alpine areas, both glaciated and nonglaciated. Elevation is 10,500 to 11,500 feet in the subalpine areas, and it is more than 11,500 feet in the alpine areas. The glaciated part extends from near Wolf Creek west to the upper reaches of Weminuche Creek. It consists of horns, cols, and cirques. The cols are sharp, but other interfluve divides have been smoothed by glacial action. The nonglaciated part is south of Wolf Creek Pass on the west side of the Continental Divide. Some of the interfluve divides are sharp, and others are broad and poorly defined. Patterned ground, stonestrips, and garlands of rock fragments are throughout this unit. The garlands are the result of frost heaving.

This unit makes up about 11 percent of the survey area. It is 57 percent Igneous outcrop and 26 percent Hossick soils. The remaining 17 percent is components of minor extent.

Igneous outcrop is throughout the unit. It occurs as peaks and headwall cliffs and as a scoured surface in cirque basins.

The moderately deep, well drained Hossick soils are on mountains. The surface layer is dark-colored gravelly loam. Bedrock is at a depth of 20 to 40 inches.

Of minor extent in this unit are Vasquez soils, Typic Cryohemists, Histic Cryaquepts, and Rubble land. Cryohemists and Cryaquepts are very poorly drained soils in the lower parts of cirques. Rubble land is talus at the base of cliffs.

This unit is used as watershed and for wildlife habitat and recreation. Parts of this unit are in the Weminuche Wilderness Area.

detailed soil map units

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

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil 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 material, 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 material. 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, Castelleia gravelly loam, 4 to 25 percent slopes, is one of several phases in the Castelleia series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Vasquez-Rock outcrop complex, 4 to 30 percent slopes, is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rubble land is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

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.

soil descriptions

1D—Adel loam, 4 to 25 percent slopes. This deep, moderately well drained soil is on hilltops, toe slopes, and interfluves. It formed in landslide and alluvial material derived from many kinds of rock. Elevation is 8,200 to 9,000 feet. The average annual precipitation is about 25 inches.

The surface layer is brown loam and clay loam 16 to 40 inches thick. The underlying material is light yellowish brown gravelly clay loam 25 to 45 inches thick. Shale is at a depth of 60 inches or more.

Included in this unit are small areas of deep loams and silt loams overlying cobbly material. These soils are on the outer edges of the toe slopes.

Permeability of this Adel soil is moderate. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for forage production.

The present vegetation in most areas is mainly Thurber fescue, Arizona fescue, brome, bluegrass, needlegrass, and carex. Standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

Steepness of slope limits road construction. Roads need to be surfaced. The hazard of cutbank slumping is slight. The shale is rippable and therefore is not a serious limitation for roads.

This map unit is in capability subclass VIe.

1E—Adel loam, 25 to 65 percent slopes. This deep, moderately well drained soil is on hummocky toe slopes. It formed in landslide material derived from many kinds of rock. Elevation is 8,200 to 9,000 feet. The average annual precipitation is 22 to 27 inches.

The surface layer is brown loam and clay loam 16 to 30 inches thick. The underlying material is light yellowish brown gravelly clay loam 25 to 35 inches thick. Shale is at a depth of 60 inches or more.

Included in this unit are small areas of Typic Ustorthents and shale outcrop.

Permeability of this Adel soil is moderate. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

This unit is used for forage production.

If this unit is used as rangeland, the main limitation is steepness of slope. Plant cover should be maintained on 40 to 50 percent of the unit to control erosion.

Steepness of slope severely limits road construction. Roads need to be surfaced. The hazard of cutbank slumping is moderate. The shale is rippable and therefore is not a serious limitation for roads.

This map unit is in capability subclass VIIe.

2D—Animas loam, 4 to 25 percent slopes. This moderately deep, somewhat poorly drained soil is in swales and on the lower parts of hummocky areas. It formed in landslide material derived from quartz latite, andesite, and other volcanic rock. Areas are circular and are 10 to 25 acres in size. The native vegetation is mainly birch, willows, and carex. Elevation is 6,500 to 9,000 feet. The average annual precipitation is 17 to 27 inches.

The surface layer is dark grayish brown and dark gray loam 5 to 12 inches thick. The subsoil is light brown gravelly sandy clay loam 7 to 13 inches thick. The substratum is brown gravelly sandy clay loam 12 to 20 inches thick. Shale is at a depth of 30 to 40 inches.

Included in this unit are small areas of Adel and Castelleia soils.

Permeability of this Animas soil is moderately slow. Available water capacity is high. Runoff is ponded or very slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 18 to 30 inches in spring and summer.

This unit is used for wildlife habitat.

This unit is poorly suited to roads because of the seasonal high water table. Where feasible, roads should be built on adjacent, more suitable soils.

This map unit is in capability subclass VIw.

2E—Animas loam, 25 to 65 percent slopes. This moderately deep, somewhat poorly drained soil is on toe slopes along minor drainageways. It formed in landslide material derived from quartz latite, andesite, and other volcanic rock. Areas are long and narrow and are 10 to 25 acres in size. The native vegetation is mainly birch, willows, and carex. Elevation is 6,500 to 9,000 feet. The average annual precipitation is 17 to 27 inches.

The surface layer is dark grayish brown and dark gray loam 5 to 12 inches thick. The subsoil is light brown gravelly sandy clay loam 6 to 12 inches thick. The substratum is brown gravelly sandy clay loam 12 to 20 inches thick. Shale is at a depth of 30 to 40 inches.

Included in this unit are small areas of soils that do not have a sandy clay loam subsoil.

Permeability of this Animas soil is moderately slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. A seasonal high water table is at a depth of 18 to 30 inches in spring and summer.

This unit is used for wildlife habitat.

If roads are built on this unit, drainage and surfacing are needed because of the seasonal high water table. The shale is rippable and therefore is not a serious limitation for roads.

This map unit is in capability subclass VIIw.

3—Badland. This map unit consists of steep to extremely steep, deeply dissected areas of barren, exposed shale. Relief ranges from about 50 to 250 feet. Runoff is very rapid, and the hazard of water erosion is high.

Included in this unit are small areas of Carracas soils.

The main limitations for engineering uses are steepness of slope and low soil strength.

This map unit is in capability subclass VIIIe.

4D—Carracas loam, 4 to 25 percent slopes. This shallow, well drained soil is on ridgetops and mesas. It formed in residuum derived from interbedded shale and sandstone. Elevation is 6,500 to 8,000 feet. The average annual precipitation is about 22 to 27 inches.

The surface layer is very dark gray loam 2 to 4 inches thick. The underlying material is yellowish brown sandy loam 8 to 18 inches thick. Interbedded sandstone and shale are at a depth of 12 to 20 inches.

Included in this unit are small areas of shale and sandstone outcrop and a soil that has bedrock at a depth of more than 20 inches.

Permeability of this Carracas soil is moderate. Available water capacity is low. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for wildlife habitat.

The vegetation on this unit is sparse and is low in productivity. Revegetation of disturbed areas is difficult because of the low available water capacity and limited fertility of the soil.

The main limitation for engineering uses, such as roads, is shallow depth to bedrock.

This map unit is in capability subclass VIe.

4E—Carracas loam, 25 to 65 percent slopes. This shallow, well drained soil is on the sides of valleys and canyons and on scarp slopes of hogbacks and cuestas. It formed in residuum derived from interbedded shale and sandstone. Elevation is 6,500 to 8,000 feet. The average annual precipitation is about 22 to 27 inches.

The surface layer is very dark gray loam 2 to 4 inches thick. The underlying material is yellowish brown sandy loam 8 to 18 inches thick. Interbedded shale and sandstone are at a depth of 12 to 20 inches.

Included in this unit are small areas of shale and sandstone outcrop.

Permeability of this Carracas soil is moderate. Available water capacity is low. Runoff is very rapid, and the hazard of water erosion is high.

This unit is used for wildlife habitat.

The vegetation on this unit is sparse and is low in productivity. Revegetation of disturbed areas is difficult because of low available water capacity and limited inherent fertility.

The main limitations for roads are depth to the weak, rippable bedrock and steepness of slope. The hazard of cutbank slumping is high.

This map unit is in capability subclass VIIe.

5D—Castelleia loam, 4 to 25 percent slopes. This deep, well drained soil is in hummocky landslide areas. It formed in mixed landslide material derived from quartz latite and igneous rock overlying shale and sandstone at a depth of 5 to 50 feet. Elevation is 8,000 to 10,500 feet. The average annual precipitation is about 22 to 34 inches.

The surface layer is very dark brown loam 2 to 5 inches thick. The upper part of the subsurface layer is dark grayish brown loam 5 to 10 inches thick. The lower part is grayish brown loam 6 to 12 inches thick. The subsoil is dark brown clay loam 6 to 10 inches thick. The substratum to a depth of 60 inches or more is brown extremely stony clay loam.

Included in this unit are small areas of somewhat poorly drained Animas and Hunchback soils in swales and other low-lying areas.

Permeability of this Castelleia soil is moderate. Available water capacity is high. Runoff is medium, and the hazard of water erosion is slight.

This unit is used for timber production and as watershed and rangeland.

The present vegetation in most areas is mainly aspen, white fir, snowberry, grasses, and forbs. Standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

The main limitation for roads is the wetness of the included soils.

This map unit is in capability subclass VIe.

5E—Castelleia loam, 25 to 65 percent slopes. This deep, well drained soil is on hillsides and on toe slopes of valley sides. It formed in landslide material derived from quartz latite and other igneous rock overlying shale and sandstone at a depth of 5 to 30 feet. Elevation is 8,000 to 10,500 feet. The average annual precipitation is about 22 to 34 inches.

The surface layer is very dark brown loam less than 5 inches thick. The upper part of the subsurface layer is dark brown loam 6 to 10 inches thick. The lower part is grayish brown loam 8 to 12 inches thick. The subsoil is dark brown clay loam 6 to 10 inches thick. The substratum to a depth of 60 inches or more is brown extremely stony clay loam.

Included in this unit are small areas of Rubble land and soils that are dominantly stones 1 inch to 8 inches in diameter.

Permeability of this Castelleia soil is moderate. Available water capacity is high. Runoff is medium, and the hazard of water erosion is high.

This unit is used for timber production and as watershed and rangeland.

The present vegetation in most areas is mainly aspen, white fir, snowberry, grasses, and forbs. Standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

Steepness of slope and seep areas limit road construction. The hazard of cutbank slumping is moderate.

This map unit is in capability subclass VIIe.

6E—Castelleia loam, dark surface, 25 to 65 percent slopes. This deep, well drained soil is in hummocky areas. It formed in mixed landslide material derived from quartz latite and other igneous rock overlying shale and sandstone at a depth of 5 to 30 feet. Elevation is 8,000 to 10,500 feet. The average annual precipitation is about 22 to 35 inches.

The surface layer is very dark brown loam 3 to 6 inches thick. The upper part of the subsurface layer is grayish brown loam 3 to 12 inches thick. The lower part is dark grayish brown and grayish brown clay loam 7 to 20 inches thick. The substratum to a depth of 60 inches or more is brown loam.

Included in this unit are small areas of somewhat poorly drained Animas and Hunchback soils in swales and other low-lying areas.

Permeability of this Castelleia soil is moderate. Available water capacity is high. Runoff is slow, and the hazard of water erosion is high.

This unit is used as watershed and for timber production.

The present vegetation in most areas is mainly white fir, Engelmann spruce, and aspen with an understory of nodding bromegrass, common snowberry, lupine, and sedges. Standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

The main limitation for roads is the wetness of the included soils.

This map unit is in capability subclass VIIe.

7D—Castelleia gravelly loam, 4 to 25 percent slopes. This deep, well drained soil is in hummocky areas. It formed in mixed landslide material derived from quartz latite and other igneous rock overlying shale and sandstone at a depth of 10 to 50 feet. Elevation is 8,000 to 10,500 feet. The average annual precipitation is about 22 to 34 inches.

The surface layer is very dark brown gravelly loam 3 to 5 inches thick. The upper part of the subsurface layer is dark grayish brown gravelly loam 5 to 10 inches thick. The lower part is grayish brown gravelly loam 6 to 12 inches thick. The subsoil is dark brown gravelly clay loam 6 to 10 inches thick. The substratum to a depth of 60 inches or more is brown very stony sandy clay loam.

Included in this unit are small areas of Animas and Hunchback soils and soils that have bedrock at a depth of less than 40 inches.

Permeability of this Castelleia soil is moderate. Available water capacity is high. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for timber production and as watershed and rangeland.

The present vegetation is mainly aspen, white fir, snowberry, grasses, and forbs. Standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

Steepness of slope is the main limitation for roads.

This map unit is in capability subclass VIe.

7E—Castelleia gravelly loam, 25 to 65 percent slopes. This deep, well drained soil is on hillsides and on toe slopes of valley sides. It formed in landslide material derived from quartz latite and other igneous rock overlying shale and sandstone at a depth of 5 to 50 feet. Elevation is 8,000 to 10,500 feet. The average annual precipitation is about 22 to 34 inches.

The surface layer is very dark gray gravelly loam 3 to 5 inches thick. The upper part of the subsurface layer is dark grayish brown gravelly loam 5 to 10 inches thick. The lower part is grayish brown gravelly loam 6 to 12 inches thick. The subsoil is dark brown gravelly clay loam 6 to 10 inches thick. The substratum to a depth of 60 inches or more is brown very stony sandy clay loam.

Included in this unit are small areas of shale outcrop and Igneous outcrop. Also included are Rubble land and soils that have bedrock at a depth of less than 40 inches.

Permeability of this Castelleia soil is moderate. Available water capacity is high. Runoff is medium, and the hazard of water erosion is high.

This unit is used for timber production and as watershed and rangeland.

The present vegetation is mainly aspen, white fir, snowberry, grasses, and forbs. Standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

The main limitation for engineering uses is steepness of slope. The hazard of cutbank slumping is moderate.

This map unit is in capability subclass VIIe.

8E—Chris gravelly loam, 25 to 65 percent slopes. This deep, well drained soil is on the sides of canyons. It formed in residuum and alluvium derived from sandstone. Elevation is 7,500 to 10,000 feet. The average annual precipitation is 20 to 30 inches.

Typically, the surface is covered with a layer of duff 2 inches thick or less. The next layer is pinkish gray gravelly loam 4 to 12 inches thick. Below this is pinkish gray and reddish brown gravelly clay loam 3 to 12 inches thick. The subsoil is reddish brown very gravelly clay 8 to 30 inches thick. The substratum to a depth of 60 inches or more is light reddish brown very stony sandy clay loam. Hard sandstone is at a depth of 40 to 80 inches.

Included in this unit are small areas of sandstone outcrop, Carracas soils, and Chris soils that have slopes of less than 25 percent.

Permeability of this Chris soil is slow. Available water capacity is moderate. Runoff is rapid, and the hazard of water erosion is moderate.

This unit is used mainly for wildlife habitat. It is also used for timber production.

Steepness of slope limits the use of equipment. Rapid runoff and droughtiness limit establishment of vegetation. Steepness of slope and depth to hard bedrock are the main limitations for engineering uses. The hazard to mass slope failure is moderate to high, depending on the local strike and dip of the sedimentary bedrock.

This map unit is in capability subclass VIe.

9E—Chris stony loam, 25 to 65 percent slopes. This deep, well drained soil is on the sides of canyons. It formed in residuum and alluvium derived from sandstone. Elevation is 7,500 to 10,000 feet. The average annual precipitation is 20 to 30 inches.

About 50 percent of the surface layer or less is covered with a layer of duff. The next layer is pinkish gray stony gravelly loam 5 to 12 inches thick. Below this is pinkish gray and reddish brown stony clay loam 6 to 12 inches thick. The subsoil is reddish brown stony clay loam 10 to 20 inches thick. The substratum to a depth of 60 inches or more is light reddish brown very stony sandy clay loam. Hard sandstone is at a depth of 40 to 80 inches.

Included in this unit are small areas of sandstone outcrop and Carracas soils.

Permeability of this Chris soil is slow. Available water capacity is moderate. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for wildlife habitat. It is also used for timber production.

Steepness of slope limits the use of equipment. Rapid runoff, droughtiness, and stones limit establishment of vegetation. Steepness of slope, stones, and depth to hard bedrock are the main limitations for engineering uses. The hazard of landsliding is moderate to high, depending on the slope of the underlying sedimentary bedrock.

This map unit is in capability subclass VIIe.

10D—Coni sandy loam, 4 to 25 percent slopes. This shallow, well drained soil is on the edges of cuesta dip slopes near canyon breaks. It formed in residuum derived from sandstone. Elevation is 8,000 to 9,000 feet. The average annual precipitation is 22 to 27 inches.

The surface layer is brown sandy loam 5 to 8 inches thick. The subsoil is dark brown loam 6 to 9 inches thick. The substratum is very pale brown loamy fine sand 1 to 9 inches thick. Unweathered sandstone is at a depth of 12 to 20 inches.

Included in this unit are small areas of Dunton and Carracas soils and sandstone outcrop.

Permeability of this Coni soil is moderate. Available water capacity is low. The hazard of water erosion is moderate.

This unit is used for wildlife habitat.

The vegetation on this unit is sparse and is low to moderate in productivity because of the shallow soil depth. Shallow depth to hard sandstone is also a severe limitation for engineering uses.

This map unit is in capability subclass VIs.

10E—Coni sandy loam, 25 to 65 percent slopes. This shallow, well drained soil is on the sides of canyons. It is below the breaks of mesas and cuesta slopes and above the very steep sides of canyons. It formed in residuum derived from sandstone. Elevation is 8,000 to 9,000 feet. The average annual precipitation is 22 to 27 inches.

The surface layer is brown sandy loam 5 to 7 inches thick. The subsoil is dark brown loam 4 to 7 inches thick. The substratum, where present, is very pale brown loamy fine sand as much as 9 inches thick. Unweathered sandstone is at a depth of 12 to 20 inches.

Included in this unit are small areas of sandstone outcrop and Carracas and Chris soils.

Permeability of this Coni soil is moderate. Available water capacity is low. The hazard of water erosion is high.

This unit is used for wildlife habitat.

The vegetation is sparse and is low in productivity because of shallow soil depth and steepness of slope. Shallow depth to hard sandstone and steepness of slope are also severe limitations for engineering uses.

This map unit is in capability subclass VIIe.

11D—Corta silt loam, 4 to 25 percent slopes. This deep, well drained soil is on mesas. It formed in material derived from interbedded shale and sandstone. Elevation is 6,500 to 8,000 feet. The average annual precipitation is about 15 to 22 inches.

The surface layer is grayish brown silt loam 2 to 5 inches thick. The subsoil is brown clay 20 to 40 inches thick. The substratum is light yellowish brown clay 5 to 25 inches thick. Shale is at a depth of 50 to 60 inches or more.

Included in this unit are small areas of Carracas and Winifred soils and sandstone outcrop.

Permeability of this Corta soil is very slow. Available water capacity is moderate. Runoff is slow to medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used mainly for wildlife habitat. It is also used for timber production and as rangeland.

Low precipitation and the clay subsoil are limitations on this unit. If the clay is exposed, it dries and becomes very hard. Most of the water held in the clay is not available for plant use. When planting, avoid exposing the subsoil. Where the clay subsoil is exposed, apply at least 4 inches of topsoil before reseeding disturbed areas, such as road cuts.

This map unit is in capability subclass VIe.

11E—Corta silt loam, 25 to 65 percent slopes. This deep, well drained soil is on mesas. It formed in material derived from interbedded shale and sandstone. Elevation is 6,500 to 8,000 feet. The average annual precipitation is about 15 to 22 inches.

The surface layer is grayish brown silt loam 3 to 5 inches thick. The subsoil is brown clay 20 to 35 inches thick. The substratum is light yellowish brown clay 10 to 30 inches thick. Shale is at a depth of 50 to 60 inches or more.

Included in this unit are small areas of Carracas and Winifred soils and sandstone and shale outcrop.

Permeability of this Corta soil is very slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

This unit is used mainly for wildlife habitat. It is also used for timber production and as rangeland.

Low precipitation, the clay subsoil, and steepness of slope are limitations on this unit. If the clay is exposed, it dries and becomes very hard. Most of the water held in the clay is not available for plant use. When planting, avoid exposing the subsoil and rooting seedlings in the subsoil. Where the clay subsoil is exposed, apply at least 4 inches of topsoil before reseeding disturbed areas, such as road cuts.

This map unit is in capability subclass VIIe.

12D—Dunton loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on mesas and cuesta dip slopes. It formed in residuum derived from sandstone. The vegetation is mainly ponderosa pine and bunchgrasses. Elevation is 7,500 to 10,000 feet. The average annual precipitation is about 20 to 32 inches.

The surface is covered with an organic layer of forest litter 1 inch to 4 inches thick. The next layer is pinkish gray loam 18 to 25 inches thick. Below this is pinkish gray loam and brown clay loam 3 to 10 inches thick. The subsoil is dark brown clay 10 to 15 inches thick. In some areas there is a light brown loam substratum 1 inch to 6 inches thick. Hard, reddish brown and buff colored sandstone is at a depth of 30 to 40 inches.

Included in this unit are small areas of Chris and Miracle soils, sandstone outcrop, and a soil that is more than 40 inches deep to bedrock.

Permeability of this Dunton soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is high.

This unit is used for timber production and wildlife habitat and as rangeland.

The clay subsoil and hard bedrock at a depth of less than 40 inches are limitations on this unit. If exposed, the subsoil dries and becomes very hard. Avoid planting seedlings in the subsoil. The use of equipment is moderately limited when the soil is wet.

This unit is in capability subclass VIe.

13D—Dunton stony loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on mesas and cuesta dip slopes. It formed in residuum derived from sandstone. The vegetation is mainly ponderosa pine and bunchgrasses. Elevation is 7,500 to 10,000 feet. The average annual precipitation is about 20 to 32 inches.

The upper layer of this soil is pinkish gray stony loam 20 to 24 inches thick. The next layer is pinkish gray stony loam and brown stony clay loam 3 to 8 inches thick. The subsoil is brown stony clay 10 to 14 inches thick. The substratum is light brown stony loam 1 inch to 5 inches thick. Hard, reddish brown and buff colored sandstone is at a depth of 30 to 40 inches. The stones in the soil are 2 to 3 inches thick and 5 to 12 inches across.

Included in this unit are small areas of Chris soils, Dunton loam, sandstone outcrop, and a soil that has bedrock at a depth of 40 to 60 inches.

Permeability of this Dunton soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production and wildlife habitat and as rangeland.

Mechanical planting of trees is limited by stones on the surface and hard sandstone at a depth of less than 40 inches.

This unit is in capability subclass VIs.

14D—Endlich stony loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on mountainsides. It formed in residuum derived from granite. The vegetation is mainly Engelmann spruce. Elevation is 10,000 to 11,500 feet. The average annual precipitation is about 32 to 38 inches.

The surface is covered with an organic layer of forest litter 1 inch to 4 inches thick. The next layer is pale brown stony loam 4 to 10 inches thick. The subsoil is reddish brown very stony loam 10 to 36 inches thick. In some areas there is a light reddish brown stony loam substratum as much as 8 inches thick. Granite is at a depth of 20 to 36 inches.

Included in this unit are small areas of granite outcrop and severely eroded soils.

Permeability of this Endlich soil is moderately rapid. Available water capacity is low. Runoff is medium, and the hazard of water erosion is slight.

This unit is used for timber production and as watershed.

This unit is limited by stones on the surface and bedrock at a depth of less than 40 inches. Fertility is low, and vegetation is difficult to establish. The hazard of plant competition is a slight limitation for timber production. Use of equipment is slightly limited.

This map unit is in capability subclass VIs.

14E—Endlich stony loam, 25 to 65 percent slopes. This moderately deep, well drained soil is on mountainsides. It formed in residuum derived from granite. The vegetation is mainly Engelmann spruce. Elevation is 10,000 to 11,500 feet. The average annual precipitation is about 32 to 38 inches.

The surface is covered with an organic layer of forest litter 1 inch to 2 inches thick. The next layer is pale brown stony loam 4 to 8 inches thick. The subsoil is reddish brown very stony loam 10 to 30 inches thick. In some areas there is a light reddish brown substratum as much as 4 inches thick. Granite is at a depth of 20 to 36 inches.

Included in this unit are small areas of granite outcrop and severely eroded soils.

Permeability of this Endlich soil is moderate. Available water capacity is low. Runoff is medium to rapid, and the hazard of water erosion is moderate.

This unit is used as watershed and for timber production.

This unit is limited by steepness of slope, stones on the surface, and bedrock at a depth of less than 40 inches. Fertility is low, and vegetation is difficult to establish. The hazard of plant competition is a slight limitation for timber production. Steepness of slope limits the use of equipment.

This map unit is in capability subclass VIIs.

15D—Gateview gravelly loam, 4 to 25 percent slopes. This deep, somewhat excessively drained soil is on high benches. It formed in thick ground moraine material overlying shale. Elevation is 7,600 to 8,400 feet. The average annual precipitation is 20 to 25 inches.

The surface layer is dark grayish brown gravelly loam and grayish brown very gravelly sandy loam 16 to 24 inches thick. The underlying material to a depth of 60 inches or more is brown very gravelly sandy loam.

Included in this unit are small areas of Molas and Winifred soils.

Permeability of this Gateview soil is rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for forage production and irrigated hay.

Although precipitation is adequate, the amount of water available for plants is limited by droughtiness. Standard range management practices are suited to this unit. Apply topsoil or mulch to road cuts before reseeding.

This map unit is in capability subclass VIs.

16D—Greenough loam, 4 to 25 percent slopes. This deep, well drained soil is on low, rolling hills. It formed in loess overlying shale and sandstone. Elevation is 6,500

to 8,000 feet. The average annual precipitation is 15 to 22 inches.

The surface is covered with an organic layer of forest litter less than 2 inches thick. The surface layer is brown loam 2 to 3 inches thick. The upper part of the subsurface layer is light yellowish brown loam 4 to 10 inches thick. The lower part is yellowish brown clay loam 4 to 10 inches thick. The subsoil is brown clay loam 15 to 24 inches thick. The substratum is brown clay loam 10 to 30 inches thick. Shale is at a depth of 40 to 48 inches.

Included in this unit are small areas of Dunton soils, soils that have bedrock at a depth of less than 40 inches, and Greenough soils that have slopes of less than 4 percent or more than 25 percent.

Permeability of this Greenough soil is moderate. Available water capacity is high. Surface runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used for timber production.

The vegetation is mainly ponderosa pine and oak brush with an understory of grasses and forbs. The soil in this unit is fertile. It has low strength when moist; therefore, equipment should not be used when the soil is wet. Roads need to be surfaced.

This map unit is in capability subclass VIe.

17D—Grenadier loam, 4 to 25 percent slopes. This deep, well drained soil is on ridges and valley sides in mountainous areas. It formed in material weathered from andesite and quartz latite. Elevation is 9,500 to 11,500 feet. The average annual precipitation is 30 to 40 inches.

The surface is covered with a layer of organic material 2 to 4 inches thick. The next layer is pinkish gray loam 2 to 8 inches thick. The subsoil is light brown very stony loam 12 to 34 inches thick. The substratum is light brown extremely stony loam 15 to 30 inches thick. Slightly fractured bedrock is at a depth of 40 to 60 inches or more.

Included in this unit are small areas of Leal and Rogert soils and Igneous outcrop.

Permeability of this Grenadier soil is moderate. Available water capacity is moderate. Runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used as watershed and for timber production.

The native vegetation is mainly Engelmann spruce. The hazard of plant competition is moderate for tree seedlings. Use of equipment is moderately limited.

This map unit is in capability subclass VIe.

17E—Grenadier loam, 25 to 65 percent slopes. This deep, well drained soil is on side slopes and in valleys of mountainous areas. It formed in material weathered from andesite and quartz latite. Elevation is 9,500 to 11,000 feet. The average annual precipitation is 30 to 40 inches.

The surface is covered with a layer of organic material 1 inch to 3 inches thick. The next layer is pinkish gray loam 3 to 8 inches thick. The subsoil is light brown very stony loam 6 to 24 inches thick. The substratum is light brown extremely stony loam 10 to 35 inches thick. Slightly fractured bedrock is at a depth of 40 to 60 inches or more.

Included in this unit are small areas of Leal and Rogert soils, a soil that has bedrock at a depth of less than 40 inches, and Igneous outcrop.

Permeability of this Grenadier soil is moderate. Available water capacity is moderate. Runoff is medium to rapid, and the hazard of water erosion is moderate.

This unit is used as watershed and for timber production.

The native vegetation is mainly Engelmann spruce. The hazard of plant competition is moderate for tree seedlings. Steepness of slope is the main limitation for use of equipment.

This map unit is in capability subclass VIIe.

18E—Grenadier stony loam, 25 to 65 percent slopes. This deep, well drained soil is on side slopes and in valleys of mountainous areas. It formed in material derived from andesite and quartz latite. Elevation is 9,500 to 11,000 feet. The average annual precipitation is 30 to 40 inches.

The surface is covered with a layer of organic material 1 inch to 3 inches thick. The next layer is pinkish gray loam 3 to 8 inches thick. The subsoil is light brown very stony loam 6 to 24 inches thick. The substratum is light brown extremely stony loam 10 to 35 inches thick. Slightly fractured bedrock is at a depth of 40 to 60 inches or more.

Included in this unit are small areas of Igneous outcrop, a soil that is less than 40 inches deep to bedrock, and Rogert soils.

Permeability of this Grenadier soil is moderate. Available water capacity is low to moderately low. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as watershed and for timber production.

The hazard of plant competition is moderate for tree seedlings. Steepness of slope and stoniness are moderate limitations for use of equipment.

This map unit is in capability subclass VIIs.

19D—Heflin sandy loam, 4 to 25 percent slopes. This deep, well drained soil is on toe slopes in valleys. It formed in alluvium derived from sandstone and some shale. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 13 to 20 inches.

The surface layer is dark grayish brown loam 2 to 5 inches thick. The subsoil is brown and yellowish brown clay loam 28 to 40 inches thick. The substratum is pale brown sandy clay loam 16 to 24 inches thick. Sandstone and shale are at a depth of 50 to 60 inches.

Included in this unit are small areas of Nunn soils and soils that have slopes of less than 4 percent.

Permeability of this Heflin soil is moderately slow. Available water capacity is high. Runoff is slow, and the

hazard of water erosion is moderate. The hazard of soil blowing is slight.

This unit is used for timber production.

Although the average annual precipitation is low, this unit receives additional water from higher lying areas. This additional moisture, along with the high available water capacity of the soil, promotes plant growth. The hazard of plant competition is slight for tree seedlings. Equipment limitations are moderate when the soil is wet.

This map unit is in capability subclass VIe.

20—Histic Cryaquepts. These deep, very poorly drained soils are on bottom lands along streams. The native vegetation is mainly willows and carex. Elevation is 7,000 to 12,500 feet. The average annual precipitation is 18 to 45 inches.

The surface layer is very dark grayish brown fibrous plant material 6 to 12 inches thick. The underlying material is dark gray silt loam 40 to 80 inches thick. Dark reddish brown mottles are common in the underlying material. These soils vary from one area to another.

Included in this unit are small areas of Hunchback soils, Typic Cryohemists, and Riverwash.

Permeability of Histic Cryaquepts is moderate. Available water capacity is high. Runoff is ponded to very slow, and the hazard of water erosion is slight. A water table is at a depth of 12 inches or less.

This unit is used as watershed.

The main limitations for engineering uses are wetness and the hazard of flooding from nearby streams.

This map unit is in capability subclass VIIw.

21D—Hossick gravelly loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on nonglaciated alpine ridgetops and side slopes. It formed in material weathered from quartz latite, andesite, and other volcanic rock. Elevation is 11,500 to 13,000 feet. The average annual precipitation is about 38 to 50 inches.

The surface layer is brown gravelly loam 5 to 20 inches thick. The subsoil is reddish brown very gravelly loam 4 to 30 inches thick. The substratum, where present, is reddish brown very gravelly or very cobbly loam as much as 25 inches thick. Slightly fractured andesite is at a depth of 20 to 40 inches.

Included in this unit are small areas of Vasquez soils, Igneous outcrop, and soils that have been severely eroded by wind. Also included is a soil that has bedrock at a depth of 20 inches or less.

Permeability of this Hossick soil is moderately rapid. Available water capacity is moderately low. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as watershed and for scenic value.

The harsh alpine climate and the moderately shallow depth to bedrock limit plant growth on this unit. Standard practices for the management of alpine areas should be used. The main limitation for engineering uses is the moderate depth to bedrock.

This map unit is in capability subclass VIIe.

21E—Hossick gravelly loam, 25 to 65 percent slopes. This moderately deep, well drained soil is on alpine ridges and side slopes. It formed in material weathered from quartz latite, andesite, and other volcanic rock. Elevation is 11,500 to 13,000 feet. The average annual precipitation is about 38 to 50 inches.

The surface layer is brown gravelly loam 3 to 15 inches thick. The subsoil is reddish brown very gravelly loam 4 to 30 inches thick. The substratum is reddish brown very gravelly or very cobbly loam 0 to 25 inches thick. Slightly fractured andesite is at a depth of 20 to 40 inches.

Included in this unit are small areas of Vasquez soils and Igneous outcrop. Also included are soils that have slopes of more than 65 percent.

Permeability of this Hossick soil is moderately rapid. Available water capacity is low to moderately low. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as watershed and for scenic value.

The harsh alpine climate, moderate soil depth, and steepness of slope limit plant growth on this unit. The main limitation for engineering uses is the moderate depth to bedrock.

This map unit is in capability subclass VIIe.

22A—Hunchback clay loam, 0 to 4 percent slopes. This deep, somewhat poorly drained soil is in swales, basins, and concave drainageways. It formed in fine textured alluvium and colluvium derived from mixed rock sources. Elevation is 7,500 to 11,000 feet. The average annual precipitation is 22 to 40 inches or more.

The surface layer is gray and dark gray clay loam about 16 to 40 inches thick. The subsoil is gray silty clay to a depth of 60 inches or more.

Included in this unit are small areas of Histic Cryaquepts, a soil that has bedrock at a depth of less than 60 inches, a poorly drained soil, and a calcareous soil.

Permeability of this Hunchback soil is slow. Available water capacity is high. Runoff is slow, and the hazard of water erosion is slight. A water table is at a depth of 18 to 24 inches in spring and early in summer.

This unit is used for forage production and as watershed.

The soil in this unit is wet part of the time in spring, and it is subject to severe compaction by trampling. It is fairly fertile and is suited to forage production.

The main limitations for engineering uses are wetness and low soil strength. It is preferable to bypass areas of this unit when building roads. If this is not feasible, however, the limitations can be easily overcome.

This map unit is in capability subclass VIw.

22D—Hunchback clay loam, 4 to 15 percent slopes. This deep, somewhat poorly drained soil is on fans and toe slopes. It formed in fine textured alluvium

and colluvium derived from mixed rock sources. Elevation is 7,500 to 11,000 feet. The average annual precipitation is 22 to 40 inches or more.

The surface layer is gray and dark gray clay loam about 16 to 40 inches thick. The subsoil to a depth of 60 inches or more is gray silty clay.

Included in this unit are small areas of well drained soils, a calcareous soil, and soils that have bedrock at a depth of less than 60 inches.

Permeability of this Hunchback soil is slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is low to moderate. A water table is at a depth of 18 to 24 inches in spring and early in summer.

This unit is used for forage production and as watershed.

When the soil in this unit is wet, it is subject to severe compaction from trampling by livestock. Standard management practices are suited to the unit.

The main limitations for engineering uses are wetness and low soil strength.

This map unit is in capability subclass VIe.

23—Igneous outcrop. This map unit consists of steep to extremely steep exposures of barren andesite and quartz latite on horns, canyon walls, and palisades.

Included in this unit are areas of granite and metamorphic rock. Also included is less than 10 percent shallow soils that support some sparse vegetation. Areas of talus are near the palisades. Material is added to these areas during frequent thunderstorms in summer.

Igneous outcrop is nearly impervious, and runoff is very rapid.

This unit is used for its scenic value.

This unit is poorly suited to recreational uses. Roads may be difficult to maintain because of steepness of slope and susceptibility of the unit to rock slides.

This map unit is in capability subclass VIII.

24—Igneous outcrop-Cryorthents complex. This map unit is on ridgetops and valley sides. It is moderately steep to extremely steep. The unit is 50 to 90 percent Igneous outcrop and 10 to 50 percent Cryorthents.

Igneous outcrop is barren exposures of bedrock, mainly andesite and quartz latite. Runoff is very rapid.

Cryorthents are shallow and moderately deep, coarse textured, somewhat excessively drained soils. These soils formed in residuum and alluvium derived from igneous rock. Permeability is moderate to rapid. Available water capacity is low. Runoff is medium, and the hazard of erosion is high.

This unit is used for scenic value.

This unit is poorly suited to recreational uses. Roads may be difficult to maintain because of the steepness of slope and susceptibility of the unit to rock slides. To reduce the hazard of erosion, the present vegetation on the Cryorthents should be preserved.

This map unit is in capability subclass VIIe.

25D—Judy silt loam, 4 to 25 percent slopes. This moderately deep, moderately well drained soil is on valley sides and alluvial fans. It formed in material weathered from limestone. Elevation is 8,000 to 11,000 feet. The average annual precipitation is 22 to 35 inches.

The surface layer is dark brown silt loam 8 to 12 inches thick. The subsoil is dark brown silty clay loam 5 to 20 inches thick. The substratum, where present, is dark brown clay loam as much as 11 inches thick. Limestone is at a depth of 24 to 38 inches.

Included in this unit are small areas of Limber soils and soils that have slopes of more than 25 percent.

Permeability of this Judy soil is slow. Available water capacity is moderate. Runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used for forage production.

This unit receives adequate moisture for plant growth. Standard range management practices are suited to the unit.

The main limitations for engineering uses are moderate depth to bedrock and low soil strength.

This map unit is in capability subclass VIe.

26D—Leal sandy loam, 4 to 25 percent slopes. This deep, well drained soil is on ridgetops and in glacial troughs and fluvial valleys. It formed in material weathered from andesite and quartz latite. Elevation is 10,000 to 11,000 feet. The average annual precipitation is 30 to 40 inches.

The surface layer is dark brown sandy loam less than 3 inches thick. The subsurface layer is dark brown sandy loam 6 to 20 inches thick. The subsoil is strong brown sandy loam 7 to 20 inches thick. The substratum is yellowish brown sandy loam 18 to 40 inches thick. Depth to hard andesite or latite ranges from 40 to 60 inches.

Included in this unit are small areas of Grenadier soils, Igneous outcrop, and soils that have bedrock at a depth of less than 40 inches. These included areas are on the ridgetops.

Permeability of this Leal soil is rapid. Available water capacity is moderate. Runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used for timber production and as watershed.

The present vegetation in most areas is mainly Engelmann spruce and subalpine fir with an understory of heartleaf arnica, vaccinium, and elk sedge. This unit has no serious limitations for plant growth. Standard range management practices, such as revegetation of disturbed areas, are suited to the unit.

There are no major limitations for engineering uses in most areas of this unit; however, steepness of slope may be a limitation in some areas.

This map unit is in capability subclass VIe.

26E—Leal sandy loam, 25 to 65 percent slopes. This deep, well drained soil is on mountainsides and in glacial troughs and fluvial valleys. It formed in material

weathered from andesite and quartz latite. Elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 40 inches.

The surface layer is dark brown sandy loam less than 3 inches thick. The subsurface layer is dark brown sandy loam 6 to 15 inches thick. The subsoil is strong brown sandy loam 7 to 20 inches thick. The substratum is yellowish brown sandy loam 19 to 40 inches thick. Hard andesite or latite is at a depth of 40 to 60 inches.

Included in this unit are small areas of Grenadier soils, Igneous outcrop, and a soil that has bedrock at a depth of less than 40 inches.

Permeability of this Leal soil is rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

This unit is used for timber production and as watershed.

The present vegetation in most areas is mainly Engelmann spruce and subalpine fir with an understory of heartleaf arnica, vaccinium, and elk sedge. The soil in this unit has no serious limitations for plant growth. Standard range management practices, such as revegetation of disturbed areas, are suited to the unit. This unit is moderately limited for equipment.

This map unit is in capability subclass VIIe.

26F—Leal sandy loam, 65 to 80 percent slopes. This deep, well drained soil is on side slopes of glacial troughs and fluvial valleys. It formed in material derived from andesite and quartz latite. Elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 40 inches.

The surface layer is dark brown sandy loam less than 3 inches thick. The subsurface layer is dark brown sandy loam 5 to 15 inches thick. The subsoil is strong brown sandy loam 5 to 20 inches thick. The substratum is yellowish brown sandy loam 19 to 40 inches thick. Hard andesite or latite is at a depth of 40 to 60 inches.

Included in this unit are small areas of Igneous outcrop, Cryorthents, and soils that have bedrock at a depth of less than 40 inches.

Permeability of this Leal soil is rapid. Available water capacity is moderate. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for timber production and as watershed.

The present vegetation in most areas is mainly Engelmann spruce and subalpine fir with an understory of heartleaf arnica, vaccinium, and elk sedge.

Extremely steep slopes, the high hazard of erosion, and the hazard of landsliding are severe limitations for most uses.

This map unit is in capability subclass VIIe.

27E—Leal stony sandy loam, 25 to 65 percent slopes. This deep, well drained soil is on valley sides, on mountainsides, and in glacial troughs. It formed in material derived from andesite and quartz latite. Elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 40 inches.

The surface layer is dark brown stony sandy loam less than 3 inches thick. The subsurface layer is dark brown stony sandy loam 5 to 15 inches thick. The subsoil is strong brown stony sandy loam 5 to 20 inches thick. The substratum is yellowish brown stony sandy loam 20 to 40 inches thick. Hard andesite or latite is at a depth of 40 to 60 inches. The stones in this soil are 3 to 15 inches across and have flat sides and sharp angles.

Included in this unit are small areas of Igneous outcrop and Cryorthents.

Permeability of this Leal soil is rapid. Available water capacity is moderately low to moderate. Runoff is medium, and the hazard of water erosion is moderate to high.

This unit is used for timber production and as watershed.

The present vegetation in most areas is mainly Engelmann spruce and subalpine fir with an understory of heartleaf arnica, vaccinium, and elk sedge. The soil in this unit is moderately fertile. It is limited mainly by stoniness and steepness of slope.

This map unit is in capability subclass VIIe.

28D—Limber loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on mountainsides and ridges. It formed in material derived from limestone. Elevation is 8,500 to 11,000 feet. The average annual precipitation is 25 to 35 inches.

The surface layer, where present, is reddish brown loam as much as 4 inches thick. The subsurface layer is reddish brown loam 4 to 12 inches thick. The subsoil is dark reddish brown clay loam 5 to 35 inches thick. The substratum, where present, is reddish brown clay loam or gravelly clay loam as much as 20 inches thick. Slightly fractured limestone is at a depth of 28 to 40 inches.

Included in this unit are small areas of Judy soils and Limestone outcrop.

Permeability of this Limber soil is moderate. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber production and as watershed.

The present vegetation on this unit is Engelmann spruce and subalpine fir. The unit receives adequate moisture for plant growth. The hazard of plant competition is moderate.

Use of equipment is limited by wetness in spring. The main limitations for engineering uses are moderate depth to limestone, slope, and low soil strength.

This map unit is in capability subclass VIe.

28E—Limber loam, 25 to 65 percent slopes. This deep, moderately well drained soil is on mountainsides, hillsides, and ridges. It formed in material derived from limestone. Elevation is 8,500 to 11,000 feet. The average annual precipitation is 25 to 35 inches.

The surface layer is reddish brown loam less than 3 inches thick. The subsurface layer is reddish brown loam 3 to 8 inches thick. The subsoil is dark reddish brown clay loam 5 to 35 inches thick. The substratum, where present, is reddish brown clay loam or gravelly clay loam as much as 20 inches thick. Slightly fractured limestone is at a depth of 28 to 40 inches.

Included in this unit are small areas of Judy soils and Limestone outcrop.

Permeability of this Limber soil is moderate. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate to high.

This unit is used for timber production and as watershed.

The present vegetation on this unit is Engelmann spruce and some subalpine fir. The unit receives adequate moisture for plant growth. The hazard of plant competition is moderate. Use of equipment is moderately limited by wetness in spring. Depth to limestone, slope, and low soil strength are moderate to severe limitations for engineering uses.

This map unit is in capability subclass VIIe.

29—Limestone outcrop-Cryorthents complex. This map unit is on ridgetops and valley sides.

This unit is 50 to 90 percent Limestone outcrop and 10 to 50 percent Cryorthents.

Limestone outcrop consists of large areas of exposed limestone.

Cryorthents have a thin surface layer of grayish brown loam or clay loam. The underlying layer is light gray loam or clay loam. Massive or slightly fractured limestone is at a depth of 10 to 40 inches.

Included in this unit are areas of Limber soils.

Runoff is very rapid, and the hazard of erosion is high on the Cryorthents and minor soils.

This unit is used for scenic value. Steepness of slope, shallow depth to bedrock, and the high hazard of erosion severely limit the unit for most other uses.

This map unit is in capability subclass VIIIe.

30E—Mayoworth silt loam, 25 to 65 percent slopes. This moderately deep, well drained soil is on mesas, scarp slopes of hogbacks, and valley sides. It is mainly on north-facing slopes. It formed in material derived from shale and sandy shale. Elevation is 6,500 to 8,500 feet. The average annual precipitation is 15 to 25 inches.

The surface layer is very dark gray silt loam 7 to 12 inches thick. The subsoil is dark brown silty clay loam 6 to 15 inches thick. The substratum is dark grayish brown clay loam 3 to 15 inches thick. Slightly fractured shale or sandstone is at a depth of 28 to 40 inches.

Included in this unit are areas of Carracas soils and sandstone and shale outcrop.

Permeability of this Mayoworth soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

This unit is used mainly for wildlife habitat. It is also used for timber production.

The present vegetation in most areas is mainly ponderosa pine, some Douglas-fir, oak brush, shrubs, forbs, and grasses. The soil in this unit is limited by moderate precipitation and the moderate hazards of windthrow and plant competition. Use of equipment in some areas is limited by steepness of slope.

The main limitations for engineering uses are steepness of slope, low sheer strength, and moderate depth to rippable bedrock.

This map unit is in capability subclass VIIe.

31D—Mayoworth loam, deep variant, 4 to 25 percent slopes. This deep, well drained soil is on mesas and moderately dissected side slopes. It formed in residuum and alluvium derived from shale, sandy shale, and sandstone. Elevation is 6,500 to 8,500 feet. The average annual precipitation is 15 to 25 inches.

The surface layer is dark grayish brown and very dark grayish brown loam 9 to 15 inches thick. The subsoil is very dark grayish brown and dark brown clay loam 8 to 25 inches thick. The substratum is dark brown clay loam 12 to 30 inches thick. Slightly fractured shale or sandstone is at a depth of 40 to 72 inches.

Included in this unit are areas of Carracas soils, Mayoworth silt loam, and sandstone and shale outcrop.

Permeability of this Mayoworth soil is moderately slow. Available water capacity is high. Runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used for timber and forage production.

The present vegetation in most areas is mainly ponderosa pine, some Douglas-fir, oak brush, shrubs, forbs, and grasses. The soil in this unit is moderately fertile, and precipitation is adequate for plant growth. Standard range management practices, such as revegetation of disturbed areas, are suited to the unit.

Low soil strength moderately limits this unit for engineering uses. Use of equipment is moderately limited by wetness in spring and during rainy periods.

This map unit is in capability subclass VIe.

31E—Mayoworth loam, deep variant, 25 to 65 percent slopes. This deep, well drained soil is on moderately dissected side slopes. It formed in residuum and alluvium derived from shale, sandy shale, and sandstone. Elevation is 6,500 to 8,500 feet. The average annual precipitation is 15 to 25 inches.

The surface layer is dark grayish brown and very dark grayish brown loam 9 to 15 inches thick. The subsoil is very dark grayish brown and dark brown clay loam 8 to 25 inches thick. The substratum is dark brown clay loam 12 to 25 inches thick. Slightly fractured shale or sandstone is at a depth of 40 to 72 inches.

Included in this unit are areas of Carracas soils, Mayoworth silt loam, and sandstone and shale outcrop.

Permeability of this Mayoworth soil is moderately slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is high.

This unit is used mainly for forage production. It is also used for timber production.

The present vegetation in most areas is mainly ponderosa pine, some Douglas-fir, oak brush, shrubs, forbs, and grasses. The hazard of plant competition is moderate. Conventional methods of harvesting timber are limited by steepness of slope.

The main limitations for engineering uses are steepness of slope, low sheer strength, and the high hazard of erosion.

This map unit is in capability subclass VIIe.

32D—Miracle loamy fine sand, 4 to 25 percent slopes. This moderately deep, well drained soil is on cuesta dip slopes. It formed in residuum and alluvium derived from sandstone. Elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 35 inches.

The surface layer is grayish brown loamy fine sand 7 to 15 inches thick. The subsoil is yellowish brown sandy loam and light brown sandy clay loam 2 to 20 inches thick. The substratum, where present, is pale brown sandy loam as much as 15 inches thick. Hard sandstone is at a depth of 30 to 40 inches.

Included in this unit are areas of Dunton and Coni soils, soils that have sandstone at a depth of more than 40 inches, and soils that have slopes of more than 25 percent.

Permeability of this Miracle soil is moderate. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for timber and forage production.

The present vegetation in most areas is mainly grasses, forbs, and some brush and ponderosa pine. The soil in this unit is moderately fertile. It receives adequate moisture for plant growth. Most standard range management practices, such as revegetation of disturbed areas, are suited to this unit.

The main limitation for engineering uses is moderate depth to sandstone.

This map unit is in capability subclass VIe.

33D—Molas loam, 4 to 25 percent slopes. This moderately deep, poorly drained soil is on concave side slopes and in swales. It formed in material derived from glacial till overlying shale. Elevation is 8,000 to 9,000 feet. The average annual precipitation is 22 to 30 inches.

The surface layer is dark grayish brown loam and clay loam 3 to 15 inches thick. The subsurface layer is light gray clay loam 4 to 8 inches thick. The subsoil is grayish brown and yellowish brown clay 8 to 40 inches thick. Soft, gray shale is at a depth of 30 to 40 inches. Mottles are in the subsurface layer and the subsoil.

Included in this unit are areas of Hunchback and Pagosa soils and soils that have slopes of less than 4 percent or more than 25 percent.

Permeability of this Molas soil is very slow. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate. A water table is at a depth of 12 to 24 inches in spring and summer.

This unit is used mainly as rangeland. Some of the gently sloping areas are used for irrigated hay.

The very slowly permeable subsoil and impervious shale limit management of this soil. The main limitations for engineering uses are low soil strength, the potential for shrinking and swelling, wetness, and depth to rippable bedrock.

This map unit is in capability subclass VIe.

34D—Muggins loam, 4 to 25 percent slopes. This deep, well drained soil is on till plains, moraines, and mountainsides. It formed in glacial till derived mainly from igneous rock deposited as terminal and lateral moraines. Elevation is 7,000 to 9,500 feet. The average annual precipitation is 20 to 30 inches.

The surface layer, where present, is very dark grayish brown loam as much as 4 inches thick. The next layer is pinkish gray loam 8 to 15 inches thick. The next layer, where present, is pinkish gray loam and reddish brown clay loam as much as 12 inches thick. The subsoil is reddish brown clay loam 6 to 20 inches thick. The substratum to a depth of 60 inches or more is dark reddish gray cobbly loam.

Included in this unit are areas of Hunchback, Pagosa, and Woodrock soils and some Riverwash.

Permeability of this Muggins soil is slow. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for timber production.

The present vegetation is either ponderosa pine or Engelmann spruce and subalpine fir. Standard range management practices are suited to this unit.

This unit has no serious limitations for engineering uses.

This map unit is in capability subclass VIe.

34E—Muggins loam, 25 to 65 percent slopes. This deep, well drained soil is on sides of terminal and lateral moraines and on mountainsides. It formed in glacial till derived mainly from igneous rock deposited as moraines. Elevation is 7,000 to 9,000 feet. The average annual precipitation is 20 to 30 inches.

The surface layer is very dark grayish brown loam less than 4 inches thick. The next layer is pinkish gray loam 8 to 12 inches thick. The next layer, where present, is pinkish gray loam and reddish brown clay loam as much as 10 inches thick. The subsoil is reddish brown clay loam 6 to 30 inches thick. The substratum to a depth of 60 inches or more is dark reddish gray cobbly loam.

Included in this unit are small areas of Woodrock soils.

Permeability of this Muggins soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

This unit is used for timber production and as watershed.

The present vegetation is either ponderosa pine or Engelmann spruce and subalpine fir. The hazard of landsliding is high if the toes of the moraines are cut.

Steepness of slope limits the use of conventional methods of harvesting timber.

This map unit is in capability subclass VIIe.

35D—Muggins cobbly loam, 4 to 25 percent slopes. This deep, well drained soil is on rounded tops of moraines and till plains. It formed in glacial till derived mainly from igneous rock deposited as terminal and lateral moraines. Elevation is 7,000 to 9,500 feet. The average annual precipitation is 20 to 30 inches.

The surface layer, where present, is very dark grayish brown cobbly loam as much as 4 inches thick. The next layer is pinkish gray cobbly loam 8 to 15 inches thick. The next layer, where present, is pinkish gray cobbly loam as much as 12 inches thick. The subsoil is reddish brown cobbly clay loam 6 to 40 inches thick. The substratum to a depth of 60 inches or more is reddish gray cobbly loam.

Included in this unit are areas of Hunchback soils and some small areas of Riverwash.

Permeability of this Muggins soil is slow. Available water capacity is moderately low. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for timber production and as watershed.

The present vegetation is either ponderosa pine or Engelmann spruce and subalpine fir.

Cobbles on the surface and throughout the soil moderately limit this unit for most uses.

This map unit is in capability subclass VIe.

35E—Muggins cobbly loam, 25 to 65 percent slopes. This deep, well drained soil is on sides of terminal and lateral moraines and on mountainsides. It formed in glacial till derived mainly from igneous rock deposited as moraines. Elevation is 7,000 to 9,500 feet. The average annual precipitation is 20 to 30 inches.

The surface layer, where present, is very dark grayish brown cobbly loam as much as 4 inches thick. The next layer is pinkish gray cobbly loam 8 to 15 inches thick. The next layer, where present, is pinkish cobbly loam as much as 12 inches thick. The subsoil is reddish brown cobbly clay loam 6 to 40 inches thick. The substratum to a depth of 60 inches or more is reddish gray cobbly loam.

Included in this unit are small areas of Woodrock soils and Igneous outcrop.

Permeability of this Muggins soil is slow. Available water capacity is moderately low. Runoff is medium, and the hazard of water erosion is moderate to high.

This unit is used for timber production and as watershed.

The present vegetation is either ponderosa pine or Engelmann spruce and subalpine fir.

The main limitations on this unit are steepness of slope, cobbles on the surface and throughout the soil, and the hazard of erosion. The hazard of landsliding is high if the toes of moraines are disturbed or excavated (fig. 3).

This map unit is in capability subclass VIIe.

36A—Nunn loam, 0 to 4 percent slopes. This deep, well drained soil is on alluvial plains and piedmonts. It formed in material derived from shale and some sandstone. Elevation is 6,000 to 7,500 feet. The average annual precipitation is 15 to 22 inches.

The surface layer is brown and grayish brown loam 8 to 14 inches thick. The subsoil is grayish brown clay loam and brown clay 15 to 24 inches thick. The substratum to a depth of 60 inches or more is light olive brown, calcareous clay.

Included in this unit are small areas of Heflin soils and soils that have a clay loam or silty clay loam surface layer. Also included are some small saline and sodic areas.

Permeability of this Nunn soil is slow. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for forage production.

The main limitation for engineering uses is the potential for shrinking and swelling of the clay subsoil.

This map unit is in capability subclass IIIe.

36D—Nunn loam, 4 to 25 percent slopes. This deep, well drained soil is on alluvial plains and piedmonts. It formed in material derived from shale and sandstone. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 15 to 22 inches.

The surface layer is brown and grayish brown loam 8 to 12 inches thick. The subsoil is grayish brown clay loam and brown clay 18 to 26 inches thick. The substratum to a depth of 60 inches or more is light olive brown, calcareous clay.

Included in this unit are areas of Heflin soils and soils that have a surface layer of clay loam or silty clay loam.

Permeability of this Nunn soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate. The hazard of gully erosion is high in some areas.

This unit is used for forage production.

The present vegetation in most areas is mainly big sagebrush, western wheatgrass, and some rabbitbrush. Because precipitation is low, management suited to drier areas should be used on this unit.

The main limitations for engineering uses are the potential for shrinking and swelling of the clay subsoil and steepness of slope.

This map unit is in capability subclass VIe.

37D—Pagosa loam, 4 to 25 percent slopes. This deep, moderately well drained soil is on interfluvial benches. It formed in till overlying shale. Elevation is 8,000 to 9,500 feet. The average annual precipitation is about 22 to 30 inches.

The surface layer is grayish brown loam 5 to 9 inches thick. The upper part of the subsurface layer is light brownish gray and brown loam 5 to 10 inches thick. The lower part is light brownish gray loam 6 to 12 inches

Figure 3. Landsliding in a disturbed area of Muggins cobbly loam, 25 to 65 percent slopes.

thick. The subsoil is brown clay loam 8 to 30 inches thick. The substratum is yellowish brown clay loam 10 to 20 inches thick. Shale is at a depth of 40 to 60 inches.

Included in this unit are areas of Woodrock, Hunchback, and Winifred soils.

Permeability of this Pagosa soil is slow. Available water capacity is high. Runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used mainly for timber production and as watershed. A few areas are used for forage production.

The native vegetation in most areas is mainly ponderosa pine and some oak brush, fescue, and danthonia. The hazard of plant competition is moderate for tree seedlings. Use of equipment is moderately limited in spring when the soil is wet.

This map unit is in capability subclass VIe.

37E—Pagosa loam, 25 to 65 percent slopes. This deep, moderately well drained soil is on the sides of interfluvial benches. It formed in till overlying shale. Elevation is 8,000 to 9,500 feet. The average annual precipitation is about 22 to 30 inches.

The surface layer is grayish brown loam 4 to 8 inches thick. The upper part of the subsurface layer is light brownish gray loam 5 to 10 inches thick. The lower part is light brownish gray loam 4 to 12 inches thick. The subsoil is brown clay loam 5 to 36 inches thick. The substratum is yellowish brown clay loam 10 to 20 inches thick. Shale is at a depth of 40 to 60 inches. The lower part of the subsurface layer has brown loam peds.

Included in this unit are areas of Woodrock, Muggins, and Winifred soils.

Permeability of this Pagosa soil is slow. Available water capacity is high. Runoff is medium, and the hazard of water erosion is high.

This unit is used mainly for timber production and as watershed. A few areas are used for forage production.

The native vegetation in most areas is mainly ponderosa pine, some oak brush, fescue, and danthonia. The hazard of plant competition is moderate for tree seedlings. Use of equipment is moderately limited in spring when the soil is wet. Steepness of slope and depth to rippable shale are the main limitations for most uses.

This map unit is in capability subclass VIIe.

38A—Pescar sandy loam, 0 to 4 percent slopes. This deep, somewhat poorly drained soil is on terraces along major streams. It formed in alluvium derived from mixed rock sources. Elevation is 6,000 to 8,000 feet. The average annual precipitation is about 15 to 22 inches.

The surface layer is light brownish gray sandy loam 4 to 12 inches thick. It is stratified with thin lenses of loamy fine sand. The next layer is pale brown fine sandy loam 5 to 22 inches thick. It is stratified with lenses of loamy fine sand and loam. The next layer is pale brown very gravelly sand several feet thick. It is stratified with lenses of loamy sand.

Included in this unit are areas of Hunchback soils and Riverwash.

Permeability of this Pescar soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is slight. A water table is at a depth of 18 to 30 inches in spring and early in summer. This soil is subject to brief periods of flooding in spring and early in summer.

This unit is used for forage production.

The native vegetation in most areas is mainly bluegrass, clover, carex, clematis, and lanceleaf cottonwood.

The soil in this unit is slightly limited for plant growth and engineering uses.

This map unit is in capability subclass VIw.

39—Riverwash. Riverwash is along the major rivers and creeks in the survey area. It consists of deposits of waterworn sand, gravel, and cobbles. In most areas these materials are mixed; however, in some places the sand and gravel are not mixed. Riverwash is mainly barren of vegetation. A few grasses, forbs, and shrubs grow in some areas.

Included in this unit are small areas of Pescar soils, Muggins soils, and other soils near streams.

This map unit is in capability subclass VIIIw.

40E—Rogert gravelly loam, 25 to 65 percent slopes. This shallow, well drained soil is on mountainsides and valley sides. It formed in residuum derived mainly from andesite and quartz latite. Elevation is 8,500 to 10,000 feet. The average annual precipitation is about 22 to 32 inches.

The surface layer is dark grayish brown gravelly loam 5 to 16 inches thick. The underlying material is light brownish gray gravelly loam 2 to 10 inches thick. Hard andesite and quartz latite are at a depth of 12 to 20 inches.

Included in this unit are areas of Skyway and Woodrock soils, Igneous outcrop, and Cryorthents. Also included are areas of soils that have slopes of more than 65 percent.

Permeability of this Rogert soil is moderately rapid. Available water capacity is low. Runoff is medium, and the hazard of water erosion is high.

This unit is used as rangeland.

If this unit is used as rangeland, the main limitation is steepness of slope. The native vegetation in most areas is mainly fescue, bluegrass, and scattered forbs and shrubs.

The main limitations for engineering uses are steepness of slope and shallow depth to hard bedrock.

This map unit is in capability subclass VIIe.

41—Rubble land. This unit consists of talus, felsenmeer, and rock debris at the base of steep cliffs, on the top of broad alpine ridges, and in alpine valleys (fig. 4). Areas of the unit are made up mainly of rock fragments that range in size from gravel to stones. Most

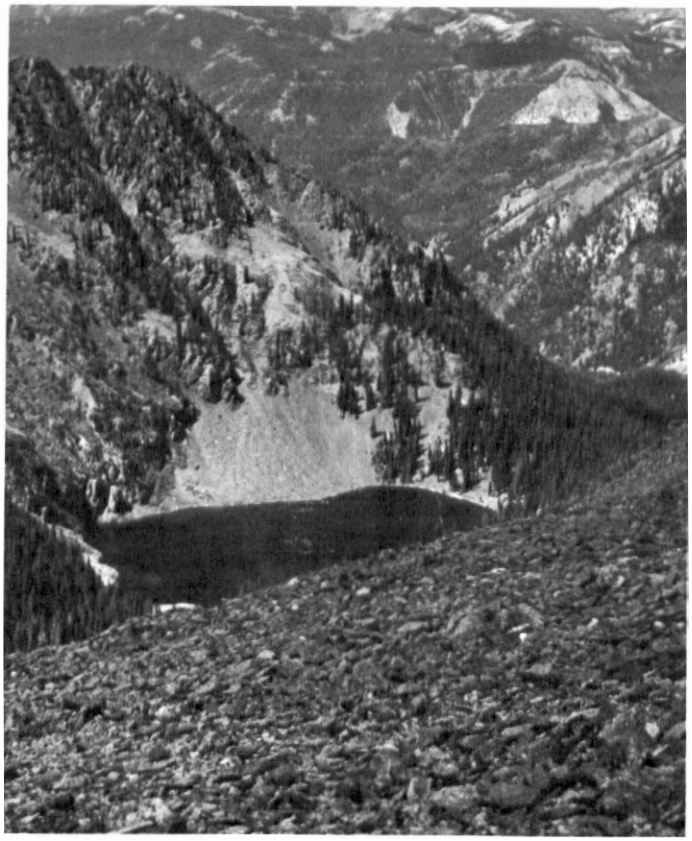

Figure 4. Area of Rubble land in foreground; cirque lake in center.

of the stones are angular, but some of those in the rock debris are rounded. Rounding of the rock because of exfoliation is slight except for that of granite, which is of minor extent in the survey area. The unit is mainly along Mosca and Coldwater Creeks and on the Pine-Piedra divide, from Graham Peak to Granite Peak.

Although Rubble land consists mainly of coarse fragments, in some areas are crevices filled with alluvial and eolian material. These areas support a few trees, shrubs, and other plants.

Rubble land is used as watershed and as a source of rock aggregate.

This map unit is in capability subclass VIIIs.

42D—Sambrito loam, 4 to 25 percent slopes. This deep, well drained soil is on toe slopes. It formed in alluvium and colluvium of mixed origin. Elevation is 8,500 to 9,500 feet. The average annual precipitation is about 22 to 30 inches.

In places the surface is covered with an organic layer of forest litter as much as 3 inches thick. The surface layer is light brownish gray loam 4 to 8 inches thick. The subsoil is pale brown gravelly coarse sandy loam 10 to 23 inches thick. The substratum is light gray gravelly coarse sandy loam 30 to 50 inches thick. Shale is at a depth of 60 inches or more.

Included in this unit are areas of Typic Ustorthents and Igneous outcrop. Also included are areas of soils that have slopes of less than 4 percent.

Permeability of this Sambrito soil is rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This unit is used for timber production and as watershed.

The native vegetation in most areas is mainly Engelmann spruce, subalpine fir, and aspen. The hazard of plant competition is moderate for seedlings. The main limitation for use of equipment is steepness of slope.

This map unit is in capability subclass VIe.

42E—Sambrito loam, 25 to 65 percent slopes. This deep, well drained soil is on toe slopes. It formed in alluvium and colluvium of mixed origin. Elevation is 8,500 to 9,500 feet. The average annual precipitation is about 22 to 30 inches.

In places the surface is covered with a layer of forest litter as much as 3 inches thick. The surface layer is light brownish gray loam 3 to 6 inches thick. The subsoil is pale brown gravelly coarse sandy loam 10 to 20 inches thick. The substratum is light gray gravelly coarse sandy loam 36 to 50 inches thick. Shale is at a depth of 60 inches or more.

Included in this unit are areas of Typic Ustorthents and Igneous outcrop.

Permeability of this Sambrito soil is rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high. The hazard of soil blowing is moderate.

This unit is used for timber production and as watershed.

The native vegetation in most areas is mainly Engelmann spruce, subalpine fir, and aspen. The hazard of plant competition is moderate. The soil in this unit is moderately limited for use of equipment. The main limitations for engineering uses are steepness of slope and low soil strength.

This map unit is in capability subclass VIe.

43—Sandstone outcrop-Ustorthents complex. This map unit is on cliffs, dip slopes of hogbacks and cuestas, and scarp slopes of hogbacks, cuestas, and mesas. It is about 50 to 90 percent hard or slightly weathered sandstone and 10 to 50 percent Typic Ustorthents and Lithic Ustorthents.

Sandstone outcrop consists of small areas of exposed sandstone and large sandstone boulders.

Ustorthents are moderately coarse textured, shallow and moderately deep, excessively drained soils. Runoff is rapid to very rapid, and the hazard of water erosion is moderate to very high.

The vegetation is mainly yucca, squaw-apple, and some bitterbrush and grama.

This unit is used for wildlife habitat and scenic value.

This map unit is in capability subclass VIIIe.

44D—Skyway loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on high, broad ridgetops. It formed in material derived mainly from andesite and quartz latite. Elevation is 8,500 to 10,500 feet. The average annual precipitation is about 22 to 35 inches.

The surface layer is dark brown and brown loam 16 to 28 inches thick. The underlying material is pink sandy loam 10 to 22 inches thick. Andesite or quartz latite is at a depth of 30 to 40 inches.

Included in this unit are areas of Leal and Grenadier soils, Cryorthents, and Igneous outcrop.

Permeability of this Skyway soil is moderately rapid. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used as rangeland in summer.

The native vegetation is mainly bluegrass, fescue, needlegrass, bromegrass, and carex.

The main limitations for engineering uses are depth to hard bedrock and steepness of slope.

This map unit is in capability subclass VIe.

44E—Skyway loam, 25 to 65 percent slopes. This moderately deep, well drained soil is on mountainsides and valley sides. It formed in material derived mainly from andesite and quartz latite. Elevation is 8,500 to 10,500 feet. The average annual precipitation is about 22 to 35 inches.

The surface layer is dark brown and brown loam 16 to 24 inches thick. The underlying material is pink sandy loam 12 to 24 inches thick. Andesite or quartz latite is at a depth of 30 to 40 inches.

Included in this unit are areas of Leal, Grenadier, and Rogert soils, Cryorthents, and Igneous outcrop.

Permeability of this Skyway soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is moderate to high.

This unit is used as rangeland in summer.

The native vegetation is mainly bluegrass, fescue, needlegrass, bromegrass, and carex. This unit is limited for use as rangeland because of steepness of slope.

The main limitations for engineering uses are steepness of slope and depth to hard bedrock.

This map unit is in capability subclass VIIe.

45—Typic Cryohemists. This map unit consists of deep, poorly drained and very poorly drained soils on the bottom of cirque basins and along streams. Areas vary in size, but they generally are 100 acres or less. The vegetation is sedges, rushes, horsetail, willows, marshmarigold, western fringed gentian, and elephanthead. Elevation is 10,000 to 12,500 feet. The average annual precipitation is 30 to 50 inches.

Typic Cryohemists have an upper layer of peat 36 to 60 inches thick. Below this is a layer of gray silt or sand. Bedrock is at a depth of 60 to 120 inches or more.

Included in this unit are areas of glacially scoured Igneous outcrop and Hunchback and Vasquez soils. Hunchback and Vasquez soils do not have an upper layer of peat.

Runoff of Typic Cryohemists is ponded to very slow. A water table is at a depth of 18 inches or less throughout the year. Additional water is received from higher lying areas.

This unit is used as summer range for wildlife.

The limitations for engineering uses are severe.

This map unit is in capability subclass VIIw.

46D—Typic Ustorthents, 4 to 25 percent slopes. This map unit consists of very deep, well drained soils on fans and toe slopes. These soils formed in detritus derived from mixed igneous material, mainly andesite and quartz latite. Vegetation includes blue spruce, narrowleaf cottonwood, subalpine fir, shrubs, forbs, and grasses. Elevation is 8,000 to 9,500 feet. The average annual precipitation is 22 to 30 inches.

These soils vary in color, thickness, and texture. Stratified layers of different textures are common. Textures are mainly coarse. The soils commonly contain stones and gravel.

Included in this unit are areas of Sambrito and Rogert soils and Igneous outcrop.

Permeability of Typic Ustorthents is moderately rapid. Available water capacity is low. Runoff is slow, and the hazard of water erosion is low to moderate. These soils are subject to periods of flash flooding.

These soils are used as a source of gravel and some sand.

The main limitations for construction of campgrounds and picnic areas are the hazard of flooding and newly deposited detritus.

This map unit is in capability subclass VIw.

46E—Typic Ustorthents, 25 to 65 percent slopes. This map unit consists of very deep, well drained soils on cones and steeper toe slopes. These soils formed in detritus derived from mixed igneous material, mainly andesite and quartz latite. Vegetation includes blue spruce, narrowleaf cottonwood, subalpine fir, shrubs, forbs, and grasses. Elevation is 8,000 to 9,500 feet. The average annual precipitation is 22 to 30 inches.

These soils vary in color, thickness, and texture. Stratified layers of different textures are common. Textures are mainly coarse. The soils commonly contain stones and gravel. Colors are the same as those of the rock from which the soils were derived.

Included in this unit are areas of Rogert soils and Igneous outcrop.

Permeability of Typic Ustorthents is moderately rapid. Available water capacity is low. Runoff is medium, and the hazard of water erosion is low.

These soils are used as a source of gravel and some sand.

These soils are subject to runoff from adjacent soils and to deposition of detritus.

This map unit is in capability subclass VIe.

47D—Vasquez loam, 4 to 30 percent slopes. This deep, poorly drained soil is in cirques. It formed in alluvium derived from andesite and quartz latite. The native vegetation is mainly willows, carex, gentian, and saxifrage. Elevation is 11,500 to 13,000 feet. The average annual precipitation is about 35 to 45 inches.

The surface layer is very dark gray loam 14 to 20 inches thick. The next layer is grayish brown loam 8 to 40 inches thick. It has yellowish brown mottles. Below this to a depth of 60 inches or more is gray loam that has light yellowish brown mottles.

Included in this unit are areas of Hossick soils, Typic Cryohemists, and Igneous outcrop.

Permeability of this Vasquez soil is moderate in the upper part and rapid below. Available water capacity is moderate. Runoff is ponded or slow, and the hazard of water erosion is slight. A water table is at a depth of 8 to 24 inches in spring and summer.

This unit is used as watershed and for scenic value.

The main limitation for engineering uses is the high water table.

This map unit is in capability subclass VIIw.

48E—Vasquez-Rock outcrop complex, 4 to 30 percent slopes. This map unit is in cirques (fig. 5). The native vegetation is mainly willows, carex, gentian, and saxifrage. Elevation is 11,500 to 13,000 feet. The average annual precipitation is about 35 to 45 inches.

This unit is 50 to 70 percent Vasquez loam and 30 to 50 percent Rock outcrop.

Included in this unit are areas of Typic Cryohemists.

The Vasquez soil is deep and poorly drained. It formed in material derived from andesite and quartz latite. The

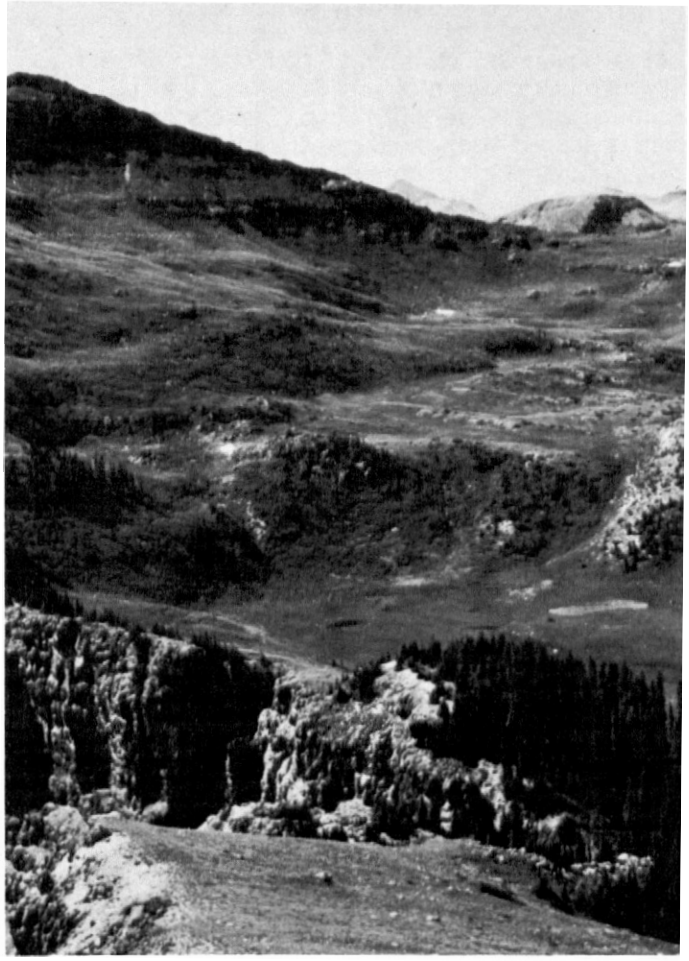

Figure 5. Area of Vasquez-Rock outcrop complex, 4 to 30 percent slopes.

surface layer is very dark gray loam 14 to 20 inches thick. The next layer is grayish brown loam 8 to 40 inches thick. It has yellowish brown mottles. Below this to a depth of 60 inches or more is gray loam that has light yellowish brown mottles.

Permeability of this Vasquez soil is moderate in the upper part and rapid in the lower part. Available water capacity is moderate. Runoff is ponded or slow, and the hazard of water erosion is slight. A water table is at a depth of 18 to 24 inches in spring and summer.

Rock outcrop consists of exposed areas of glacially scoured andesite or quartz latite.

This unit is used as watershed and for scenic value.

The main limitations for engineering uses are the high water table and Rock outcrop.

This map unit is in capability subclass VIIw.

49D—Winifred clay, 4 to 25 percent slopes. This moderately deep, well drained soil is in rolling and hilly areas in and around O'Neal Park. It formed in residuum derived from black or dark gray shale. The native vegetation is mainly fescue, junegrass, and some oak brush. Elevation is 7,600 to 8,400 feet. The average annual precipitation is 20 to 25 inches.

The surface layer is very dark grayish brown clay and dark grayish brown clay loam 7 to 12 inches thick. The subsoil is dark grayish brown clay 8 to 15 inches thick. The substratum is light gray clay 12 to 24 inches thick. Shale is at a depth of 30 to 40 inches.

Included in this unit are areas of Carracas and Hunchback soils and a soil that has bedrock at a depth of more than 40 inches.

Permeability of this Winifred soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is low to moderate.

This unit is used as rangeland and for crops such as hay and small grain.

The main limitations for engineering uses are low soil strength and moderate depth to rippable shale.

This map unit is in capability subclass VIe.

49E—Winifred clay, 25 to 65 percent slopes. This moderately deep, well drained soils is on hillsides in and around O'Neal Park. It formed in residuum derived from black or dark gray shale. The native vegetation is mainly fescue, junegrass, and some oak brush. Elevation is 7,600 to 8,400 feet. The average annual precipitation is 20 to 25 inches.

The surface layer is very dark grayish brown clay and dark grayish brown clay loam 8 to 14 inches thick. The subsoil is dark grayish brown clay 8 to 12 inches thick. The substratum is light gray clay 14 to 24 inches thick. Shale is at a depth of 30 to 40 inches.

Included in this unit are areas of Carracas soils, shale outcrop, and severely eroded soils.

Permeability of this Winifred soil is slow. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is high.

This unit is used as rangeland.

The main limitations for engineering uses are low soil strength, steepness of slope, and moderate depth to rippable bedrock.

This map unit is in capability subclass VIIe.

50D—Woodrock silt loam, 4 to 25 percent slopes. This moderately deep, well drained soil is on mountainsides. It formed in material derived from andesite and quartz latite. Elevation is 8,500 to 10,000 feet. The average annual precipitation is about 25 to 35 inches.

The surface is covered by a layer of forest litter 2 to 4 inches thick. The surface layer is very dark grayish brown silt loam 1 inch to 4 inches thick. The subsurface layer is grayish brown silt loam 6 to 10 inches thick. The upper part of the subsoil is grayish brown silt loam and dark brown clay loam 10 to 15 inches thick. The lower part is dark brown gravelly clay loam 8 to 12 inches

thick. The substratum is very dark gray very gravelly clay loam 4 to 12 inches thick. Slightly weathered andesite or quartz latite is at a depth of 30 to 40 inches.

Included in this unit are areas of Coni soils and Igneous outcrop.

Permeability of this Woodrock soil is moderately rapid. Available water capacity is moderate. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used for timber production and as watershed.

The native vegetation is mainly white fir, Engelmann spruce, and aspen with an understory of snowberry, serviceberry, rose, elderberry, grasses, and sedges. The hazard of plant competition is moderate. Equipment limitations are slight.

The main limitations for engineering uses are depth to hard bedrock and steepness of slope.

This map unit is in capability subclass VIe.

50E—Woodrock silt loam, 25 to 65 percent slopes. This moderately deep, well drained soil is on mountainsides. It formed in material derived from andesite and quartz latite. Elevation is 8,500 to 10,000 feet. The average annual precipitation is about 25 to 35 inches.

The surface is covered by a layer of forest litter 1 inch to 4 inches thick. The surface layer, where present, is very dark grayish brown silt loam as much as 3 inches thick. The subsurface layer is grayish brown silt loam 6 to 12 inches thick. The upper part of the subsoil is grayish brown silt loam and dark brown clay loam 8 to 15 inches thick. The lower part is dark brown gravelly clay loam 8 to 12 inches thick. The substratum is very dark gray very gravelly clay loam 6 to 15 inches thick. Quartz latite or andesite is at a depth of 30 to 40 inches.

Included in this unit are areas of Grenadier soils and Igneous outcrop.

Permeability of this Woodrock soil is moderately rapid. Available water capacity is moderate. Runoff is rapid, and the hazard of water erosion is moderate to high. The hazard of soil blowing is moderate.

This unit is used for timber production and as watershed.

The native vegetation is mainly white fir, Engelmann spruce, and aspen with an understory of snowberry, serviceberry, rose, elderberry, grasses, and sedges. The hazard of plant competition is moderate. Equipment limitations are moderate.

The main limitations for engineering uses are steepness of slope and depth to hard bedrock.

This map unit is in capability subclass VIIe.

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 behavior 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.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*5*). 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 slight 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

David Cook, range conservationist, Forest Service, helped to prepare this section.

Piedra Area is within the boundaries of the San Juan National Forest livestock allotments. Approximately 60 percent of the area supports vegetation that is used to compute the grazing capacity for these allotments. The remaining 40 percent supports dense stands of timber or is too steep or rocky for livestock grazing. The allotments above an elevation of 10,000 feet generally are used for sheep and goats, and those below 10,000 feet are used for cattle. Because raising sheep is not economically feasible, very few of the sheep allotments are being used.

Ranching is important to the economy of the area. Most of the ranches are cow and calf operations, but the number of steer and yearling operations is increasing each year. More than one-half of the ranches depend on allotments to supplement their operations.

Ranchers that use nearby rangeland throughout the year grow hay for feeding livestock in winter. Many ranchers use rangeland at lower elevations that is suitable for livestock grazing in winter.

Slope and the soils associated on the landscape greatly influence the natural vegetation. The moderately sloping to steeply sloping soils are moderately deep to shallow. Areas of these soils at higher elevations in the San Juan Mountains, mainly in the eastern and northern parts of the survey area, support alpine-type vegetation such as willows, cushion-type forbs, sheep fescue, alpine timothy, dryland sedges, and mountain avena. The soils in valleys and swales are commonly moderately deep to deep. These soils support lush vegetation such as tufted hairgrass, bluegrass, timothy, sedges, and elephanthead.

The soils in the Navajo section of the Colorado Plateau generally are derived from sandstone and shale. These soils are highly productive in areas where the slope is moderate and where adequate moisture is available. The soils in this section that are at higher elevations support bluegrass, bromes, wheatgrasses, and fescue. The vegetation at the lower elevations is mainly mountain muhly, needlegrass, wheatgrasses, oak brush, sagebrush, and mountainmahogany.

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 5 shows, for each soil in the survey area, 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 or are suited to rangeland are listed. Explanation of the column headings in table 5 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 high water table are also important.

Potential 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 reduced to a common percent of air dry moisture.

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, 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.

The major management concern on most rangeland is control of grazing so that the kinds and amounts of plants that make up the potential natural plant community are reestablished. Forage production is much less than that originally produced because the natural vegetation in many parts of the survey area has been greatly depleted by heavy grazing by both wildlife and livestock. Much of the acreage that was once open grassland is now covered with shrubs and trees.

Sound range management practices based on soil surveys and other rangeland inventories are the basis for maintaining or improving forage production.

woodland management and productivity

Robert Clauson, forester, Forest Service, assisted in preparing this section.

The main forest cover types in the survey area are pinyon-juniper, ponderosa pine, Douglas-fir-white fir, spruce-fir, and aspen. The type of forest cover in an area is determined by elevation, precipitation, and the kinds of soil. Pinyon-juniper is at an elevation of 6,000 to 7,000 feet, ponderosa pine is at 7,000 to 8,500 feet, Douglas-fir-white fir is at 8,000 to 9,500 feet, spruce-fir is at 8,500 to 11,500 feet, and aspen is at 8,000 to 11,000 feet. Above an elevation of 11,500 feet the vegetation is nonforest except for scattered alpine and subalpine firs.

Approximately 90 percent of the survey area is forested, and about 80 percent is commercial forest land that is capable of producing at least 20 cubic feet of wood per acre per year. In an unmanaged stand, the total annual growth of saw-log sized timber is 17 cubic feet per acre for ponderosa pine, 49 for Douglas-fir-white fir, 77 for spruce-fir, and 28 for aspen. The net annual growth is 17 cubic feet per acre for ponderosa pine, 30 for Douglas fir-white fir, 64 for spruce-fir, and 28 for aspen. The growth rate of the ponderosa pine forest type is low because heavy cutting in the 1900's left large areas understocked.

Table 6 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.

In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

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 a few trees may be blown down by normal 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 *important 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 that form

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 7 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 7 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.

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: 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, the 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.

construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 8 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 10 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few

cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 10.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

water management

Table 9 gives information on the soil properties and site features that affect water management.

This table also gives for each soil the restrictive features that affect pond reservoir areas; embankments, dikes, and levees; 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.

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.

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 10 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 a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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.

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 oven-dry 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 11 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.

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 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.

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.

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, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 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 following distinctions:

1. Sands, coarse 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.

soil and water features

Table 12 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils 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 is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 12 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. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the

need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). 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. In table 13, the soils of the survey area are classified according to the system. They are in 4 orders, 22 subgroups, 27 families, and 31 series and 1 variant. 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 Alfisol.

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 Boralf (*Bor*, meaning cool, plus *alf*, from Alfisol).

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 Paleboralfs (*Pale*, meaning old horizonation, plus *boralf*, the suborder of the Alfisols that are cold.

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 Paleboralfs.

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, montmorillonitic Typic Paleboralfs.

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. The soil is compared with similar soils and with nearby soils of other 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 (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). 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."

Adel series

The Adel series consists of deep, well drained soils. These soils formed in mixed landslide and alluvial material derived from a variety of rock.

Typical pedon of an Adel loam in sec. 23, T. 37 N., R. 1 E.

A11—0 to 14 inches; brown (10YR 5/3) loam; moderate very fine granular structure; soft, very friable; many fine and medium roots; neutral; gradual wavy boundary.

A12—14 to 21 inches; brown (10YR 5/3) loam; moderate fine granular structure; soft, very friable, slightly plastic; many fine and medium roots; neutral; gradual wavy boundary.
A13—21 to 25 inches; brown (10YR 5/3) clay loam; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky; many fine roots; neutral; gradual irregular boundary.
C—25 to 60 inches; light yellowish brown (10YR 6/4) gravelly clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, firm, slightly sticky and plastic; few fine roots; slightly acid; abrupt wavy boundary.
IIC—60 inches; black and dark gray shale.

Animas series

The Animas series consists of moderately deep, somewhat poorly drained soils. These soils formed in landslide material derived from quartz latite, andesite, and other volcanic rock of Tertiary age. Depth to impervious or slowly pervious shale ranges from 30 to 40 inches.

Typical pedon of an Animas loam in sec. 4, T. 36 N., R. 1 E.

O1—1 inch to 0; undecomposed twigs, needles, bark, and other woody and herbaceous material.
A11—0 to 5 inches; dark grayish brown (10YR 4/2) loam, black (10YR 2/1) moist; strong medium granular structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; many medium and coarse roots; slightly acid; gradual irregular boundary.
A12—5 to 12 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; common medium distinct dark brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to strong medium granular; soft, very friable, slightly sticky and slightly plastic; 5 percent igneous gravel; common fine and medium roots; slightly acid; gradual irregular boundary.
B2t—12 to 23 inches; light brown (7.5YR 6/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; common fine strong brown (7.5YR 5/6) mottles; moderate coarse subangular blocky structure; very hard, very firm, sticky and plastic; 15 percent igneous gravel; few fine and medium roots; thin patchy clay films; medium acid; gradual irregular boundary.
C1—23 to 38 inches; brown (7.5YR 6/4) gravelly sandy clay loam, brown (7.5YR 4/4) moist; common medium distinct dark brown (7.5YR 3/2), strong brown (7.5YR 5/6), and greenish gray (5GY 5/1) mottles; massive; very hard, very firm, sticky and plastic; 15 percent gravel and 10 percent stones; few fine roots; medium acid; abrupt irregular boundary.
C2r—38 inches; clay shale.

Carracas series

The Carracas series consists of shallow, well drained soils. These soils formed in residuum derived from interbedded shale and sandstone. Depth to bedrock ranges from 12 to 20 inches.

Typical pedon of a Carracas loam in the SE1/4 of sec. 4, T. 34 N., R. 6 W.

A1—0 to 4 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; strong fine crumb structure; soft, very friable, slightly sticky and slightly plastic; 5 percent sandstone fragments; slightly acid; clear wavy boundary.
C1—4 to 14 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable; 5 percent small sandstone fragments; slightly acid; gradual wavy boundary.
IIC2—14 inches; soft interbedded sandstone and shale.

Castelleia series

The Castelleia series consists of deep, well drained soils. These soils formed in landslide material derived from quartz latite and other igneous rock. The O1 and O2 horizons range from 2 to 4 inches thick. Shale and sandstone are at a depth of 5 to 50 feet.

Typical pedon of a Castelleia loam in the SW1/4 of sec. 35, T. 34 N., R. 1 E.

O1—3 inches to 1 inch; recent forest litter.
O2—1 inch to 0; decomposed humus.
A1—0 to 4 inches; very dark brown (10YR 2/2) loam; moderate medium granular structure; soft, very friable, slightly sticky; common roots; 5 percent gravel; strongly acid; clear wavy boundary.
A2—4 to 10 inches; dark grayish brown (10YR 4/2) loam; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky; common roots; 5 percent gravel; strongly acid; gradual wavy boundary.
A&B—10 to 19 inches; grayish brown (10YR 5/2) loam; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky; many fine pores; thin patchy clay films on faces of peds and in pores; common roots; 5 percent gravel; strongly acid; gradual wavy boundary.
B2t—19 to 26 inches; dark brown (10YR 5/2) clay loam; moderate medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few pores; distinct patchy clay films on faces of peds and in pores; 5 percent gravel; strongly acid; gradual wavy boundary.

C1—26 to 32 inches; brown (10YR 5/3) moist; very stony sandy clay loam; massive; very hard, very firm, slightly sticky and slightly plastic; few roots; 40 percent stones and 15 percent gravel; medium acid; gradual wavy boundary.
IIC2—32 to 120 inches; brown (10YR 5/3) extremely stony light clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; 65 percent stones and 15 percent gravel; medium acid; clear smooth boundary.
IIC3—120 inches; shale.

Chris series

The Chris series consists of deep, well drained soils. These soils formed in residuum and alluvium derived from sandstone. Depth to sandstone ranges from 40 to 80 inches.

Typical pedon of a Chris gravelly loam in sec. 32, T. 38 N., R. 4 W.

O1—2 inches to 1 inch; undecomposed organic material, principally needles, bark, leaves, and grasses.
O2—1 inch to 0; partially decomposed organic material similar to that of the horizon above.
A2—0 to 7 inches; pinkish gray (7.5YR 6/2) gravelly loam, brown (7.5YR 5/2) moist; weak thick platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; 15 percent gravel and few cobbles and stones; medium acid; clear irregular boundary.
A&B—7 to 16 inches; mixed pinkish gray (7.5YR 6/2) and reddish brown (5YR 5/4) gravelly light clay loam, brown (7.5YR 5/2) and reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; very hard clayey peds; thin glossy patches on faces of peds; 20 percent gravel and 5 percent cobbles and stones; medium acid; tongues of albic material extend into the reddish brown underlying material; gradual wavy boundary.
B2t—16 to 24 inches; reddish brown (5YR 5/4) very gravelly light clay, reddish brown (5YR 4/4) moist; moderate medium angular blocky structure; extremely hard, friable, sticky and plastic; thin continuous clay films on faces of peds, in pores and root channels, and as coatings on coarse fragments; 25 percent gravel and 15 percent cobbles and stones; medium acid; gradual wavy boundary.
C—24 to 60 inches; light reddish brown (5YR 6/4) very stony sandy clay loam, reddish brown (5YR 5/4) moist; massive; very hard, firm, slightly sticky and slightly plastic; 25 percent gravel and 25 percent cobbles and stones; slightly acid.

Coni series

The Coni series consists of shallow, well drained soils. These soils formed in residuum derived from sandstone. Depth to bedrock ranges from 12 to 20 inches.

Typical pedon of a Coni sandy loam in sec. 18, T. 37 N., R. 3 W.

O1—2 inches to 1 inch; recent litter.
O2—1 inch to 0; humus.
A1—0 to 5 inches; brown (10YR 5/3) sandy loam; moderate fine granular structure; soft, very friable; common roots; slightly acid; gradual wavy boundary.
B2t—5 to 13 inches; dark brown (10YR 4/3) loam; weak medium subangular blocky structure; slightly hard, firm, plastic; common roots; slightly acid; clear wavy boundary.
C—13 to 20 inches; very pale brown (10YR 7/3) loamy fine sand; loose; few roots; slightly acid; gradual wavy boundary.
R—20 inches; sandstone.

Corta series

The Corta series consists of deep, well drained soils. These soils formed in residuum derived from interbedded sandstone and shale. Bedrock is at a depth of 50 to 60 inches or more.

Typical pedon of a Corta silt loam in the NE1/4 of sec. 34, T. 35 N., R. 6 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; soft, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.
B2t—4 to 31 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; weak very coarse prismatic structure parting to moderate coarse angular blocky; wide cracks between peds when dry; extremely hard, friable, sticky and plastic; common clay films on faces of peds, in root channels, and in pores; common slickensides; slightly acid; gradual wavy boundary.
B3—31 to 36 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; weak coarse angular blocky structure; cracks between peds when dry; extremely hard, firm, sticky and plastic; few thin clay films on faces of peds and discontinuous clay films in root channels; neutral; gradual wavy boundary.
C1—36 to 50 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; massive; cracks erratically when dry; extremely hard, very firm, sticky and plastic; common small shale chips; mildly alkaline; gradual irregular boundary.
C2r—50 inches; shale.

Dunton series

The Dunton series consists of moderately deep, moderately well drained soils. These soils formed in residuum derived from sandstone. Depth to hard sandstone ranges from 30 to 40 inches.

Typical pedon of a Dunton loam in the NE1/4 of sec. 13, T. 35 N., R. 3 W.

O1—2 inches to 0; undecomposed forest litter.
A2—0 to 24 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; moderate medium granular structure; soft, friable; neutral; clear irregular boundary.
A&B—24 to 27 inches; 60 percent pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist, and 40 percent brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; A2 part has moderate medium granular structure and is soft and friable; B2 part has medium subangular blocky structure and is hard, firm, slightly sticky and slightly plastic; tongues and fingers of the lighter colored material extend into and are mixed with clayey material similar to that of the underlying horizon; slightly acid; clear wavy boundary.
B2t—27 to 38 inches; brown (7.5YR 4/4) heavy clay loam, dark brown (7.5YR 3/4) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; few roots; many continuous thin clay films on faces of peds; slightly acid; clear wavy boundary.
R—38 inches; hard reddish brown and buff colored sandstone.

Endlich series

The Endlich series consists of moderately deep, well drained soils. These soils formed in residuum derived from granite. Depth to fractured bedrock ranges from 20 to 36 inches.

Typical pedon of an Endlich stony loam in the SE1/4 of sec. 20, T. 38 N., R. 4 W.

O1—2 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and leaves.
O2—1 inch to 0; partially decomposed organic material similar to that of the horizon above.
A2—0 to 7 inches; pale brown (10YR 6/3) stony loam, brown (10YR 5/3) moist; moderate thick platy structure parting to moderate medium granular; soft, friable; 40 percent stones and 10 percent gravel; extremely acid; clear smooth boundary.
B2—7 to 22 inches; reddish brown (5YR 5/4) very stony loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; 40 percent stones and 10 percent gravel; very strongly acid; abrupt wavy boundary.
R—22 inches; hard, massive granite.

Gateview series

The Gateview series consists of deep, somewhat excessively drained soils. These soils formed in ground moraine material overlying shale.

Typical pedon of a Gateway gravelly loam in the NE1/4 of sec. 21, T. 37 N., R. 3 W.

A11—0 to 10 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; 20 percent gravel and some cobbles; neutral; clear smooth boundary.
A12—10 to 22 inches; grayish brown (10YR 5/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to fine granular; slightly hard, very friable; 60 percent gravel and some cobbles; neutral; gradual smooth boundary.
C—22 to 60 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; 60 percent gravel and some cobbles; neutral.

Greenough series

The Greenough series consists of deep, well drained soils. These soils formed in eolian material overlying shale and sandstone. Depth to shale ranges from 40 to 48 inches.

Typical pedon of a Greenough loam in the SW1/4 of sec. 14, T. 35 N., R. 6 W.

O1—1 to 1/2 inch; pine needles and twigs.
O2—1/2 inch to 0; humus.
A1—0 to 3 inches; brown (10YR 5/3) loam; weak thin platy structure; soft, very friable; common roots; neutral; clear smooth boundary.
A2—3 to 8 inches; light yellowish brown (10YR 6/4) loam; weak medium subangular blocky structure; soft, very friable, slightly plastic; common roots; slightly acid; gradual wavy boundary.
A&B—8 to 12 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; slightly hard, friable, slightly plastic; common roots; medium acid; gradual irregular boundary.
B21t—12 to 24 inches; brown (7.5YR 5/4) clay loam; moderate medium and coarse subangular blocky structure; hard, firm, plastic; common roots; medium acid; clear wavy boundary.
B22t—24 to 30 inches; brown (7.5YR 5/4) clay loam; weak medium subangular blocky structure; hard, firm, plastic; few roots; neutral; clear wavy boundary.
C1—30 to 44 inches; brown (7.5YR 5/4) clay loam; massive; hard, firm, plastic; mildly alkaline; clear wavy boundary.
IIC2—44 inches; shale.

Grenadier series

The Grenadier series consists of deep, well drained soils. These soils formed in residuum derived from andesite and quartz latite of Tertiary age. Depth to hard, very slightly fractured bedrock ranges from 40 to 60 inches or more.

Typical pedon of a Grenadier loam in the NE1/4 of sec. 2, T. 37 N., R. 1 E.

O1—3 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and leaves.
O2—1 inch to 0; partially decomposed organic material similar to that of the horizon above.
A2—0 to 3 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 5/4) moist; weak medium platy structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; 5 percent stones; strongly acid; clear wavy boundary.
B2—3 to 18 inches; light brown (7.5YR 6/4) very stony loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few dark colored pellets in lower part of horizon; 35 percent stones; strongly acid; gradual wavy boundary.
C—18 to 60 inches; light brown (7.5YR 6/3) extremely stony loam, brown (7.5YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 75 percent stones; strongly acid.

Heflin series

The Heflin series consists of deep, well drained soils on toe slopes in valleys. These soils formed in alluvium derived from sandstone and some shale. Depth to bedrock is 50 to 60 inches.

Typical pedon of a Heflin sandy loam in the SW1/4 of sec. 4, T. 34 N., R. 6 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, very friable; common roots; neutral; clear wavy boundary.
B1—4 to 7 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, firm, slightly sticky and plastic; thin clay films on faces of peds; common roots; slightly acid; clear wavy boundary.
B21t—7 to 14 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, very firm, sticky and very plastic; thin continuous clay films on faces of peds; few roots; slightly acid; clear wavy boundary.
B22t—14 to 25 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very firm, sticky and plastic; thin discontinuous clay films on faces of peds; few roots; slightly acid; clear wavy boundary.
B3—25 to 36 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, very firm, sticky and plastic; very few roots; slightly acid; clear wavy boundary.
C1—36 to 56 inches; pale brown (10YR 6/3) sandy clay loam; massive; slightly hard, firm; slightly acid; clear smooth boundary.
IIC2—56 inches; sandstone and shale.

Hossick series

The Hossick series consists of moderately deep, well drained soils. These soils formed in residuum derived from igneous material such as andesite and quartz latite. Depth to slightly fractured bedrock ranges from 20 to 40 inches.

Typical pedon of a Hossick gravelly loam in the SW1/4 of sec. 31, T. 38 N., R. 2 E.

A11—0 to 5 inches; brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; 15 percent cobbles and 15 percent gravel; very strongly acid; clear smooth boundary.
A12—5 to 11 inches; brown (7.5YR 5/3) gravelly loam, dark brown (7.5YR 3/3) moist; weak fine subangular blocky structure parting to strong fine crumb and granular; soft, very friable, slightly sticky and slightly plastic; 15 percent cobbles and 20 percent gravel; very strongly acid; clear smooth boundary.
B2—11 to 18 inches; reddish brown (5YR 5/3) very gravelly loam, reddish brown (5YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 20 percent cobbles and 30 percent gravel; very strongly acid; gradual wavy boundary.
C—18 to 23 inches; reddish brown (5YR 5/4) very cobbly loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 40 percent cobbles and 30 percent gravel; strongly acid; abrupt wavy boundary.
R—23 inches; hard, massive andesite and latite bedrock.

Hunchback series

The Hunchback series consists of deep, somewhat poorly drained soils. These soils formed in colluvium and alluvium derived from mixed material. Depth to bedrock is more than 72 inches.

Typical pedon of a Hunchback clay loam in the NE1/4 of sec. 15, T. 33 N., R. 1 E.

A11—0 to 14 inches; gray (10YR 5/1) clay loam, very dark brown (10YR 2/2) moist; strong medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; medium acid; clear smooth boundary.

A12—14 to 24 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; moderate medium and fine subangular blocky structure parting to medium and coarse granular; slightly hard and very hard, very friable, slightly sticky and slightly plastic; medium acid; gradual smooth boundary.
A13g—24 to 37 inches; dark gray (10YR 4/1) heavy clay loam, black (10YR 2/1) moist; common medium distinct dark yellowish brown (10YR 4/4, moist) mottles; moderate coarse and medium angular blocky structure; extremely hard, friable, sticky and plastic; medium acid; gradual wavy boundary.
B2g—37 to 60 inches; gray (2.5Y 5/1) silty clay, dark gray (2.5Y 4/1) moist; many large prominent dark yellowish brown (10YR 4/4, moist) mottles; massive; extremely hard, firm, sticky and plastic; neutral.

Judy series

The Judy series consists of moderately deep, moderately well drained soils. These soils formed in residuum derived from limestone. Limestone is at a depth of 24 to 38 inches. A few limestone fragments are in these soils in places.

Typical pedon of a Judy silt loam in sec. 9, T. 35 N., R. 4 W.

O1—3 to 2 inches; leaves, twigs, and other undecomposed organic matter.
O2—2 inches to 0; slightly decomposed organic matter.
A1—0 to 10 inches; dark brown (7.5YR 3/2, moist) silt loam; moderate fine granular structure; soft, very friable, slightly sticky; many fine roots; neutral; gradual wavy boundary.
B21t—10 to 15 inches; dark brown (7.5YR 4/2, moist) silty clay loam; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; few roots; thin patchy faint clay films on faces of peds; mildly alkaline; clear wavy boundary.
B22t—15 to 28 inches; dark brown (7.5YR 4/2, moist) silty clay loam; moderate medium prismatic structure; hard, firm, slightly sticky and plastic; few roots; thick patchy clay films on faces of peds; mildly alkaline; clear wavy boundary.
C—28 to 38 inches; dark brown (7.5YR 4/3, moist) clay loam; moderate medium subangular blocky structure; hard, firm; 10 percent limestone rock fragments 2 to 3 inches thick and 5 to 10 inches across; moderately alkaline; clear wavy boundary.
R—38 inches; limestone.

Leal series

The Leal series consists of deep, well drained soils. These soils formed in residuum derived from andesite and quartz latite. Depth to bedrock ranges from 40 to 60 inches.

Typical pedon of a Leal sandy loam in sec. 5, T. 37 N., R. 2 E.

O1—3 inches to 0; forest litter and humus.
A1—0 to 2 inches; dark brown (7.5YR 3/3) sandy loam; weak very fine granular structure; soft, very friable; common roots; strongly acid; abrupt smooth boundary.
A2—2 to 15 inches; dark brown (7.5YR 4/3) sandy loam; moderate very fine and fine granular structure; soft, very friable; common roots; 10 percent rock fragments; strongly acid; gradual wavy boundary.
B2—15 to 22 inches; strong brown (7.5YR 5/6) sandy loam; weak fine granular structure; soft, friable; few roots; 15 percent rock fragments; medium acid; gradual wavy boundary.
C—22 to 41 inches; yellowish brown (10YR 5/4) sandy loam; weak very fine granular structure; soft, very friable; very few roots; medium acid; abrupt irregular boundary.
R—41 inches; andesite and quartz latite.

Limber series

The Limber series consists of moderately deep, well drained soils. These soils formed in residuum derived from limestone. Depth to limestone ranges from 28 to 40 inches.

Typical pedon of a Limber loam in the NE1/4 of sec. 23, T. 37 N., R. 5 W.

O1—3 to 2 inches; recent forest litter.
O2—2 inches to 0; humus.
A1—0 to 3 inches; reddish brown (5YR 4/3, moist) loam; moderate thin and medium platy structure; soft, very friable, slightly plastic; common roots; 1 percent limestone rock fragments 5 inches across; medium acid; abrupt smooth boundary.
A2—3 to 7 inches; reddish brown (5YR 4/3, moist) loam; weak medium subangular blocky structure; slightly hard, friable, plastic; common roots; 5 percent limestone rock fragments 5 to 8 inches across; medium acid; gradual irregular boundary.
B2t—7 to 15 inches; dark reddish brown (5YR 3/3, moist) clay loam; moderate medium and coarse subangular blocky structure; hard, firm, slightly sticky and plastic; common roots; 10 percent limestone rock fragments 5 to 8 inches across; neutral; gradual wavy boundary.
C—15 to 30 inches; reddish brown (5YR 5/3, moist) clay loam; massive; hard, firm, slightly sticky and slightly plastic; very few roots; 20 percent limestone rock fragments; mildly alkaline; strongly effervescent; abrupt irregular boundary.
R—30 inches; slightly fractured to massive limestone.

Mayoworth series

The Mayoworth series consists of moderately deep, well drained soils. These soils formed in residuum and alluvium derived from shale and sandy shale. Depth to bedrock ranges from 28 to 40 inches.

Typical pedon of a Mayoworth silt loam in sec. 15, T. 34 N., R. 5 W.

O1—3 inches to 0; humus.
A1—0 to 8 inches; very dark gray (10YR 3/1, moist) silt loam; moderate fine granular structure; soft, very friable; common medium roots; 10 percent gravel and small stones; medium acid; clear wavy boundary.
B2t—8 to 14 inches; dark brown (10YR 4/3, moist) silty clay loam; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common medium roots; 15 percent gravel and small stones; medium acid; gradual wavy boundary.
C—14 to 28 inches; dark grayish brown (10YR 4/2, moist) clay loam; massive; slightly hard, firm, sticky and plastic; few roots; 35 percent gravel and small stones; medium acid; abrupt irregular boundary.
R—28 inches; very slightly fractured shale and sandstone.

Mayoworth Variant

Mayoworth Variant consists of deep, well drained soils. These soils formed in material weathered from partially decomposed shale, sandy shale, and sandstone. Depth to bedrock is 40 to 72 inches.

Typical pedon of a Mayoworth loam, deep variant, in sec. 10, T. 37 N., R. 3 W.

O1—4 to 3 inches; undecomposed forest litter consisting of needles, twigs, bark, other woody fragments, and some herbaceous plant material.
O2—3 inches to 0; partially decomposed to decomposed wood and herbaceous plant material.
A11—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; weak very thin platy structure parting to moderate very fine granular; soft, very friable, slightly sticky and slightly plastic; less than 5 percent gravel; many fine roots and common medium roots; few fine tubular pores; strongly acid; abrupt smooth boundary.
A12—3 to 9 inches; very dark grayish brown (10YR 3/2) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, sticky; common fine and medium roots and few coarse roots; few fine tubular pores; strongly acid; clear wavy boundary.
B21t—9 to 18 inches; very dark grayish brown (10YR 3/2) clay loam, dark brown (7.5YR 3/2) moist; strong coarse subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, sticky and plastic; few fine roots; common fine tubular pores; medium acid; clear wavy boundary.
B22t—18 to 28 inches; dark brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/2) moist; strong coarse subangular blocky structure parting to moderate medium subangular blocky; hard, very firm, very sticky; 5 percent channery fragments; few fine roots; medium acid; clear wavy boundary.
C1—28 to 43 inches; dark brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/2) moist; few fine distinct strong brown (7.5YR 5/6) mottles; massive; extremely hard, extremely firm, very sticky and very plastic; 5 percent channery fragments; medium acid; abrupt smooth boundary.
IIC2r—43 inches; partially decomposed shale and sandstone.

Miracle series

The Miracle series consists of moderately deep, well drained soils. These soils formed in residuum and alluvium derived from sandstone. Depth to hard sandstone ranges from 30 to 40 inches.

Typical pedon of a Miracle loamy fine sand in the SW1/4 of sec. 10, T. 35 N., R. 4 W.

O1—1 inch to 0; leaves, needles, and twigs.
A1—0 to 12 inches; grayish brown (10YR 5/2) loamy fine sand; moderate fine granular structure; soft, very friable; neutral; clear smooth boundary.
B1—12 to 17 inches; yellowish brown (10YR 5/4) sandy loam; weak fine granular structure; soft, very friable; common roots; neutral; gradual wavy boundary.
B2t—17 to 24 inches; light brown (7.5YR 6/5) sandy clay loam; weak fine subangular blocky structure; slightly hard, firm, slightly sticky and plastic; few roots; few weathered sandstone rock fragments; thin patchy clay films on faces of peds; slightly acid; clear wavy boundary.
B3—24 to 31 inches; light brown (7.5YR 6/4) sandy clay loam; massive; slightly hard, firm, slightly sticky and slightly plastic; few roots; few weathered sandstone rock fragments; medium acid; clear wavy boundary.
C—31 to 38 inches; pale brown (10YR 6/3) sandy loam; massive; slightly hard, firm, slightly sticky; 5 percent sandstone rock fragments; slightly acid; clear irregular boundary.
R—38 inches; sandstone.

Molas series

The Molas series consists of moderately deep, poorly drained soils. These soils formed in glacial till overlying shale. Depth to soft shale ranges from 30 to 40 inches.

Typical pedon of a Molas loam in the NE1/4 of sec. 8, T. 37 N., R. 3 W.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine crumb structure; soft, very friable, slightly sticky and slightly plastic; 10 percent fine gravel and 5 percent cobbles; medium acid; clear smooth boundary.

A12—5 to 13 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate very fine subangular blocky structure parting to strong fine granular; slightly hard and hard, very friable, slightly sticky and slightly plastic; 10 percent fine gravel and 5 percent cobbles; medium acid; clear smooth boundary.

A2—13 to 18 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; medium fine distinct yellowish brown (10YR 5/6, moist) mottles; moderate thin platy structure parting to strong very fine granular; slightly hard, very friable, slightly sticky and slightly plastic; few small dark concretions; 5 percent fine gravel and 5 percent cobbles; medium acid; abrupt smooth boundary.

B2t—18 to 26 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; many large prominent yellowish brown (10YR 5/6) mottles; strong medium angular blocky structure; extremely hard, very friable, sticky and plastic; thin continuous clay films on faces of peds and as coatings and fillings in root channels and in pores; few slickensides; medium acid; gradual wavy boundary.

B3—26 to 33 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; common medium distinct dark gray (10YR 4/1) mottles; weak coarse angular blocky structure; extremely hard, friable, sticky and plastic; few shale chips; medium acid; gradual wavy boundary.

IIC—33 inches; gray and olive gray shale.

Muggins series

The Muggins series consists of deep, well drained soils on terminal and lateral moraines. These soils formed in till derived mainly from igneous rock of Tertiary age. Depth to bedrock ranges from 5 to 15 feet or more.

Typical pedon of a Muggins loam in the NW1/4 of sec. 13, T. 37 N., R. 3 W.

O2—1 inch to 0; partially decomposed organic matter.

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) loam; moderate very fine granular structure; soft, very friable; common roots; 5 percent cobbles; medium acid; clear wavy boundary.

A2—4 to 14 inches; pinkish gray (7.5YR 6/2) loam; weak very fine granular structure; soft, friable, slightly sticky; common roots; 5 percent cobbles; medium acid; gradual wavy boundary.

B&A—14 to 19 inches; pinkish gray (7.5YR 6/2) loam and reddish brown (5YR 5/3) clay loam; strong fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few roots; 15 percent cobbles; thick patchy clay films on faces of peds; medium acid; gradual wavy boundary.

B2t—19 to 27 inches; reddish brown (5YR 5/3) clay loam; strong medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few roots; 15 percent cobbles; thick continuous clay films on faces of peds; medium acid; clear wavy boundary.

C—27 to 60 inches; dark reddish gray (5YR 4/2) cobbly loam; massive; slightly hard, firm; few roots; 30 percent cobbles; slightly acid.

Nunn series

The Nunn series consists of deep, well drained soils on alluvial plains and coalescing alluvial fans. These soils formed in material derived from shale and some sandstone.

Typical pedon of a Nunn loam (fig. 6) in the NW1/4 of sec. 4, T. 34 N., R. 6 W.

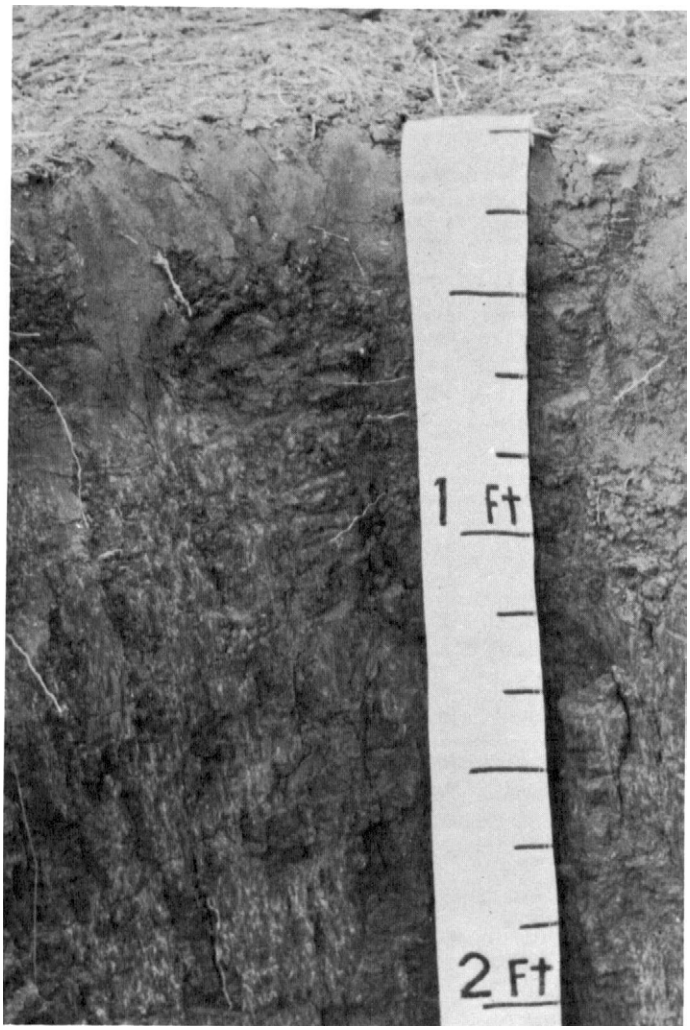

Figure 6. Profile of a Nunn loam.

A11—0 to 5 inches, brown (10YR 5/3) loam; weak very fine granular structure; soft, very friable; common roots; neutral; gradual wavy boundary.
A12—5 to 10 inches; grayish brown (10YR 5/2) clay loam; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky; few roots; neutral; abrupt wavy boundary.
B21t—10 to 19 inches; grayish brown (10YR 5/2) clay loam; moderate medium prismatic structure; hard, firm, sticky and slightly plastic; few roots; neutral; clear wavy boundary.
B22t—19 to 25 inches; brown (10YR 5/3) clay; moderate coarse prismatic structure; very hard, very firm, sticky and plastic; few roots; neutral; gradual irregular boundary.
C—25 to 60 inches; light olive brown (2.5Y 5/4) clay; massive; very hard, very firm, slightly sticky and plastic; moderately alkaline; slightly effervescent.

Pagosa series

The Pagosa series consists of deep, moderately well drained soils. These soils formed in glacial till overlying shale. Bedrock is at a depth of 40 to 60 inches.

Typical pedon of a Pagosa loam in the NE1/4 of sec. 3, T. 37 N., R. 3 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; soft, very friable, slightly sticky and slightly plastic; 10 percent gravel; strongly acid; clear wavy boundary.
A2—6 to 13 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak fine subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky and slightly plastic; 5 percent stones and 5 percent gravel; strongly acid; gradual wavy boundary.
A&B—13 to 22 inches; mixed light brownish gray (10YR 6/2) and brown (7.5YR 5/4) heavy loam, grayish brown (10YR 5/2) and dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; hard clayey peds; thin clay films on faces of some peds and in root channels; 10 percent stones and 5 percent gravel; seams and nodules of clayey material similar to the underlying horizon are embedded in a lighter colored matrix similar to the overlying horizon; medium acid; clear irregular boundary.
B2t—22 to 30 inches; brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, very friable, sticky and plastic; thin nearly continuous clay films on faces of peds and in root channels and pores; 10 percent stones and 5 percent gravel; medium acid; diffuse wavy boundary.
C1—30 to 44 inches; yellowish brown (10YR 5/4) light clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; 10 percent stones and 5 percent gravel; medium acid; clear smooth boundary.
IIC2—44 inches; shale and sandstone.

Pescar series

The Pescar series consists of deep, somewhat poorly drained soils. These soils formed in alluvium overlying outwash or waterworn material derived from mixed sources.

Typical pedon of a Pescar sandy loam in the NW1/4 of sec. 25, T. 34 N., R. 5 W.

A1—0 to 8 inches; light brownish gray (10YR 6/2) sandy loam stratified with thin lenses of loamy fine sand, dark grayish brown (10YR 4/2) moist; moderate fine granular and crumb structure; soft, very friable; calcareous; mildly alkaline; clear smooth boundary.
C1—8 to 22 inches; pale brown (10YR 6/3) fine sandy loam stratified with loamy fine sand and loam, brown (10YR 5/3) moist; common medium distinct yellowish brown (10YR 5/6, moist) and gray (N 6/0, moist) mottles; massive; soft, very friable; calcareous; mildly alkaline; clear wavy boundary.
IIC2—22 to 60 inches; pale brown (10YR 6/3) very gravelly sand stratified with lenses of loamy sand, brown (10YR 5/3) moist; common medium distinct yellowish brown (10YR 5/6, moist) mottles; single grain; loose; calcareous; moderately alkaline.

Rogert series

The Rogert series consists of shallow, well drained soils. These soils formed in residuum derived from andesite, quartz latite, and other igneous rock of Tertiary age. Bedrock is at a depth of 12 to 20 inches.

Typical pedon of a Rogert gravelly loam in the NW1/4 of sec. 4, T. 36 N., R. 1 E.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam; weak fine granular structure; soft, very friable; common roots; 40 percent gravel; neutral; clear wavy boundary.
C—6 to 18 inches; light brownish gray (10YR 6/2) gravelly loam; single grain; loose; few roots; 50 percent gravel and stones; neutral; abrupt irregular boundary.
R—18 inches; andesite.

Sambrito series

The Sambrito series consists of deep, well drained soils. These soils formed in colluvium and alluvium of mixed origin. Depth to shale is 60 inches or more.

Typical pedon of a Sambrito loam in the NW1/4 of sec. 5, T. 36 N., R. 2 E.

O1—2 inches to 1 inch; undecomposed organic material, principally needles, bark, twigs, and grasses.
O2—1 inch to 0; partially decomposed organic material similar to that of the horizon above.
A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; moderate fine granular and crumb structure; soft, very friable; strongly acid; clear smooth boundary.
B2—4 to 20 inches; pale brown (10YR 6/3) gravelly coarse sandy loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, very friable; 20 percent gravel; medium acid; gradual wavy boundary.
C—20 to 60 inches; light gray (10YR 7/2) gravelly coarse sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; 30 percent gravel; medium acid; gradual wavy boundary.
IIC—60 inches; shale.

Skyway series

The Skyway series consists of moderately deep, well drained soils. These soils formed in residuum derived from many kinds of igneous rock of Tertiary age. Hard bedrock is at a depth of 30 to 40 inches.

Typical pedon of a Skyway loam in the SW1/4 of sec. 13, T. 37 N., R. 1 E.

A11—0 to 12 inches; dark brown (10YR 3/3) loam; moderate fine granular structure; soft, very friable, slightly plastic; many fine and medium roots; slightly acid; clear wavy boundary.
A12—12 to 21 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; soft, friable, slightly plastic; common roots; medium acid; clear wavy boundary.
C—21 to 36 inches; pink (7.5YR 7/4) sandy loam; massive; hard, firm, slightly sticky and slightly plastic; medium acid; clear wavy boundary.
R—36 inches; quartz latite.

Vasquez series

The Vasquez series consists of deep, poorly drained soils. These soils formed in alluvium derived from andesite and quartz latite. Bedrock is at a depth of 5 to 10 feet.

Typical pedon of a Vasquez loam in sec. 30, T. 39 N., R. 4 W.

A1—0 to 16 inches; very dark gray (10YR 3/1) loam; moderate medium granular structure; soft, very friable; common medium roots; very strongly acid; gradual wavy boundary.
C1—16 to 30 inches; grayish brown (10YR 5/2) loam; yellowish brown (10YR 5/8) mottles; massive; slightly hard, firm, slightly plastic; few fine roots; strongly acid; gradual irregular boundary.
C2—30 to 60 inches; gray (N 5/0) loam; common medium distinct light yellowish brown (10YR 6/4) mottles; massive; slightly hard, firm, slightly plastic; strongly acid.

Winifred series

The Winifred series consists of moderately deep, well drained soils. These soils formed in residuum derived from black or dark gray shale. Depth to soft shale ranges from 30 to 40 inches.

Typical pedon of a Winifred clay in the NE1/4 of sec. 35, T. 36 N., R. 2 1/2 W.

A1—0 to 4 inches; very dark grayish brown (10YR 3/2, moist) clay; moderate fine and very fine granular structure; slightly hard, firm, slightly sticky and slightly plastic; common roots; neutral; abrupt smooth boundary.
A3—4 to 10 inches; dark grayish brown (10YR 4/2, moist) clay loam; weak very fine subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; neutral; slight effervescence; abrupt smooth boundary.
B2—10 to 21 inches; dark grayish brown (10YR 4/2, moist) clay; weak medium prismatic structure; hard, firm, slightly sticky and plastic; few roots; neutral; slight effervescence; clear wavy boundary.
C1—21 to 38 inches; light gray (10YR 6/1) clay; massive; hard, very firm, sticky and slightly plastic; very few roots; mildly alkaline; strongly calcareous; abrupt wavy boundary.
C2r—38 inches; soft shale.

Woodrock series

The Woodrock series consists of moderately deep, well drained soils. These soils formed in residuum derived from andesite and quartz latite. Depth to bedrock ranges from 30 to 40 inches.

Typical pedon of a Woodrock silt loam in the SW1/4 of sec. 27, T. 38 N., R. 3 W.

O1—4 to 3 inches; plant litter consisting mainly of needles, twigs, bark, and some herbaceous plant material.
O2—3 inches to 0; decomposed and partially decomposed organic matter.
A1—0 to 3 inches; very dark grayish brown (10YR 3/2, moist) silt loam; weak fine granular structure; soft, friable; many medium and fine roots; few coarse roots; neutral; clear smooth boundary.
A2—3 to 10 inches; grayish brown (10YR 5/2, moist) silt loam; weak fine subangular blocky structure; soft, friable, slightly plastic; 10 percent gravel and stones; many coarse roots and common fine and medium roots; slightly acid; clear wavy boundary.
B&A—10 to 23 inches; 60 percent dark brown (10YR 3/3, moist) clay loam and 40 percent grayish brown

(10YR 5/2) loam; A part has weak fine subangular blocky structure, and B part has moderate medium subangular blocky structure; soft, friable, slightly plastic; 15 percent gravel and stones; common fine and medium roots; slightly acid; clear wavy boundary.

B2t—23 to 32 inches; dark brown (10YR 3/3, moist) gravelly clay loam; moderate medium and coarse subangular blocky structure; slightly hard, firm, slightly sticky and plastic; 20 percent gravel and stones; few fine and medium roots; neutral; clear irregular boundary.

C—32 to 38 inches; very dark gray (10YR 3/1, moist) very gravelly clay loam; massive; hard, firm, sticky and plastic; 40 percent gravel and 10 percent stones; few fine roots; neutral; abrupt wavy boundary.

R—38 inches; slightly weathered quartz latite.

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glossary

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.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

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.

Association, soil. A group of soils 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

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid 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.

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil 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 are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock. Bedrock is too near the surface for the specified use.

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.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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.

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.

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.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

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 drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 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, up to 3 inches (7.5 centimeters) in diameter.

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.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

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.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

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. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

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 A or B horizon. 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 Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but 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.

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.

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.

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.

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.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured (moderately light textured) soil. 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).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

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 of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

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 melt water.

Parent material. The unconsolidated organic and mineral material in which soil forms.

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.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, 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 0.20 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, differences in 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.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

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

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.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

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.

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.

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 about the same profile, 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. 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.

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 feet.

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.

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.

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 mm 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 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.

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).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

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."

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

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, silt loam, 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.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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.

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.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
[Recorded in the period 1951-74 at Vallecito Dam, Colorado]											
January	37.8	6.2	22.1	54	-18	0	2.27	.78	3.40	2	27.9
February	41.0	7.9	24.5	57	-22	12	1.43	.35	2.14	4	18.0
March	46.8	15.7	31.3	67	-13	32	2.00	.70	3.03	5	22.3
April	56.3	24.8	40.5	72	7	97	1.75	.95	2.39	5	9.5
May	65.9	32.6	49.3	81	20	292	1.34	.51	1.99	3	1.4
June	76.1	40.0	58.1	89	27	543	1.09	.29	1.71	3	.0
July	81.4	47.4	64.5	91	38	760	2.71	1.34	3.81	7	.0
August	78.6	46.3	62.4	89	37	694	3.09	1.66	4.24	9	.0
September	72.9	39.0	56.0	86	25	480	2.00	.62	.62	5	.0
October	82.5	30.8	46.6	77	15	222	2.95	.46	4.85	5	3.5
November	48.3	20.2	34.3	65	-2	35	1.87	1.01	2.57	4	13.7
December	39.2	11.2	25.2	56	-13	7	2.81	1.06	4.22	6	28.4
Year	58.9	26.8	42.9	92	-25	3,174	25.37	20.76	29.72	62	124.7
[Recorded in the period 1951-74 at Wolf Creek Pass, Colorado]											
January	29.9	5.0	17.5	50	-22	0	3.06	1.28	4.50	6	67.3
February	29.7	6.0	17.9	50	-16	0	2.99	1.35	4.32	7	63.2
March	33.2	10.0	21.6	52	-15	7	4.10	2.05	5.76	9	74.9
April	40.1	17.8	29.0	59	-4	10	2.78	1.61	3.72	7	44.2
May	51.4	27.8	39.6	67	8	82	1.55	.77	2.22	4	11.1
June	60.3	35.5	47.9	73	19	243	1.72	.62	2.59	5	2.1
July	65.5	41.1	53.3	75	31	412	3.27	2.15	4.28	10	.0
August	63.0	40.1	51.6	74	30	360	4.08	2.35	5.49	10	.0
September	56.2	34.0	45.1	70	19	169	4.33	2.27	6.01	8	4.7
October	48.2	25.2	36.7	64	5	85	4.44	1.46	6.84	6	29.9
November	37.8	14.9	26.4	58	-7	0	3.27	2.02	4.38	6	44.0
December	31.7	6.8	19.3	51	-17	0	5.10	2.21	7.45	8	96.80
Year	45.6	22.0	33.8	75	-23	1,368	40.69	34.90	46.25	86	438.2

[1]A growing degree day is index of the amount of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
[Recorded in the period 1951-74 at Vallecito Dam, Colorado]			
Last freezing temperature in spring:			
1 year in 10 later than--	May 28	June 11	June 23
2 years in 10 later than--	May 22	June 6	June 12
5 years in 10 later than--	May 11	May 26	June 9
First freezing temperature in fall:			
1 year in 10 earlier than--	September 29	September 14	September 2
2 years in 10 earlier than--	October 4	September 20	September 7
5 years in 10 earlier than--	October 15	October 2	September 18
[Recorded in the period 1951-74 at Wolf Creek Pass, Colorado]			
Last freezing temperature in spring:			
1 year in 10 later than--	June 18	June 25	June 29
2 years in 10 later than--	June 10	June 10	June 23
5 years in 10 later than--	May 25	June 5	June 13
First freezing temperature in fall:			
1 year in 10 earlier than--	August 30	August 8	July 18
2 years in 10 earlier than--	September 10	August 21	July 31
5 years in 10 earlier than--	October 1	September 15	August 26

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
[Recorded in the period 1951-74 at Vallecito Dam, Colorado]			
9 years in 10	133	100	75
8 years in 10	141	110	84
5 years in 10	156	127	100
2 years in 10	171	145	116
1 year in 10	178	155	124
[Recorded in the period 1951-74 at Wolf Creek Pass, Colorado]			
9 years in 10	85	58	29
8 years in 10	100	73	44
5 years in 10	129	102	73
2 years in 10	157	131	103
1 year in 10	172	146	118

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1D	Adel loam, 4 to 25 percent slopes	2,826	0.3
1E	Adel loam, 25 to 65 percent slopes	357	(1)
2D	Animas loam, 4 to 25 percent slopes	1,711	0.2
2E	Animas loam, 25 to 65 percent slopes	602	0.1
3	Badland	6,268	0.7
4D	Carracas loam, 4 to 25 percent slopes	18,709	2.2
4E	Carracas loam, 25 to 65 percent slopes	55,582	6.6
5D	Castelleia loam, 4 to 25 percent slopes	15,083	1.8
5E	Castelleia loam, 25 to 65 percent slopes	4,211	0.5
6E	Castelleia loam, dark surface, 25 to 65 percent slopes	1,611	0.2
7D	Castelleia gravelly loam, 4 to 25 percent slopes	922	0.1
7E	Castelleia gravelly loam, 25 to 65 percent slopes	1,103	0.1
8E	Chris gravelly loam, 25 to 65 percent slopes	42,953	5.1
9E	Chris stony loam, 25 to 65 percent slopes	27,704	3.3
10D	Coni sandy loam, 4 to 25 percent slopes	1,790	0.2
10E	Coni sandy loam, 25 to 65 percent slopes	458	0.1
11D	Corta silt loam, 4 to 25 percent slopes	43,507	5.1
11E	Corta silt loam, 25 to 65 percent slopes	35,566	4.2
12D	Dunton loam, 4 to 25 percent slopes	75,780	8.9
13D	Dunton stony loam, 4 to 25 percent slopes	6,330	0.7
14D	Endlich stony loam, 4 to 25 percent slopes	1,386	0.2
14E	Endlich stony loam, 25 to 65 percent slopes	4,398	0.5
15D	Gateview gravelly loam, 4 to 25 percent slopes	1,977	0.2
16D	Greenough loam, 4 to 25 percent slopes	3,259	0.4
17D	Grenadier loam, 4 to 25 percent slopes	11,085	1.3
17E	Grenadier loam, 25 to 65 percent slopes	29,535	3.5
18E	Grenadier stony loam, 25 to 65 percent slopes	1,638	0.2
19D	Heflin sandy loam, 4 to 25 percent slopes	8,513	1.0
20	Histic Cryaquepts	3,913	0.5
21D	Hossick gravelly loam, 4 to 25 percent slopes	8,429	1.0
21E	Hossick gravelly loam, 25 to 65 percent slopes	16,865	2.0
22A	Hunchback clay loam, 0 to 4 percent slopes	3,382	0.4
22D	Hunchback clay loam, 4 to 15 percent slopes	21,739	2.6
23	Igneous rock outcrop	47,602	5.6
24	Igneous rock outcrop-Cryorthents complex	61,873	7.3
25D	Judy silt loam, 4 to 25 percent slopes	1,175	0.1
26D	Leal sandy loam, 4 to 25 percent slopes	12,860	1.5
26E	Leal sandy loam, 25 to 65 percent slopes	49,820	5.9
26F	Leal sandy loam, 65 to 80 percent slopes	6,297	0.7
27E	Leal stony sandy loam, 25 to 65 percent slopes	7,980	0.9
28D	Limber loam, 4 to 25 percent slopes	752	0.1
28E	Limber loam, 25 to 65 percent slopes	3,318	0.4
29	Limestone rock outcrop-Cryorthents complex	444	0.1
30E	Mayoworth silt loam, 25 to 65 percent slopes	7,199	0.8
31D	Mayoworth loam, deep variant, 4 to 25 percent slopes	1,551	0.2
31E	Mayoworth loam, deep variant, 25 to 65 percent slopes	1,299	0.2
32D	Miracle loamy fine sand, 4 to 25 percent slopes	3,290	0.4
33D	Molas loam, 4 to 25 percent slopes	3,957	0.5
34D	Muggins loam, 4 to 25 percent slope	2,490	0.3
34E	Muggins loam, 25 to 65 percent slopes	1,456	0.2
35D	Muggins cobbly loam, 4 to 25 percent slopes	1,411	0.2
35E	Muggins cobbly loam, 25 to 65 percent slopes	2,756	0.3
36A	Nunn loam, 0 to 4 percent slopes	7,033	0.8
36D	Nunn loam, 4 to 25 percent slopes	16,366	1.9
37D	Pagosa loam, 4 to 25 percent slopes	22,708	2.7
37E	Pagosa loam, 25 to 65 percent slopes	5,278	0.6
38A	Pescar loam, 0 to 4 percent slopes	6,401	0.8
39	Riverwash	2,922	0.3
40E	Rogert gravelly loam, 25 to 65 percent slopes	5,555	0.7
41	Rubble land	13,781	1.6
42D	Sambrito loam, 4 to 25 percent slopes	2,653	0.3
42E	Sambrito loam, 25 to 65 percent slopes	1,412	0.2
43	Sandstone rock outcrop-Ustorthents complex	32,572	3.8
44D	Skyway loam, 4 to 25 percent slopes	2,064	0.2
44E	Skyway loam, 25 to 65 percent slopes	2,366	0.3
45	Typic Cryohemists	1,239	0.1
46D	Typic Ustorthents, 4 to 25 percent slopes	2,302	0.3
46E	Typic Ustorthents, 25 to 65 percent slopes	3,041	0.4

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
47D	Vasquez loam, 4 to 30 percent slopes	981	0.1
48E	Vasquez-Rock outcrop complex, 4 to 30 percent slopes	1,222	0.1
49D	Winifred clay, 4 to 25 percent slopes	8,735	1.0
49E	Winifred clay, 25 to 65 percent slopes	3,546	0.4
50D	Woodrock silt loam, 4 to 25 percent slopes	12,815	1.5
50E	Woodrock silt loam, 25 to 65 percent slopes	15,860	1.9
	Water	627	0.1
	Total	848,219	100.0

[1]Less than 0.1 percent.

TABLE 5.--RANGE PRODUCTIVITY AND COMPOSITION

[Soils not listed are not in range sites; such soils can be used for grazing if grass cover is established]

Soil name and map symbol	Range site name	Potential production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Adel:					
1D, 1E	Subalpine loam	Favorable	2,300	Thurber fescue	40
		Normal	2,100	Parry oatgrass	20
		Unfavorable	1,900	Arizona fescue	10
				Bromegrass	10
				Bluegrass	5
				Needlegrass	5
				Sedge	5
Animas:					
2D, 2E	Mountain meadow	Favorable	1,200	Willow	30
		Normal	1,000	Sedge	10
		Unfavorable	600	Spike trisetum	5
				Baltic rush	5
Coni:					
10D, 10E	Shallow slope	Favorable	1,800	Western wheatgrass	20
		Normal	1,500	Blue grama	10
		Unfavorable	1,200	Mountain muhly	10
				Mountain brome	8
				Arizona fescue	5
				Bluegrass	5
				Little bluestem	5
				Needlegrass	5
Gateview:					
15D	Subalpine loam	Favorable	4,000	Thurber fescue	45
		Normal	3,000	Parry oatgrass	10
		Unfavorable	2,000	Bluegrass	5
				Nodding bromegrass	5
Hossick:					
21D, 21E	Alpine slopes	Favorable	1,000	Showy cinquefoil	15
		Normal	800	Tufted hairgrass	10
		Unfavorable	700	Sedge	10
				Willow	10
				Alpine timothy	5
				Ligusticum	5
				Parry clover	5
				American bistort	5
				Kobresia	5
Hunchback:					
22A, 22D	Mountain meadow	Favorable	3,500	Tufted hairgrass	40
		Normal	2,500	Sedge	12
		Unfavorable	2,000	American bistort	6
				Baltic rush	5
				Willow	5
Judy:					
25D	Subalpine loam	Favorable	4,000	Thurber fescue	40
		Normal	3,000	Parry oatgrass	10
		Unfavorable	2,000	Nodding bromegrass	5
				Bearded wheatgrass	5
				Muttongrass	5

See footnote at end of table.

TABLE 5.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Mayoworth:					
30E	Mountain loam	Favorable	2,600	Idaho fescue	15
		Normal	2,200	Bluebunch wheatgrass	10
		Unfavorable	1,800	Serviceberry	10
				Spike-fescue	10
				Thickspike wheatgrass	10
				Columbia needlegrass	5
				Common chokecherry	5
				Kentucky bluegrass	5
				Prairie junegrass	5
				Snowberry	5
				Snowbrush ceanothus	5
Miracle:					
32D	Mountain loam	Favorable	1,800	Arizona fescue	20
		Normal	1,600	Western wheatgrass	15
		Unfavorable	1,200	Muttongrass	15
				Big sagebrush	15
				Letterman needlegrass	5
				Sandberg bluegrass	5
Molas:					
33D	Mountain swale	Favorable	3,500	Tufted hairgrass	30
		Normal	3,000	Sedge	20
		Unfavorable	2,500	Wheatgrass	10
				Baltic rush	10
				Showy cinquefoil	5
				Lupine	5
				American bistort	5
Nunn:					
36A, 36D	Loamy foothills	Favorable	1,800	Blue grama	50
		Normal	1,400	Western wheatgrass	20
		Unfavorable	1,000	Buffalograss	5
				Fourwing saltbush	5
Rogert:					
40E	Shallow slopes	Favorable	1,200	Thurber fescue	15
		Normal	900	Bluegrass	10
		Unfavorable	600	Mountain muhly	5
				Needleandthread	5
				Pine needlegrass	5
				Junegrass	5
				Squirreltail	5
				Buckwheat	5
Skyway:					
44D, 44E	Subalpine loam	Favorable	4,000	Thurber fescue	40
		Normal	3,000	Needlegrass	10
		Unfavorable	2,000	Silver sagebrush	10
				Aspen peavine	6
				Bearded wheatgrass	5
				Mountain brome	5
				Nodding bromegrass	5
				Lupine	5
Vasquez:					
47D	Alpine meadow	Favorable	1,200	Willow	35
		Normal	900	Sedge	25
		Unfavorable	500	Tufted hairgrass	15
				American bistort	10
				Parry clover	5

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
Carracas:								
4D, 4E	Severe	Moderate	Severe	Moderate	Moderate	Ponderosa pine	45	Ponderosa pine.
Castelleia:								
5D, 5E, 7D, 7E	Slight	Slight	Slight	Slight	Slight	White fir	---	Engelmann spruce.
						Quaking aspen	---	
6E	Moderate	Moderate	Moderate	Slight	Moderate	Engelmann spruce	65	Engelmann spruce.
						White fir	50	
Chris:								
8E, 9E	Moderate	Severe	Moderate	Slight	Moderate	Engelmann spruce	60	Engelmann spruce.
						Subalpine fir	---	
						Ponderosa pine	65	
Corta:								
11D	Moderate	Slight	Moderate	Slight	Moderate	Ponderosa pine	47	Ponderosa pine.
11E	Severe	Moderate	Moderate	Slight	Moderate	Ponderosa pine	47	Ponderosa pine.
Dunton:								
12D, 13D	Moderate	Moderate	Slight	Severe	Moderate	Ponderosa pine	50	Ponderosa pine.
Endlich:								
14D	Slight	Slight	Moderate	Slight	Slight	Engelmann spruce	35	Engelmann spruce.
						Subalpine fir	---	
14E	Moderate	Moderate	Moderate	Slight	Slight	Engelmann spruce	35	Engelmann spruce.
						Subalpine fir	---	
Greenough:								
16D	Moderate	Moderate	Moderate	Slight	Moderate	Ponderosa pine	85	Ponderosa pine.
						Douglas-fir	46	
Grenadier:								
17D, 17E, 18E	Moderate	Moderate	Moderate	Slight	Slight	Engelmann spruce	65	Engelmann spruce,
						Subalpine fir	44	subalpine fir.
Heflin:								
19D	Moderate	Moderate	Moderate	Slight	Slight	Ponderosa pine	75	Ponderosa pine.
Leal:								
26D	Moderate	Slight	Moderate	Slight	Slight	Engelmann spruce	75	Engelmann spruce.
						Subalpine fir	---	
26E, 27E	Severe	Moderate	Moderate	Slight	Slight	Engelmann spruce	70	Engelmann spruce.
						Subalpine fir	---	
26F	Severe	Severe	Moderate	Slight	Slight	Engelmann spruce	65	Engelmann spruce.
						Subalpine fir	---	
Limber:								
28D	Moderate	Moderate	Moderate	Slight	Moderate	Engelmann spruce	75	Engelmann spruce.
						Douglas-fir	---	
						Blue spruce	---	
28E	Severe	Moderate	Moderate	Slight	Moderate	Engelmann spruce	70	Engelmann spruce.
						Douglas-fir	---	
						Blue spruce	---	

TABLE 5.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production		Common plant name	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
[1]48E:					
Vasquez part----	Alpine meadow----------	Favorable	1,200	Willow----------	35
		Normal	900	Sedge----------	25
		Unfavorable	500	Tufted hairgrass----------	15
				American bistort----------	10
				Parry clover----------	5
Rock outcrop part.					
Winifred:					
49D, 49E----------	Clayey foothills----------	Favorable	2,300	Rough fescue----------	30
		Normal	2,000	Bluebunch wheatgrass----------	20
		Unfavorable	1,800	Green needlegrass----------	15
				Western wheatgrass----------	10
				Idaho fescue----------	5

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Management concerns					Potential productivity		Trees to plant
	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
Mayoworth variant:								
31D	Moderate	Moderate	Slight	Slight	Moderate	Ponderosa pine Douglas-fir	65 60	Ponderosa pine, Douglas-fir.
31E	Severe	Severe	Slight	Slight	Moderate	Ponderosa pine Douglas-fir	65 60	Ponderosa pine, Douglas-fir.
Muggins:								
34D, 35D	Moderate	Slight	Moderate	Slight	Slight	Ponderosa pine Engelmann spruce Subalpine fir	65 56 56	Ponderosa pine, Engelmann spruce, subalpine fir.
34E, 35E	Severe	Moderate	Moderate	Slight	Slight	Ponderosa pine Engelmann spruce Subalpine fir	65 56 56	Ponderosa pine, Engelmann spruce, subalpine fir.
Pagosa:								
37D	Moderate	Moderate	Moderate	Slight	Moderate	Ponderosa pine Engelmann spruce	70 48	Ponderosa pine.
37E	Severe	Moderate	Moderate	Slight	Moderate	Ponderosa pine Engelmann spruce	70 48	Ponderosa pine.
Pescar:								
38A	Slight	Moderate	Slight	Slight	Moderate	Narrowleaf cottonwood	---	Narrowleaf cottonwood.
Sambrito:								
42D	Moderate	Slight	Moderate	Moderate	Moderate	Engelmann spruce Subalpine fir	48 ---	Engelmann spruce.
42E	Severe	Moderate	Moderate	Moderate	Moderate	Engelmann spruce Subalpine fir	48 ---	Engelmann spruce.
Woodrock:								
50D	Moderate	Slight	Moderate	Moderate	Moderate	White fir Engelmann spruce	75 65	Engelmann spruce.
50E	Severe	Moderate	Moderate	Moderate	Moderate	White fir Engelmann spruce	75 65	Engelmann spruce.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION

[Only the soils suitable for production of commercial trees are listed]

Soil name and map symbol	Potential production		Common plant name	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
Carracas:				
4D, 4E	Favorable	650	Gambel oak	15
	Normal	550	True mountainmahogany	10
	Unfavorable	500	Antelope bitterbrush	10
			Needlegrass	10
			Mountain muhly	10
			Arizona fescue	10
			Fringed sagebrush	5
			Big sagebrush	5
			Bluegrass	5
			Bottlebrush squirreltail	5
Castelleia:				
5D, 5E	Favorable	1,800	Aspen peavine	25
	Normal	1,500	Common snowberry	10
	Unfavorable	1,200	Heartleaf arnica	5
			Dwarf blueberry	5
			Senecio	5
6E	Favorable	2,100	Nodding bromegrass	20
	Normal	1,600	Common snowberry	20
	Unfavorable	1,200	Aspen peavine	15
			Rose	5
			Sedge	5
			Lupine	5
7D, 7E	Favorable	1,200	Common snowberry	15
	Normal	1,000	Aspen peavine	15
	Unfavorable	600	Heartleaf arnica	5
			Dwarf blueberry	5
			Senecio	5
Chris:				
8E, 9E	Favorable	250	Vaccinium	15
	Normal	200	Sedge	15
	Unfavorable	200	Serviceberry	10
			Nodding brome	10
			Ceanothus	5
			Aspen peavine	5
			Rose	5
			Boxleaf myrtle	5
			Oregon-grape	5
Corta:				
11D, 11E	Favorable	1,000	Gambel oak	25
	Normal	800	Arizona fescue	15
	Unfavorable	600	Fringed sagebrush	10
			Antelope bitterbrush	5
			Pine dropseed	5
			Western wheatgrass	5
Dunton:				
12D, 13D	Favorable	1,200	Gambel oak	25
	Normal	1,000	Sedge	10
	Unfavorable	800	Arizona fescue	10
			Mountain brome	7
			Oregon-grape	5
			Saskatoon serviceberry	5
			Senecio	5
			Kinnikinnick	5

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Potential production		Common plant name	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
Endlich:				
14D, 14E	Favorable	300	Dwarf blueberry	20
	Normal	250	Elk sedge	15
	Unfavorable	200	Oregon-grape	10
			Myrtle boxleaf	10
			Kinnikinnick	10
			Russet buffaloberry	5
			Common snowberry	5
			Tufted hairgrass	5
Greenough:				
16D	Favorable	2,200	Gambel oak	25
	Normal	2,000	Arizona fescue	15
	Unfavorable	1,800	Mountain brome	15
			Parry oatgrass	10
			Pine dropseed	5
			Antelope bitterbrush	5
			Sedge	5
Grenadier:				
17D, 17E, 18E	Favorable	250	Dwarf blueberry	20
	Normal	225	Heartleaf arnica	20
	Unfavorable	200	Elk sedge	15
			Oregon-grape	10
			Strawberry	5
			Russet buffaloberry	5
			Tufted hairgrass	5
			Kinnikinnick	5
Heflin:				
19D	Favorable	350	Western wheatgrass	20
	Normal	300	Arizona fescue	15
	Unfavorable	250	Gambel oak	15
			Mountain muhly	10
			Fringed sagebrush	10
			Buckwheat	5
Leal:				
26D, 26E, 26F, 27E	Favorable	200	Vaccinium	20
	Normal	150	Heartleaf arnica	20
	Unfavorable	125	Elk sedge	15
			Oregon-grape	10
			Lupine	5
			Common juniper	5
			Kinnikinnick	5
Limber:				
28D, 28E	Favorable	150	Kinnikinnick	20
	Normal	100	Dwarf blueberry	20
	Unfavorable	50	Gambel oak	10
			Aspen peavine	10
			Elk sedge	10
			Bluegrass	5
			Nodding bromegrass	5
Mayoworth variant:				
31D, 31E	Favorable	1,800	Gambel oak	25
	Normal	1,500	Needlegrass	10
	Unfavorable	900	Arizona fescue	10
			Sedge	5
			American vetch	5
			Lupine	5
			Bluebells	5
			Rose	5
			Common snowberry	5

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Potential production		Common plant name	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
Muggins:				
34D, 34E, 35D, 35E	Favorable	250	Heartleaf arnica	20
	Normal	200	Sedge	15
	Unfavorable	150	Oregon-grape	10
			Bluegrass	10
			Vaccinium	10
			Creeping juniper	5
			Kinnikinnick	5
			Strawberry	5
			Buffaloberry	5
			Lupine	5
Pagosa:				
37D, 37E	Favorable	450	Western wheatgrass	20
	Normal	400	Arizona fescue	15
	Unfavorable	300	Mountain muhly	10
			Oakbrush	10
			Fringed sagebrush	10
			Parry oatgrass	5
			Pine dropseed	5
Pescar:				
38A	Favorable	3,000	Bromegrass	20
	Normal	2,800	Bluegrass	15
	Unfavorable	2,600	Arizona fescue	10
			Lupine	10
			American vetch	10
			Needlegrass	5
			Parry oatgrass	5
			Sedge	5
Sambrito:				
42D, 42E	Favorable	250	Dwarf blueberry	20
	Normal	200	Spike trisetum	10
	Unfavorable	150	Boxleaf myrtle	10
			Oregon-grape	10
			Russet buffaloberry	5
			Elk sedge	5
			Lupine	5
			Bluegrass	5
Woodrock:				
50D, 50E	Favorable	1,200	Dwarf blueberry	20
	Normal	1,000	Heartleaf arnica	20
	Unfavorable	800	Elk sedge	15
			Russet buffaloberry	15
			Tufted hairgrass	10
			Kinnikinnick	5

TABLE 8.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Adel:				
1D	Poor: low strength.	Unsuited	Unsuited	Fair: slope.
1E	Poor: low strength.	Unsuited	Unsuited	Poor: slope.
Animas:				
2D	Poor: frost action, thin layer.	Unsuited	Unsuited	Fair: slope, small stones, thin layer.
2E	Poor: slope, thin layer, frost action.	Unsuited	Unsuited	Poor: slope.
Badland:				
3	---	---	---	---
Carracas:				
4D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
4E	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, thin layer, area reclaim.
Castelleia:				
5D, 7D	Fair: large stones, frost action.	Unsuited	Unsuited	Poor: small stones.
5E, 6E, 7E	Poor: slope.	Unsuited	Unsuited	Poor: slope, small stones.
Chris:				
8E, 9E	Poor: slope.	Unsuited	Unsuited	Poor: slope, small stones.
Coni:				
10D	Poor: area reclaim, thin layer.	Unsuited	Unsuited	Poor: area reclaim.
10E	Poor: slope, area reclaim, thin layer.	Unsuited	Unsuited	Poor: slope, area reclaim.
Corta:				
11D	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
11E	Poor: slope, shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, slope.

TABLE 8.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Dunton:				
12D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Fair: slope.
13D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: large stones.
Endlich:				
14D	Poor: thin layer, area reclaim.	Poor: excess fines, large stones.	Poor: excess fines, large stones.	Poor: large stones.
14E	Poor: slope, thin layer, area reclaim.	Poor: excess fines, large stones.	Poor: excess fines, large stones.	Poor: large stones, slope.
Gateview:				
15D	Fair: frost action.	Poor	Poor	Poor: small stones.
Greenough:				
16D	Poor: frost action.	Unsuited	Unsuited	Fair: slope.
Grenadier:				
17D	Fair: large stones, frost action.	Unsuited	Unsuited	Poor: large stones.
17E, 18E	Poor: slope.	Unsuited	Unsuited	Poor: large stones, slope.
Heflin:				
19D	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Fair: too clayey, small stones.
Histic Cryaquepts:				
20	Poor: wetness.	Unsuited	Unsuited	Poor: wetness.
Hossick:				
21D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: large stones, small stones.
21E	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: small stones, slope, large stones.
Hunchback:				
22A, 22D	Poor: wetness, shrink-swell, frost action.	Unsuited	Unsuited	Poor: wetness.
Igneous rock outcrop:				
23	---	---	---	---

TABLE 8.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Igneous rock outcrop:				
†24:				
Igneous rock outcrop part	---	---	---	---
Cryorthents part	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Judy:				
25D	Poor: thin layer, low strength, shrink-swell.	Unsuited	Unsuited	Poor: thin layer.
Leal:				
26D	Fair: frost action.	Poor: excess fines.	Unsuited	Fair: small stones.
26E, 26F, 27E	Poor: slope.	Poor: excess fines.	Unsuited	Poor: slope.
Limber:				
28D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Fair: small stones, area reclaim.
28E	Poor: thin layer, slope, area reclaim.	Unsuited	Unsuited	Poor: slope, area reclaim.
Limestone rock outcrop:				
†29:				
Limestone rock outcrop part	---	---	---	---
Cryorthents part	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Mayoworth:				
30E	Poor: slope, thin layer, shrink-swell.	Unsuited	Unsuited	Poor: slope, thin layer.
Mayoworth variant:				
31D	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: slope, thin layer.
31E	Poor: shrink-swell, low strength, slope.	Unsuited	Unsuited	Poor: slope.
Miracle:				
32D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Fair: slope, too clayey.
Molas:				
33D	Poor: frost action, wetness, shrink-swell.	Unsuited	Unsuited	Poor: area reclaim, wetness.

See footnote at end of table.

TABLE 8.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Muggins:				
34D	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer, slope.
34E	Poor: shrink-swell, slope, low strength.	Unsuited	Unsuited	Poor: slope.
35D	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: small stones.
35E	Poor: shrink-swell, slope, low strength.	Unsuited	Unsuited	Poor: small stones, slope.
Nunn:				
36A	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer.
36D	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer, slope.
Pagosa:				
37D	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: slope.
37E	Poor: shrink-swell, slope, low strength.	Unsuited	Unsuited	Poor: slope.
Pescar:				
38A	Poor: frost action.	Good	Good	Fair: small stones, area reclaim.
Riverwash:				
39	---	---	---	---
Rogert:				
40E	Poor: thin layer, slope, area reclaim.	Unsuited	Unsuited	Poor: small stones, slope, area reclaim.
Rubble land:				
41	---	---	---	---
Sambrito:				
42D	Fair: frost action.	Poor: excess fines.	Poor: excess fines.	Poor: small stones.
42E	Poor: slope.	Poor: excess fines.	Poor: excess fines.	Poor: small stones, slope.
Sandstone rock outcrop:				
143: Sandstone rock outcrop part	---	---	---	---

See footnote at end of table.

TABLE 8.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
[1]43: Ustorthents part	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Skyway: 44D	Poor: thin layer, frost action.	Poor: excess fines.	Unsuited	Fair: slope.
Skyway: 44E	Poor: thin layer, slope, frost action.	Poor: excess fines.	Unsuited	Poor: slope.
Typic Cryohemists: 45	Poor: wetness, excess humus.	Unsuited	Unsuited	Poor: wetness.
Typic Ustorthents: 46D, 46E	---	---	---	---
Vasquez: 47D	Poor: wetness, frost action, large stones.	Unsuited	Unsuited	Poor: wetness, small stones, slope.
[1]48E: Vasquez part	Poor: wetness, frost action, slope.	Unsuited	Unsuited	Poor: wetness, small stones, slope.
Rock outcrop part	---	---	---	---
Winifred: 49D	Poor: low strength, thin layer, shrink-swell.	Unsuited	Unsuited	Poor: thin layer, too clayey.
49E	Poor: low strength, thin layer, slope.	Unsuited	Unsuited	Poor: slope, thin layer, too clayey.
Woodrock: 50D	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Fair: thin layer, slope.
50E	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 9.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Features affecting--					
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Adel: 1D, 1E	Slope, excess humus.	Low strength, hard to pack, piping.	Slope, frost action, poor outlets.	Slope	Slope, piping, poor outlets.	Slope.
Animas: 2D, 2E	Depth to rock, slope.	Thin layer	---	---	Depth to rock, slope.	Wetness, slope.
Badland: 3	---	---	---	---	---	---
Carracas: 4D, 4E	Depth to rock, slope.	Thin layer	---	---	Depth to rock, slope.	Droughty, rooting depth, slope.
Castelleia: 5D, 5E, 6E, 7D, 7E	Slope	Large stones	---	---	Large stones, slope.	Slope.
Chris: 8E, 9E	Slope	Compressible, piping.	---	---	Slope, small stones.	Slope.
Coni: 10D, 10E	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	---	---	Depth to rock, slope.	Slope, droughty, rooting depth.
Corta: 11D, 11E	Slope	Low strength, compressible, shrink-swell.	---	---	Percs slowly, slope.	Percs slowly, slope.
Dunton: 12D, 13D	Slope, depth to rock.	Thin layer, low strength.	---	---	Depth to rock, slope, percs slowly.	Slope, percs slowly.
Endlich: 14D, 14E	Depth to rock, slope, seepage.	Hard to pack, large stones, thin layer.	---	---	Depth to rock, large stones, slope.	Slope, large stones.
Gateview: 15D	Seepage, slope.	Piping	Slope, frost action.	Slope, droughty.	Slope	Slope, droughty.
Greenough: 16D	Slope	Low strength, piping, compressible.	---	---	Slope, piping, depth to rock.	Slope.
Grenadier: 17D, 17E, 18E	Seepage, slope, large stones.	Large stones, piping.	---	---	Large stones, slope.	Large stones, slope.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Features affecting--					
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Heflin: 19D	Depth to rock, slope.	Low strength, compressible, shrink-swell.	---	---	Slope, percs slowly.	Slope, percs slowly.
Histic Cryaquepts: 20	---	---	---	---	---	---
Hossick: 21D, 21E	Depth to rock, slope, seepage.	Piping, large stones, thin layer.	---	---	Depth to rock, slope, large stones.	Large stones, slope.
Hunchback: 22A, 22D	Slope	Low strength, shrink-swell, compressible.	---	---	Slope, percs slowly, wetness.	Percs slowly, wetness, slope.
Igneous rock outcrop: 23	---	---	---	---	---	---
[1]24: Igneous rock outcrop part	---	---	---	---	---	---
Cryorthents part	Depth to rock	Thin layer	---	---	Depth to rock	Slope, droughty.
Judy: 25D	Depth to rock, slope.	Thin layer, shrink-swell, low strength.	---	---	Slope, percs slowly.	Slope, percs slowly.
Leal: 26D, 26E, 26F, 27E	Seepage, slope.	Piping	---	---	Complex slope	Slope.
Limber: 28D, 28E	Depth to rock, slope, seepage.	Low strength, thin layer.	---	---	Depth to rock, erodes easily.	Erodes easily, slope.
Limestone rock outcrop: [1]29: Limestone rock outcrop part	---	---	---	---	---	---
Cryorthents part	Depth to rock	Thin layer	---	---	Depth to rock	Slope, droughty.
Mayoworth: 30E	Slope, depth to rock.	Thin layer, shrink-swell, low strength.	---	---	Slope, percs slowly, depth to rock.	Slope, percs slowly.
Mayoworth variant: 31D, 31E	Slope	Low strength, shrink-swell, hard to pack.	---	---	Slope	Slope.
Miracle: 32D	Depth to rock, slope.	Thin layer, low strength.	---	---	Depth to rock, erodes easily, slope.	Slope, erodes easily.

See footnote at end of table.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Features affecting-- Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Molas: 33D	Slope, depth to rock.	Low strength, compressible, thin layer.	---	---	Wetness, slope, depth to rock.	Percs slowly, slope, wetness.
Muggins: 34D, 34E, 35D, 35E	Slope	Shrink-swell, compressible, low strength.	---	---	Slope, percs slowly.	Slope, percs slowly.
Nunn: 36A	Favorable	Compressible, shrink-swell, low strength.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly	Favorable.
36D	Slope	Compressible, shrink-swell, low strength.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly, slope.	Slope.
Pagosa: 37D, 37E	Slope, depth to rock.	Compressible, low strength, shrink-swell.	---	---	Percs slowly, slope.	Slope, percs slowly.
Pescar: 38A	Seepage	Seepage, piping.	Floods, wetness.	Floods, wetness.	Wetness, piping, too sandy.	Wetness.
Riverwash: 39	---	---	---	---	---	---
Rogert: 40E	Depth to rock, slope.	Thin layer, piping.	---	---	Depth to rock, slope.	Droughty, slope, rooting depth.
Rubble land: 41	---	---	---	---	---	---
Sambrito: 42D, 42E	Slope, seepage, depth to rock.	Piping	---	---	Piping, slope.	Slope, droughty.
Sandstone rock outcrop: 143:						
Sandstone rock outcrop part--	---	---	---	---	---	---
Ustorthents part	Depth to rock	Thin layer	---	---	Depth to rock	Slope, droughty.
Skyway: 44D, 44E	Seepage, slope, depth to rock.	Thin layer, piping.	---	---	Depth to rock, slope.	Slope.
Typic Cryohemists: 45	Excess humus	Excess humus, compressible, hard to pack.	Wetness	Wetness	Wetness	Wetness.

See footnote at end of table.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Features affecting--					
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Typic Ustorthents: 46D, 46E	---	---	---	---	---	---
Vasquez: 47D	Seepage, slope.	Large stones, piping.	---	---	Large stones, wetness, slope.	Wetness, slope.
[1]48E: Vasquez part	Seepage, slope.	Large stones, piping.	---	---	Large stones, wetness, slope.	Wetness, slope.
Rock outcrop part	---	---	---	---	---	---
Winifred: 49D, 49E	Slope, depth to rock.	Low strength, shrink-swell, thin layer.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.
Woodrock: 50D, 50E	Slope, depth to rock, seepage.	Thin layer, piping.	---	---	Slope, depth to rock.	Slope.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 10.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means greater than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Adel:											
1D, 1E	0-21	Loam	CL-ML	A-4	0-10	85-100	85-100	80-95	65-80	25-30	5-10
	21-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0-10	85-100	85-100	80-95	65-80	25-40	5-15
	25-60	Gravelly clay loam.	CL	A-6	0-15	75-90	65-80	60-75	50-65	---	---
	60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Animas:											
2D, 2E	0-12	Loam	ML	A-4	0-5	90-100	85-95	80-90	55-75	30-40	5-10
	12-38	Gravelly sandy clay loam.	GC, SC	A-6, A-2	5-15	50-95	50-75	40-65	20-40	25-35	10-15
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Badland:											
3	---	---	---	---	---	---	---	---	---	---	---
Carracas:											
4D, 4E	0-4	Loam	SM, ML	A-2, A-4	0-5	75-100	75-100	60-90	25-75	---	NP
	4-14	Sandy loam, loam, gravelly sandy clay loam.	GM-GC, GM, SM, SM-SC	A-1, A-2, A-4	0-5	60-90	50-85	35-75	20-50	15-35	NP-10
	14	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Castelleia:											
5D, 5E	0-19	Loam	ML	A-4	0-5	80-95	75-95	65-75	50-60	25-40	NP-10
	19-26	Clay loam	CL	A-6	0-5	90-100	80-95	70-80	55-65	30-40	10-20
	26-60	Very stony sandy clay loam, extremely stony clay loam.	SC, SM, SM-SC	A-2	35-70	70-95	60-80	40-65	25-35	15-35	NP-10
6E	0-18	Loam	ML, SM	A-4	0-5	85-95	75-95	65-75	45-55	25-40	NP-10
	18-36	Clay loam	CL	A-6	0-5	90-100	80-95	70-80	55-65	30-40	10-20
	36-60	Loam	ML, CL	A-6	0-15	75-100	75-100	60-90	50-75	25-35	10-20
7D, 7E	0-19	Gravelly loam	SM, GM	A-4	0-5	70-75	65-75	60-70	40-50	25-40	NP-10
	19-26	Gravelly clay loam.	CL	A-6	0-5	70-100	65-95	60-80	50-65	30-40	10-20
	26-60	Very stony sandy clay loam.	SC	A-2	35-70	70-95	60-80	40-65	25-35	25-35	10-20
Chris:											
8E	0-7	Gravelly loam	CL-ML, GM-GC	A-2, A-4	0-10	55-80	50-75	45-65	30-55	20-30	5-10
	7-16	Gravelly clay loam.	CL, GC	A-6	5-15	55-80	50-75	45-65	35-60	25-35	10-15
	16-24	Very gravelly clay, very gravelly clay loam.	GC	A-2, A-6, A-7	10-25	25-60	20-50	20-50	15-45	35-60	15-30
	24-60	Very gravelly sandy clay loam, very stony sandy clay loam.	GC	A-2	15-40	25-60	20-50	15-40	10-35	25-35	10-15

TABLE 10.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Chris:											
9E	0-7	Stony loam	CL-ML, GM-GC	A-2, A-4	10-25	55-80	50-75	45-65	30-55	20-30	5-10
	7-16	Gravelly clay loam, stony clay loam.	CL, GC	A-6	5-25	55-80	50-75	45-65	35-60	25-35	10-15
	16-30	Very stony clay loam, very gravelly clay loam.	GC	A-2, A-6, A-7	10-40	25-60	20-50	20-50	15-45	35-60	15-30
	30-60	Very gravelly sandy clay loam, very stony sandy clay loam.	GC	A-2	15-40	25-60	20-50	15-40	10-35	25-35	10-15
Coni:											
10D, 10E	0-5	Sandy loam	SM	A-2, A-4	0-5	95-100	75-100	50-75	25-50	20-30	NP-5
	5-13	Clay loam, loam	CL	A-6	0-5	75-100	75-100	60-90	50-70	25-40	10-25
	13-20	Loamy fine sand	SM	A-1, A-2	0-5	80-100	75-100	35-50	15-30	---	NP
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Corta:											
11D, 11E	0-4	Silt loam	ML	A-4	0	100	100	90-100	70-90	30-40	NP-10
	4-50	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	40-60	25-40
	50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Dunton:											
12D	0-27	Loam	ML	A-4	0-10	75-100	75-100	65-95	50-75	20-30	NP-5
	27-38	Clay loam, clay, stony clay loam.	CL	A-6, A-7	0-25	80-100	75-100	70-95	60-90	35-50	15-25
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
13D	0-27	Stony loam	ML	A-4	10-25	75-100	75-100	65-95	50-75	20-30	NP-5
	27-38	Stony clay, stony clay loam.	CL	A-6, A-7	15-25	80-100	75-100	70-95	60-90	35-50	15-25
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Endlich:											
14D, 14E	0-22	Stony loam	GM	A-4, A-2	35-65	65-85	50-70	45-60	30-50	25-35	NP-10
	22	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Gateview:											
15D	0-10	Gravelly loam	SM, GM	A-4	15-30	65-90	65-90	55-65	40-50	---	NP
	10-60	Very gravelly sandy loam, very cobbly sandy loam.	SM, GM	A-1	15-45	35-65	30-60	20-45	10-25	---	NP
Greenough:											
16D	0-8	Loam	ML, OL	A-4, A-5	0	95-100	95-100	95-100	75-90	30-45	5-10
	8-44	Silty clay loam, silt loam, clay loam.	CL	A-6	0	95-100	95-100	95-100	85-95	25-40	10-15
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 10.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Grenadier:											
17D, 17E	0-3	Loam	ML, GM, SM	A-4	0-10	50-95	50-90	45-80	40-60	25-35	NP-10
	3-18	Very stony loam	SM, ML, GM	A-4	5-40	50-95	50-85	45-75	40-55	25-35	NP-10
	18-60	Extremely stony loam.	SM, GM	A-2, A-4	50-80	50-75	50-75	45-65	30-50	25-35	NP-10
18E	0-3	Stony loam	ML, GM, SM	A-4	10-25	50-95	50-90	45-80	40-60	25-35	NP-10
	3-18	Very stony loam	SM, ML, GM	A-4	5-40	50-95	50-85	45-75	40-55	25-35	NP-10
	18-60	Extremely stony loam.	SM, GM	A-2, A-4	50-80	50-75	50-75	45-65	30-50	25-35	NP-10
Heflin:											
19D	0-4	Sandy loam	SM	A-2, A-4	0-5	85-100	75-100	50-75	35-50	---	NP
	4-36	Clay loam	CL	A-6, A-7	0-5	85-100	75-100	60-85	50-70	25-45	15-25
	36-56	Sandy clay loam, clay loam.	SC, CL	A-2, A-6	0-5	85-100	75-100	50-75	25-60	20-40	15-25
	56	Unweathered bedrock, weathered bedrock.	---	---	---	---	---	---	---	---	---
Histic Cryaquepts:											
20	---	---	---	---	---	---	---	---	---	---	---
Hossick:											
21D, 21E	0-11	Gravelly loam	GM, SM	A-2, A-4	10-20	60-90	50-75	35-55	30-40	25-35	NP-10
	11-23	Very cobbly loam, very gravelly loam.	GM, SM	A-1, A-2	10-40	25-60	20-55	20-50	15-35	25-35	NP-10
	23	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Hunchback:											
22A, 22D	0-14	Clay loam	CL	A-6, A-7	0	90-100	90-100	85-95	65-80	30-50	15-25
	14-60	Clay loam, clay, silty clay.	CL, CH	A-7	0	90-100	90-100	90-100	70-90	40-60	20-35
Igneous rock outcrop:											
23	---	---	---	---	---	---	---	---	---	---	---
[1]24:											
Igneous rock outcrop part	---	---	---	---	---	---	---	---	---	---	---
Cryorthents part	---	---	---	---	---	---	---	---	---	---	---
Judy:											
25D	0-10	Silt loam	CL-ML, CL	A-4, A-6	0-5	90-100	85-100	80-100	70-90	25-35	5-15
	8-38	Silty clay loam, silty clay, clay loam.	CH, CL	A-7	0-5	90-100	80-100	75-100	75-95	40-60	20-40
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Leal:											
26D, 26E, 26F	0-15	Sandy loam	SM	A-2, A-4	0-10	80-100	75-100	40-65	20-40	---	NP
	15-41	Gravelly sandy loam, sandy loam.	SM	A-2	20-30	70-100	50-100	35-55	20-35	15-20	NP-5
	41	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 10.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Leal:											
27E	0-15	Stony sandy loam	SM	A-2, A-4	10-25	80-100	75-100	40-65	20-40	---	NP
	15-41	Gravelly sandy loam, stony sandy loam.	SM	A-2	20-30	70-80	50-60	35-45	20-30	15-20	NP-5
	41	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Limber:											
28D, 28E	0-7	Loam	SM-SC, CL-ML	A-4	0-10	80-90	75-85	65-85	45-60	25-35	5-10
	7-15	Clay loam, gravelly clay loam.	SC, CL	A-6	10-20	70-100	65-90	60-85	45-70	30-40	10-15
	15-30	Gravelly clay loam, clay loam	SM-SC, CL-ML, CL	A-4	25-35	70-100	65-90	60-85	45-70	25-35	5-10
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Limestone rock outcrop:											
[1]29:											
Limestone rock outcrop part	---	---	---	---	---	---	---	---	---	---	---
Cryorthents part	---	---	---	---	---	---	---	---	---	---	---
Mayoworth:											
30E	0-8	Silt loam	CL-ML	A-4	0	85-100	85-100	70-100	65-90	20-25	5-10
	8-14	Silty clay loam	CL	A-6, A-7	0	90-100	90-100	85-95	85-95	35-45	15-25
	14-28	Clay loam	CL	A-6, A-7	0	85-100	85-100	70-90	65-80	35-45	15-25
	28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Mayoworth variant:											
31D, 31E	0-9	Loam	CL, CL-ML	A-6, A-4	0	90-100	90-100	80-100	50-65	20-30	5-15
	9-28	Clay loam	CL	A-6	0	90-100	90-100	65-90	55-60	30-40	15-25
	28-43	Clay loam	CL	A-7, A-6	0	90-100	85-100	65-85	55-60	35-45	20-30
	43	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Miracle:											
32D	0-12	Loamy fine sand	SM	A-2	0	90-100	85-100	75-85	15-30	---	NP
	12-38	Sandy clay loam, sandy loam.	SC, CL	A-4, A-6	0	80-100	75-100	70-90	35-55	25-35	10-15
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Molas:											
33D	0-5	Loam	ML, CL-ML	A-4	0-10	75-100	75-100	70-100	50-70	20-30	NP-10
	5-33	Clay, clay loam	CL, CH	A-7	0-10	75-100	75-100	70-100	65-90	40-60	20-35
	33	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Muggins:											
34D, 34E	0-19	Loam	ML	A-4	0-10	90-100	85-95	80-90	50-65	20-30	NP-5
	19-27	Sandy clay, clay, clay loam.	CH, CL	A-7	15-25	95-100	90-100	70-80	50-75	40-55	20-30
	27-60	Sandy clay loam, cobbly loam.	CL, SC	A-6	15-25	95-100	85-95	65-75	45-55	30-40	10-15
35D, 35E	0-19	Cobbly loam	ML	A-4	10-30	90-100	85-95	80-90	50-65	20-30	NP-5
	19-27	Cobbly sandy clay, cobbly clay, cobbly clay loam.	CH, CL	A-7	15-25	95-100	90-100	70-80	50-75	40-55	20-30
	27-60	Cobbly sandy clay loam, cobbly loam.	CL, SC	A-6	15-25	95-100	85-95	65-75	45-55	30-40	10-15

See footnote at end of table.

TABLE 10.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Nunn:											
36A, 36D	0-5	Loam	CL, SC	A-6, A-4	0-5	95-100	80-95	70-95	45-75	25-40	10-20
	5-10	Clay loam, clay	CL, CH	A-6, A-7	0-5	95-100	90-100	85-95	65-75	35-60	20-35
	10-60	Clay loam, clay	CL, CH	A-6, A-7	0-5	90-100	85-100	80-95	65-75	35-60	20-35
Pagosa:											
37D, 37E	0-22	Loam	ML, CL-ML	A-4, A-6	5-20	90-100	85-95	75-85	60-70	25-40	5-15
	22-44	Clay loam, clay	CL, CH	A-6, A-7	10-40	90-100	90-100	80-90	55-65	30-60	15-35
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Pescar:											
38A	0-8	Sandy loam	SM, ML	A-4	0-5	90-100	80-100	65-80	45-65	20-35	NP-5
	8-22	Stratified loam to loamy fine sand.	SM	A-4, A-2	0-5	90-100	80-100	65-80	20-50	20-35	NP-5
	22-60	Very gravelly sand, very gravelly loamy sand.	SP, GP	A-1	0-5	50-70	20-50	10-30	0-5	---	NP
Riverwash:											
39	---	---	---	---	---	---	---	---	---	---	---
Rogert:											
40E	0-18	Gravelly loam	GM	A-2, A-4	5-15	40-60	40-60	35-50	25-40	25-35	NP-5
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rubble land:											
41	---	---	---	---	---	---	---	---	---	---	---
Sambrito:											
42D, 42E	0-4	Loam	ML	A-4	0-5	90-100	90-100	80-95	50-70	15-25	NP-5
	4-60	Gravelly coarse sandy loam.	SM	A-1, A-2	5-30	70-90	50-75	25-40	15-30	---	NP
	60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sandstone rock outcrop:											
[1]43:											
Sandstone rock outcrop part	---	---	---	---	---	---	---	---	---	---	---
Ustorthents part	---	---	---	---	---	---	---	---	---	---	---
Skyway:											
44D, 44E	0-21	Loam	SM, ML	A-4	0-10	90-100	75-100	60-80	40-65	25-35	NP-5
	21-36	Sandy loam	SM	A-2, A-4	0-30	75-100	75-100	60-80	25-50	20-30	NP-5
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Typic Cryohemists:											
45	---	---	---	---	---	---	---	---	---	---	---
Typic Ustorthents:											
46D, 46E	---	---	---	---	---	---	---	---	---	---	---
Vasquez:											
47D	0-16	Loam	ML	A-4	0-5	90-100	85-95	60-75	50-65	15-30	NP-5
	16-30	Loam, sandy loam	SM	A-2, A-4	0-5	80-90	80-90	40-65	25-45	15-35	NP-5
	30-60	Sandy loam, loam	SM	A-1, A-2	0-5	85-95	80-90	40-60	15-35	15-30	NP-5
[1]48E:											
Vasquez part	0-16	Loam	SM, ML	A-4	0-5	80-100	75-95	40-75	40-65	15-30	NP-5
	16-30	Loam, sandy loam	SM	A-2, A-4	0-5	80-90	80-90	40-65	25-45	15-35	NP-5
	30-60	Sandy loam, loam	SM	A-1, A-2	0-5	85-95	80-90	40-60	15-35	15-30	NP-5
Rock outcrop part	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 10.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Winifred:											
49D, 49E	0-10	Clay	CL	A-6, A-7	0	95-100	95-100	90-100	85-95	30-45	15-25
	10-38	Silty clay, clay loam, clay	CL, CH	A-7	0	95-100	95-100	90-100	90-95	40-55	20-35
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Woodrock:											
50D, 50E	0-10	Silt loam	ML	A-4	0-5	95-100	95-100	90-95	75-85	20-30	NP-5
	10-23	Clay loam	CL	A-6, A-7	0-5	90-100	80-100	75-95	60-75	35-45	20-30
	23-38	Gravelly clay loam, very gravelly clay loam.	SC	A-6, A-7	0-20	50-80	40-70	40-65	35-50	35-45	10-30
	38	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 11.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[Dashes indicate data were not available. The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
Adel:											
1D, 1E	0-21	0.6-2.0	0.18-0.20	6.1-7.3	---	Low	Moderate	Low	0.28	5	5
	21-25	0.6-2.0	0.14-0.18	6.1-7.3	---	Low	High	Low	0.43		
	25-60	0.6-2.0	0.14-0.18	6.1-7.8	<2	Moderate	High	Low	0.43		
	60	---	---	---	---	---	---	---	---		
Animas:											
2D, 2E	0-12	0.6-2.0	0.16-0.18	6.1-6.5	---	Low	High	Moderate	0.24	2	5
	12-38	0.2-0.6	0.14-0.18	5.6-6.0	---	Moderate	High	Moderate	0.24		
	38	---	---	---	---	---	---	---	---		
Badland:											
3.											
Carracas:											
4D, 4E	0-4	0.6-2.0	0.14-0.17	5.6-7.3	---	Low	High	Moderate	0.20	1	5
	4-14	0.6-2.0	0.12-0.15	5.6-7.8	---	Low	High	Moderate	0.20		
	14	---	---	---	---	---	---	---	---		
Castelleia:											
5D, 5E, 7D, 7E	0-19	0.6-2.0	0.16-0.19	5.1-5.5	---	Low	High	Moderate	0.24	5	5
	19-26	0.6-2.0	0.15-0.17	5.1-5.5	---	Moderate	High	Moderate	0.32		
	26-60	0.6-2.0	0.10-0.13	5.6-6.0	---	Low	High	Moderate	0.10		
6E	0-18	0.6-2.0	0.16-0.19	5.1-6.0	---	Low	High	Moderate	0.24	5	5
	18-36	0.6-2.0	0.16-0.19	5.1-6.0	---	Moderate	High	Moderate	0.32		
	36-60	0.6-2.0	0.12-0.14	5.1-6.0	---	Low	High	Moderate	0.10		
Chris:											
8E, 9E	0-7	0.6-2.0	0.15-0.18	5.6-6.5	---	Low	High	Moderate	0.24	3	5
	7-16	0.2-0.6	0.15-0.18	5.6-6.5	---	Moderate	High	Moderate	0.17		
	16-24	0.06-0.2	0.12-0.15	5.6-6.5	---	Moderate	High	Moderate	0.10		
	24-60	0.2-0.6	0.08-0.12	5.6-7.3	<2	Low	High	Low	0.10		
	60	---	---	---	---	---	---	---			
Coni:											
10D, 10E	0-5	2.0-6.0	0.11-0.14	6.1-7.3	---	Low	Moderate	Low	0.24	1	3
	5-13	0.6-2.0	0.14-0.18	6.1-7.3	---	Moderate	Moderate	Low	0.24		
	13-20	2.0-6.0	0.04-0.08	6.1-7.3	---	Low	Moderate	Low	0.32		
	20	---	---	---	---	---	---	---	---		
Corta:											
11D, 11E	0-4	0.2-0.6	0.18-0.20	6.1-6.5	---	Low	High	Low	0.28	4	5
	4-50	<0.06	0.14-0.16	6.1-7.8	<2	High	High	Low	0.37		
	50	---	---	---	---	---	---	---	---		
Dunton:											
12D, 13D	0-27	0.6-2.0	0.15-0.18	5.6-7.3	---	Low	High	Moderate	0.32	2	5
	27-38	0.06-0.2	0.17-0.20	5.6-7.3	---	High	High	Moderate	0.24		
	38	---	---	---	---	---	---	---	---		
Endlich:											
14D, 14E	0-22	2.0-6.0	0.12-0.15	3.6-5.0	---	Low	High	High	0.10	2	8
	22	---	---	---	---	---	---	---	---		
Gateview:											
15D	0-10	0.6-2.0	0.10-0.15	6.6-7.3	---	Low	Moderate	Low	0.10	5	5
	10-60	6.0-20	0.05-0.07	6.6-7.3	---	Low	Moderate	Low	0.10		
Greenough:											
16D	0-8	0.6-2.0	0.18-0.22	5.6-7.3	---	Low	Moderate	Moderate	0.37	3	5
	8-44	0.6-2.0	0.16-0.20	5.6-7.8	---	Moderate	Moderate	Moderate	0.37		
	44	---	---	---	---	---	---	---	---		

See footnote at end of table.

TABLE 11.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
Grenadier:											
17D, 17E, 18E	0-3	0.6-2.0	0.16-0.18	5.1-5.5	---	Low	High	High	0.28	5	5
	3-18	0.6-2.0	0.10-0.13	5.1-5.5	---	Low	High	High	0.15		
	18-60	2.0-6.0	0.04-0.08	5.1-5.5	---	Low	High	High	0.10		
Heflin:											
19D	0-4	2.0-6.0	0.11-0.14	6.6-7.3	---	Low	Moderate	Low	0.32	3	3
	4-36	0.2-0.6	0.17-0.19	6.1-6.5	---	High	Moderate	Low	0.32		
	36-56	0.6-2.0	0.14-0.16	6.1-6.5	---	Moderate	Moderate	Low	0.32		
	56	---	---	---	---	---	---	---	---		
Histic Cryaquepts: 20.											
Hossick:											
21D, 21E	0-11	2.0-6.0	0.13-0.17	4.5-5.0	---	Low	High	High	0.10	2	5
	11-23	2.0-6.0	0.10-0.13	4.5-5.5	---	Low	High	High	0.10		
	23	---	---	---	---	---	---	---	---		
Hunchback:											
22A, 22D	0-14	0.06-0.2	0.18-0.21	5.6-7.3	---	High	High	Moderate	0.32	5	6
	14-60	0.06-0.2	0.16-0.19	5.6-7.3	<2	High	High	Moderate	0.32		
Igneous rock outcrop: 23.											
[1]24: Igneous rock outcrop part.											
Cryorthents part											
Judy:											
25D	0-10	0.6-2.0	0.18-0.20	6.6-7.3	---	Low	Moderate	Low	0.37	5	5
	10-38	0.06-0.2	0.12-0.16	6.6-8.4	<2	High	High	Low	0.37		
	38	---	---	---	---	---	---	---	---		
Leal:											
26D, 26E, 26F, 27E	0-15	2.0-6.0	0.11-0.14	4.5-5.5	---	Low	High	High	0.24	5	3
	15-41	6.0-20	0.07-0.09	4.5-6.0	---	Low	High	High	0.10		
	41	---	---	---	---	---	---	---	---		
Limber:											
28D, 28E	0-7	0.6-2.0	0.16-0.18	6.6-7.3	---	Low	Moderate	Low	0.37	2	5
	7-15	0.6-2.0	0.12-0.15	6.6-7.3	---	Low	Moderate	Low	0.28		
	15-30	0.6-2.0	0.10-0.12	7.4-8.4	<2	Low	High	Low	0.24		
	30	---	---	---	---	---	---	---	---		
Limestone-Rock outcrop: [1]29: Limestone rock outcrop part.											
Cryorthents part											
Mayoworth:											
30E	0-8	0.6-2.0	0.19-0.21	5.6-7.8	---	Low	High	Low	0.37	2	5
	8-14	0.06-0.2	0.19-0.21	5.6-7.8	---	Moderate	High	Low	0.43		
	14-28	0.06-0.2	0.14-0.16	5.6-7.8	<2	High	High	Low	0.37		
	28	---	---	---	---	---	---	---	---		
Mayoworth variant:											
31D, 31E	0-9	0.6-2.0	0.18-0.20	5.6-6.0	---	Moderate	Moderate	Moderate	0.37	4	5
	9-28	0.2-0.6	0.16-0.19	6.1-6.5	---	Moderate	Moderate	Low	0.40		
	28-43	0.2-0.6	0.16-0.18	6.1-6.5	---	High	Moderate	Low	0.40		
	43	---	---	---	---	---	---	---	---		

See footnote at end of table.

TABLE 11.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
Miracle:											
32D	0-12	2.0-6.0	0.10-0.12	6.6-7.3	---	Low	Low	Low	0.32	3	2
	12-38	0.6-2.0	0.14-0.16	5.6-7.3	---	Low	Moderate	Low	0.28		
	38	---	---	---	---	---	---	---	---		
Molas:											
33D	0-5	0.6-2.0	0.16-0.18	5.1-6.0	---	Low	High	High	0.28	2	5
	5-33	<0.06	0.14-0.16	5.1-6.0	---	High	High	High	0.24		
	33	---	---	---	---	---	---	---	---		
Muggins:											
34D, 34E, 35D, 35E	0-19	0.6-2.0	0.15-0.17	5.6-6.5	---	Low	High	Low	0.32	5	5
	19-27	0.06-0.2	0.15-0.17	5.6-6.5	---	High	High	Low	0.10		
	27-60	0.2-0.6	0.14-0.16	5.6-6.5	---	Moderate	High	Moderate	0.10		
Nunn:											
36A, 36D	0-5	0.2-2.0	0.15-0.20	6.6-7.8	---	Moderate	Moderate	Low	0.24	5	5
	5-10	0.06-0.6	0.15-0.18	6.6-8.4	<2	High	High	Low	0.28		
	10-60	0.2-2.0	0.10-0.18	6.6-8.4	<2	Moderate	High	Low	0.24		
Pagosa:											
37D, 37E	0-22	0.6-2.0	0.17-0.20	5.1-6.0	---	Low	High	Moderate	0.24	4	5
	22-44	0.06-0.2	0.16-0.18	5.6-6.0	---	High	High	Moderate	0.28		
	44	---	---	---	---	---	---	---	---		
Pescar:											
38A	0-8	0.6-2.0	0.14-0.16	7.4-7.8	---	Low	High	Low	0.28	5	5
	8-22	0.6-2.0	0.13-0.15	7.4-7.8	<2	Low	High	Low	0.24		
	22-60	>20	0.05-0.07	7.9-8.4	<2	Low	High	Low	0.10		
Riverwash:											
39.											
Rogert:											
40E	0-18	2.0-6.0	0.06-0.09	6.1-7.8	<2	Low	High	Low	0.17	1	5
	18	---	---	---	---	---	---	---	---		
Rubble land:											
41.											
Sambrito:											
42D, 42E	0-4	2.0-6.0	0.19-0.21	5.1-5.5	---	Low	High	Moderate	0.24	5	5
	4-60	6.0-20	0.07-0.09	5.6-6.0	---	Low	High	Low	0.17		
	60	---	---	---	---	---	---	---	---		
Sandstone rock outcrop:											
143:											
Sandstone rock outcrop part.											
Ustorthents part											
Skyway:											
44D, 44E	0-21	2.0-6.0	0.16-0.18	5.6-7.3	---	Low	Moderate	Low	0.20	2	5
	21-36	2.0-6.0	0.13-0.15	5.6-7.8	<2	Low	High	Low	0.28		
	36	---	---	---	---	---	---	---	---		
Typic Cryohemists:											
45.											
Typic Ustorthents:											
46D, 46E.											
Vasquez:											
47D	0-16	2.0-6.0	0.12-0.17	3.6-5.0	---	Low	High	High	0.10	5	5
	16-30	2.0-6.0	0.06-0.10	3.6-5.5	---	Low	High	High	0.10		
	30-60	6.0-20	0.05-0.07	4.5-5.5	---	Low	High	High	0.10		

See footnote at end of table.

TABLE 11.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
Vasquez:											
[1]48E:											
Vasquez part----	0-16	2.0-6.0	0.12-0.17	3.6-5.0	---	Low-------	High-----	High-----	0.10	5	8
	16-30	2.0-6.0	0.06-0.10	3.6-5.5	---	Low-------	High-----	High-----	0.10		
	30-60	6.0-20	0.05-0.07	4.5-5.5	---	Low-------	High-----	High-----	0.10		
Rock outcrop part.											
Winifred:											
49D, 49E----------	0-10	0.06-0.2	0.14-0.20	6.6-7.8	<2	High------	High-----	Low------	0.37	2	4
	10-38	0.06-0.2	0.12-0.18	6.6-8.4	<4	High------	High-----	Low------	0.37		
	38	---	---	---	---	----------	---------	---------	---		
Woodrock:											
50D, 50E----------	0-10	2.0-6.0	0.16-0.18	5.1-7.3	---	Low-------	High-----	Moderate	0.28	2	5
	10-23	2.0-6.0	0.10-0.12	5.1-6.5	---	Low-------	High-----	Moderate	0.24		
	23-38	2.0-6.0	0.04-0.10	5.1-7.3	---	Low-------	High-----	Moderate	0.24		
	38	---	---	---	---	----------	---------	---------	---		

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 12.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "brief" and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
Adel: 1D, 1E	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Animas: 2D, 2E	C	None	---	---	1.5-2.5	Apparent	Mar-Jul	30-40	Rippable	High.
Badland: 3.										
Carracas: 4D, 4E	D	None	---	---	>6.0	---	---	12-20	Rippable	Low.
Castelleia: 5D, 5E, 6E, 7D, 7E	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Chris: 8E, 9E	C	None	---	---	>6.0	---	---	40-80	Hard	Moderate.
Coni: 10D, 10E	D	None	---	---	>6.0	---	---	12-20	Hard	Moderate.
Corta: 11D, 11E	D	None	---	---	>6.0	---	---	>50	---	Moderate.
Dunton: 12D, 13D	C	None	---	---	>6.0	---	---	30-40	Hard	Moderate.
Endlich: 14D, 14E	C	None	---	---	>6.0	---	---	20-36	Hard	Moderate.
Gateview: 15D	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Greenough: 16D	C	None	---	---	>6.0	---	---	40-48	Rippable	High.
Grenadier: 17D, 17E, 18E	B	None	---	---	>6.0	---	---	>40	Hard	Moderate.
Heflin: 19D	B	None	---	---	>6.0	---	---	50-60	Rippable	Moderate.
Histic Cryaquepts: 20.										
Hossick: 21D, 21E	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate.
Hunchback: 22A, 22D	D	None	---	---	1.5-2.0	Apparent	Mar-Jun	>60	---	High.
Igneous rock outcrop: 23.										
[1]24: Igneous rock outcrop part.										
Cryorthents part.										

See footnote at end of table.

TABLE 12.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
Judy: 25D	C	None	---	---	>6.0	---	---	24-38	Hard	Moderate.
Leal: 26D, 26E, 26F, 27E	B	None	---	---	>6.0	---	---	40-60	---	Moderate.
Limber: 28D, 28E	C	None	---	---	>6.0	---	---	28-40	Hard	Moderate.
Limestone rock outcrop: [1]29: Limestone rock outcrop part. Cryorthents part.										
Mayoworth: 30E	C	None	---	---	>6.0	---	---	28-40	Rippable	Moderate.
Mayoworth variant: 31D, 31E	C	None	---	---	>6.0	---	---	40-72	Rippable	Moderate.
Miracle: 32D	C	None	---	---	>6.0	---	---	30-40	Hard	Moderate.
Molas: 33D	D	None	---	---	1.0-2.0	Apparent	Mar-Jul	30-40	Rippable	High.
Muggins: 34D, 34E, 35D, 35E	C	None	---	---	>6.0	---	---	>60	---	Moderate.
Nunn: 36A, 36D	C	None	---	---	>6.0	---	---	>60	---	Moderate.
Pagosa: 37D, 37E	C	None	---	---	>6.0	---	---	40-60	Hard	Moderate.
Pescar: 38A	C	Frequent	Brief	Apr-Sep	1.5-2.5	Apparent	Mar-Jun	>60	---	High.
Riverwash: 39.										
Rogert: 40E	D	None	---	---	>6.0	---	---	12-20	Hard	Low.
Rubble land: 41.										
Sambrito: 42D, 42E	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Sandstone rock outcrop: [1]43: Sandstone rock outcrop part. Ustorthents part.										
Skyway: 44D, 44E	C	None	---	---	>6.0	---	---	30-40	Hard	High.
Typic Cryohemists: 45.										

See footnote at end of table.

TABLE 12.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
Typic Ustorthents: 46D, 46E	A	None	---	---	>6.0	---	---	>60	---	---
Vasquez: 47D	C	None	---	---	1.5-2.0	Perched	Mar-Jul	>60	---	High.
[1]48E: Vasquez part	C	None	---	---	1.5-2.0	Perched	Mar-Jul	>60	---	High.
Rock outcrop part.										
Winifred: 49D, 49E	C	None	---	---	>6.0	---	---	30-40	Rippable	Low.
Woodrock: 50D, 50E	C	None	---	---	>6.0	---	---	30-40	Hard	Low.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 13.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adel	Fine-loamy, mixed Pachic Cryoborolls
Animas	Fine-loamy, mixed Argiaquic Cryoborolls
Carracas	Loamy, mixed, nonacid, mesic, shallow Typic Ustorthents
Castelleia	Fine-loamy, mixed Typic Cryoboralfs
Chris	Clayey-skeletal, montmorillonitic Glossic Cryoboralfs
Coni	Loamy, mixed Lithic Argiborolls
Corta	Fine, montmorillonitic, mesic Udertic Paleustalfs
Dunton	Fine, montmorillonitic Typic Paleboralfs
Endlich	Loamy-skeletal, mixed Dystric Cryochrepts
Gateview	Loamy-skeletal, mixed Pachic Cryoborolls
Greenough	Fine-silty, mixed Typic Eutroboralfs
Grenadier	Loamy-skeletal, mixed Dystric Cryochrepts
Heflin	Fine-loamy, mixed, mesic Udic Haplustalfs
Hossick	Loamy-skeletal, mixed Typic Cryumbrepts
Hunchback	Fine, montmorillonitic Cumulic Cryaquolls
Judy	Fine, montmorillonitic Argic Cryoborolls
Leal	Coarse-loamy, mixed Dystric Cryochrepts
Limber	Fine-loamy, mixed Typic Cryoboralfs
Mayoworth	Fine, montmorillonitic Argic Cryoborolls
Mayoworth variant	Fine-loamy, mixed Argic Cryoborolls
Miracle	Fine-loamy, mixed Argic Cryoborolls
Molas	Fine, montmorillonitic, frigid Typic Argialbolls
Muggins	Fine, montmorillonitic Typic Cryoboralfs
Nunn	Fine, montmorillonitic, mesic Aridic Argiustolls
Pagosa	Fine, montmorillonitic Mollic Cryoboralfs
Pescar	Coarse-loamy over sandy or sandy-skeletal, mixed (calcareous), frigid Aquic Ustifluvents
Rogert	Loamy-skeletal, mixed Lithic Cryoborolls
Sambrito	Coarse-loamy, mixed Typic Cryochrepts
Skyway	Coarse-loamy, mixed Pachic Cryoborolls
Vasquez	Coarse-loamy, mixed, acid Humic Pergelic Cryaquepts
Winifred	Fine, montmorillonitic Typic Haploborolls
Woodrock	Fine-loamy, mixed Typic Cryoboralfs

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