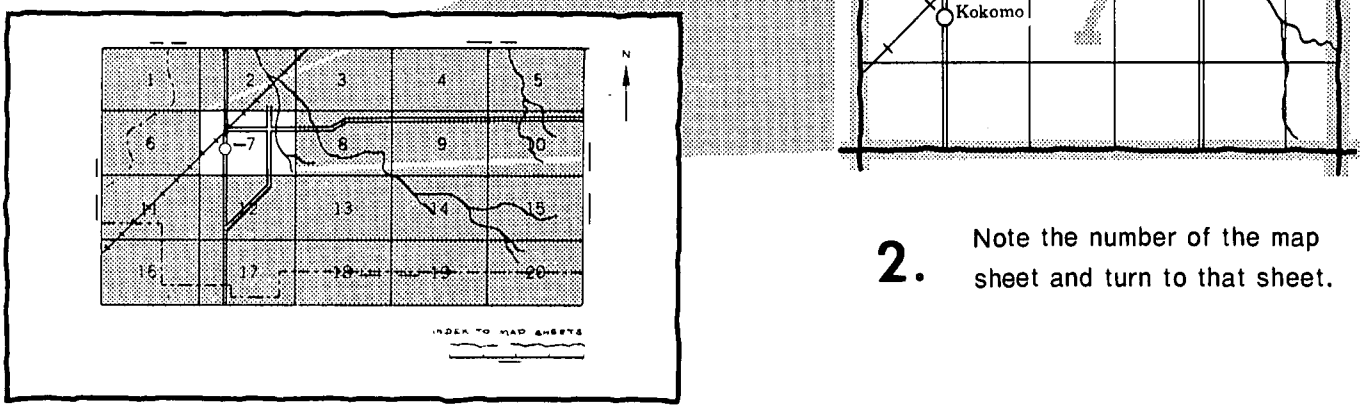
Soil Survey of Custer County Area Colorado

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Colorado Agricultural Experiment Station

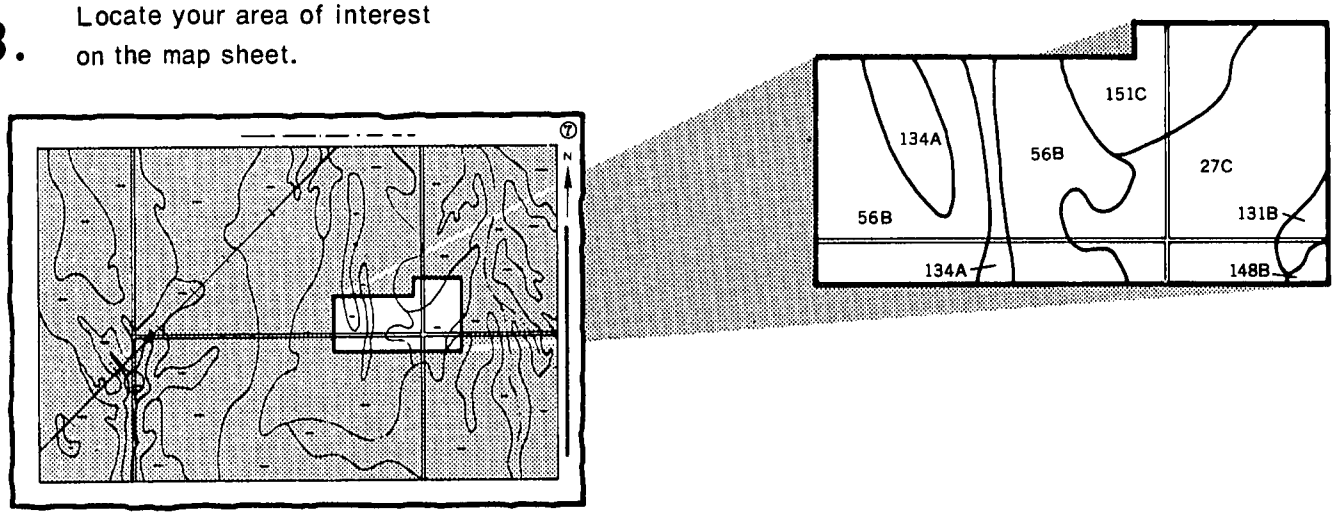
HOW TO USE

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

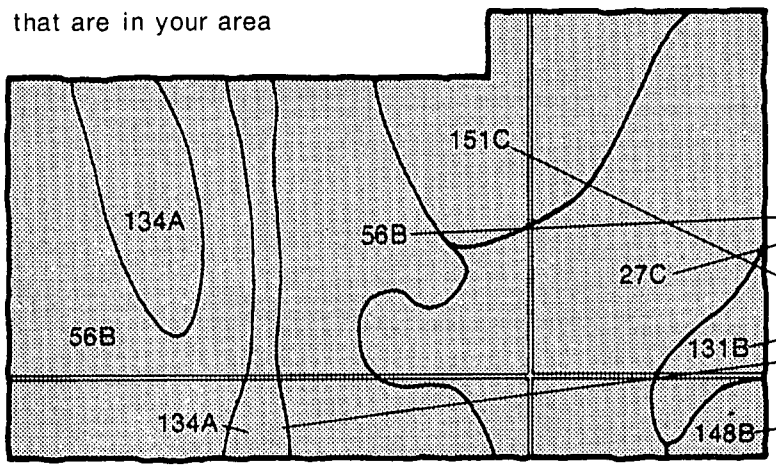


2. Note the number of the map sheet and turn to that sheet.

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



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



Symbols

27C
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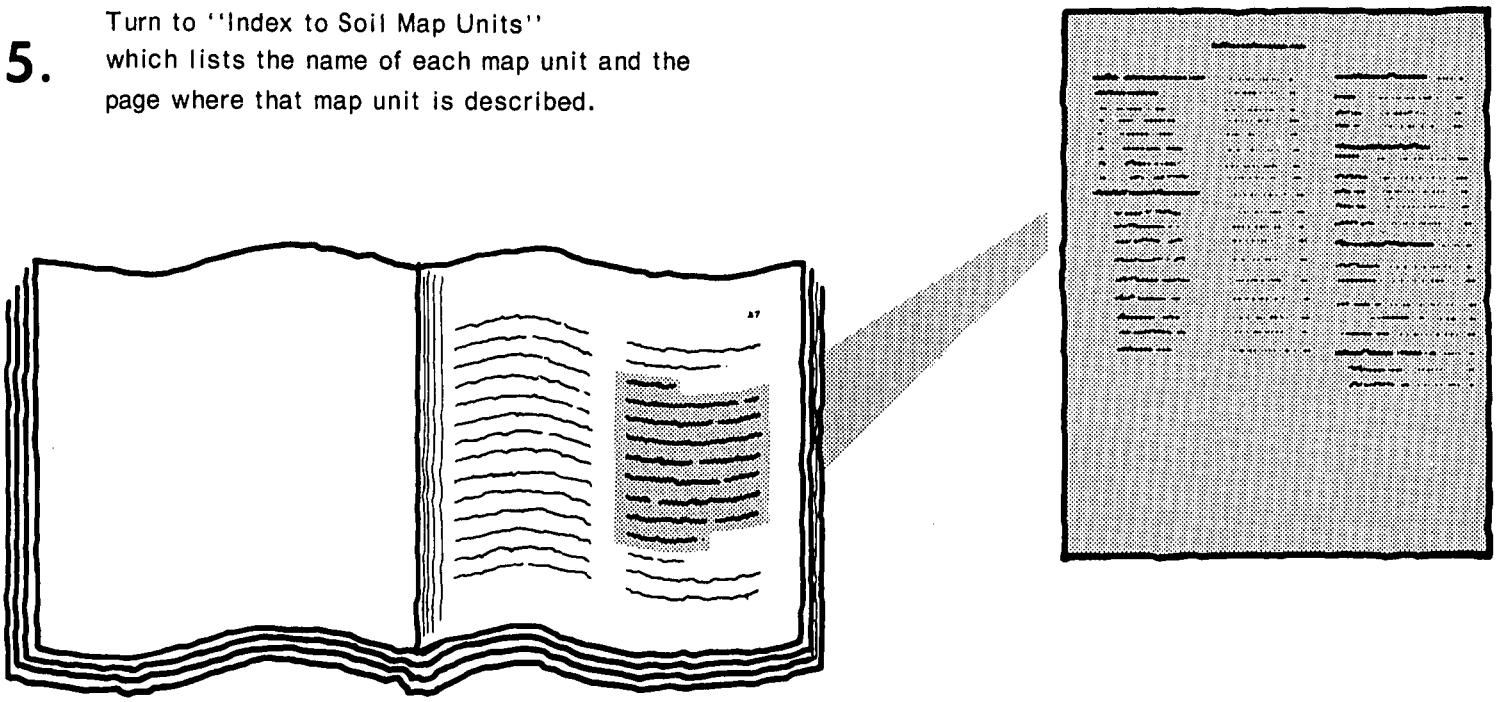
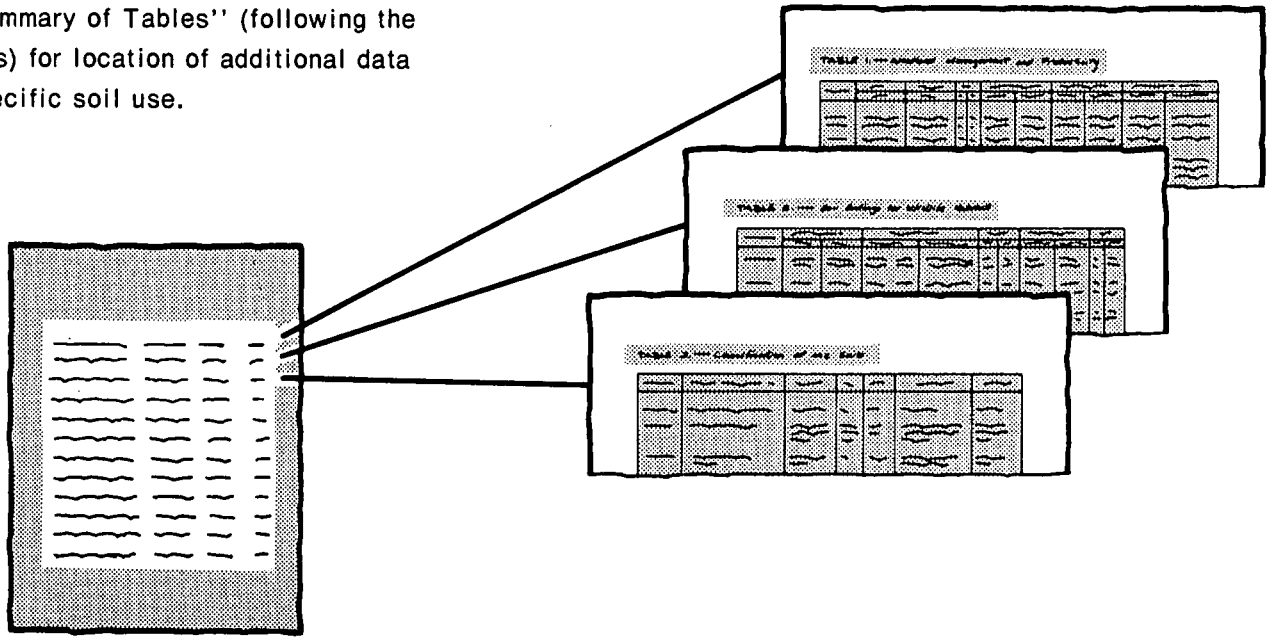
THIS SOIL SURVEY

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

Major fieldwork for this soil survey was performed in the period 1972-78. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Custer County-Divide Soil Conservation District. Funds have been provided by Custer County and the Custer County-Divide Soil Conservation District.

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

Cover: The Sangre de Cristo Range towers above the alluvial Wet Mountain Valley. The town of Westcliffe in the valley is on a broad fan of Feltonia sandy loam, 2 to 6 percent slopes. The soil in the foreground is Buena Vista sandy loam, 3 to 20 percent slopes.

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soil series

Issued August 1982

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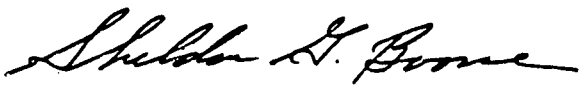
foreword

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

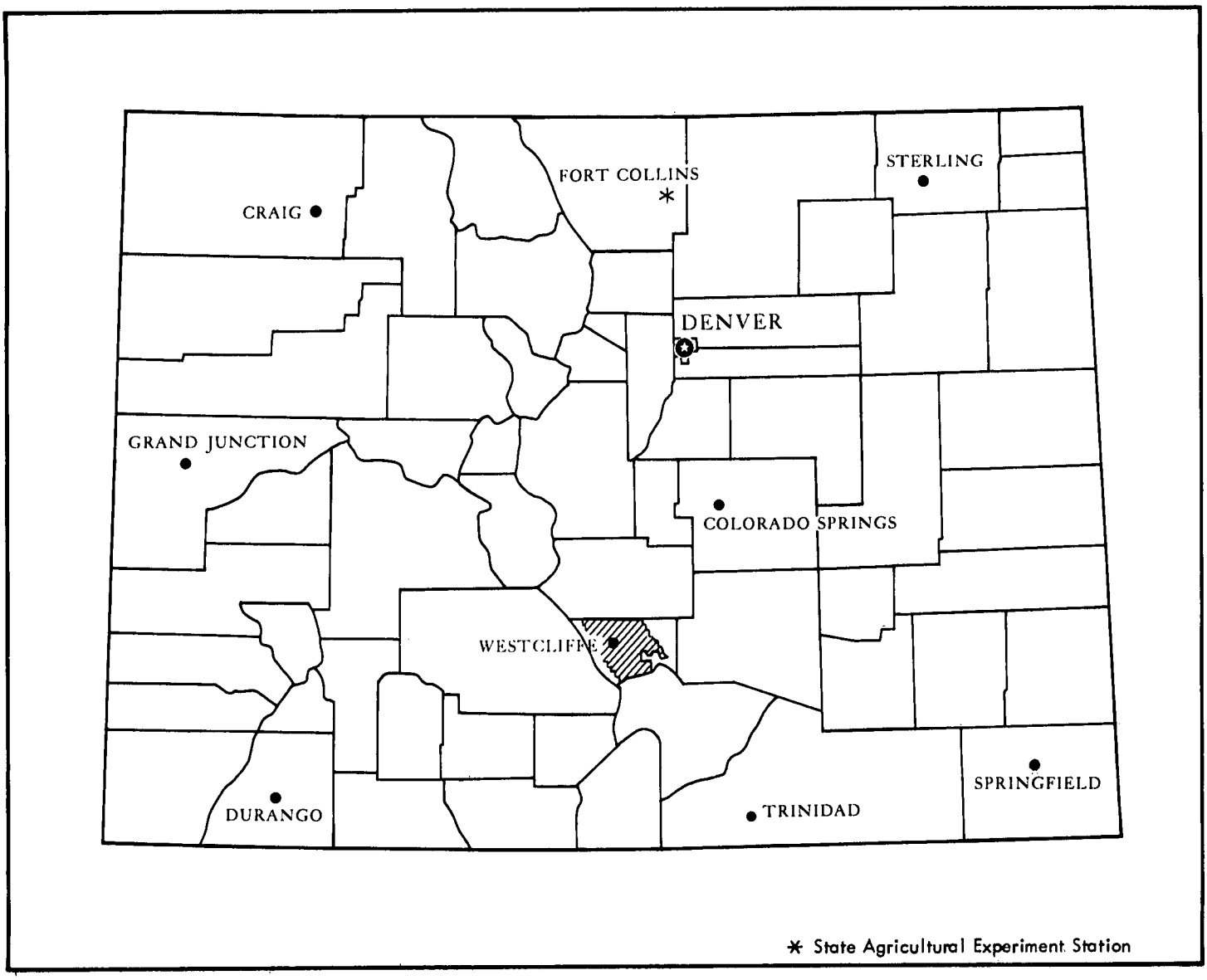
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use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

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

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



Sheldon G. Boone
State Conservationist
Soil Conservation Service



Location of Custer County Area in Colorado

soil survey of
Custer County Area, Colorado

By M. Bruce McCullough, David L. Anderson, William S. Hawn, Mark C. Neeley, Kenneth Radek, Gregory L. Snell, Richard C. Stover and Timothy J. Wheeler, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service in cooperation with Colorado Agricultural Experiment Station, and Custer County-Divide Soil Conservation District

CUSTER COUNTY AREA is in the central part of Custer County, which is in south-central Colorado. It encompasses 288,720 acres. Westcliffe, the county seat, has a population of 243 (*9*). The total county population is 1,120, of whom about 800 live in the survey area.

Custer County Area is bounded on the north by Fremont County and on the east and west by the San Isabel National Forest. The Wet Mountain Range is to the east, and the Sangre De Cristo Range is to the west. The Wet Mountain Valley formed between these two ranges of the Rocky Mountains. Huerfano County along the Promontory Divide is the southern boundary.

general nature of the area

All streams leaving the area converge on the Arkansas River. Grape Creek and Texas Creek encompass the Wet Mountain Valley and drain about 80 percent of the survey area. Grape Creek drains approximately 187,000 acres, and Texas Creek about 50,000 acres. Oak Creek drains 18,000 acres in the northeast corner, Hardscrabble Creek drains about 32,000 acres along the east side of the Wet Mountains, and the Saint Charles River drains less than 2,000 acres.

The elevation within the area surveyed ranges from about 7,300 feet where Grape Creek leaves the county to about 11,100 feet several miles east of Rosita in the Wet Mountain Range.

history of settlement

From November 1861, when it was first settled, to 1877 the present Custer County, which included the Wet Mountain Valley, made up the southern part of Fremont County. On March 9, 1877, this area was organized as Custer County, named for the famous cavalry leader, General George A. Custer. It covered an area of 720 square miles (*4*).

The Ute Indians occupied the valley when Lieutenant Zebulon M. Pike and his handful of soldiers crossed it in 1806. By 1826 the early mountaineers had come to hunt and trap, and in 1853 Captain J. W. Gunnison scouted the valley for settlement.

The first settlers who made any substantial improvements in Custer County were Elisha P. Horn, John Taylor, and William Voris. In 1869 they staked ranch claims, erected cabins, and began tilling the soil. Horn settled on the west side of the valley, John Taylor on the creek which bears his name, and Voris below him on the same stream near the small town of Dora. In 1870 a number of other settlers constructed a wagon road to Canon City in nearby Fremont County and thus opened communication with the older settlements and markets.

The discovery of valuable gold and silver mines brought thousands of people to the Area. In June of 1880 the county had a population of 7,967, and Silver Cliff, which had a total of 5,087 people, was the third largest town in the state. The population dropped, however, as the volume of gold and silver was diminished. By 1890, the population of Silver Cliff totaled 2,970 and livestock again became the mainstay of the Area (*5*).

The town of Ula on Taylor Creek was the original county seat. It next moved to Rosita, then to Silver Cliff in 1886, and to Westcliffe in 1928.

Westcliffe, which was established about 1885, owed its inception and growth to the entry of the narrow gauge Denver and Rio Grande Railroad into the Wet Mountain Valley in 1881. Floods along Grape Creek and other disasters soon caused the railroad company to take up its tracks, however, and by 1890 the Wet Mountain Valley was again isolated. In 1900 the same railroad built a standard gauge line along Texas Creek to Westcliffe. The development of the automobile and the Great Depression caused this line, too, to be abandoned in 1937, leaving farmers and ranchers to depend on trucks for shipping their cattle and hay.

physiography, relief, and drainage

Custer County Area consists of the Wet Mountain Valley and the hills and mountains below the San Isabel National Forest east and west of the valley. It encompasses four distinct physiographic areas. Like the Wet Mountains and Sangre de Cristo Mountains, these physiographic areas are oriented southeast to northwest.

The first of these physiographic areas averages 5 to 6 miles in width and extends from the Promontory Divide in the south to the Fremont County border. Sloping to very steep mountainsides in the western part give way to gently sloping to moderately sloping fans and terraces leading northeastward to the valley floor. These mountainsides, fans, and terraces formed in glacial till and outwash and are dissected by numerous small streams that generally flow in a northeasterly direction. The major streams are Grape Creek, Texas Creek, Alvarado Creek, and Horn Creek. In small areas along the extreme western edge of this physiographic area, the mountain slopes are underlain by sandstone and siltstone.

The second physiographic area is a valley floor made up of level to gently sloping bottom lands and low stream terraces. It ranges from 1/2 mile to 2 miles in width and extends east, west, and south into fans and terraces along mountain streams. The terraces are adjacent to segments of Grape Creek and Texas Creek that flow northwest. Much of the valley fill has a fluctuating high water table that rises to within 20 inches of the surface.

The third physiographic area ranges from several miles to about 10 miles in width and extends from Promontory Divide to the Fremont County border. South of Westcliffe it is dissected by many mountain streams that mainly flow east. In this area fans and terraces of moderately coarse textured gravelly and very gravelly alluvium slope westward from the Wet Mountains to the valley floor. They are sloping to moderately steep and are underlain by sandstone, tuff, and granite. The rocks outcrop frequently on steep south-facing terrace edges.

The fourth physiographic area is part of the Wet Mountain Range and includes sloping to very steep uplands, hills, and mountains in the eastern part of the survey area. They are underlain by granite, gneiss, and schist. The uplands and hills extend westward to Texas Creek in the northern part of Custer County. The uplands in the north form the DeWeese Plateau, which slopes to the northeast and is broken by numerous hills, ridges, and mountains. Grape Creek drains much of this area north of Rosita. Oak Creek drains the eastern edge of the northern part. Upper tributaries of Grape Creek, such as Antelope Creek and Froze Creek, drain this area south of Rosita and generally flow west.

The elevation within Custer County Area ranges from approximately 7,300 feet above sea level along Grape Creek on the north edge of the survey area to approximately 11,100 feet east of Rosita in the Wet Mountain Range. The elevation is generally just under 10,000 feet on mountainsides along the east and west borders. The elevation at Westcliffe, the county seat, is 7,888 feet.

Grape Creek and its tributaries drain most of Wet Mountain Valley. Grape Creek flows in a northeasterly direction out of the Sangre de Cristo Mountains, turns north near the valley floor, then northwest towards Westcliffe, and finally flows in a northeasterly direction into Fremont County. Texas Creek and its tributaries drain the northwestern corner of the survey area. Texas Creek flows in a northeasterly direction out of the Sangre de Cristo Mountains and turns near Beddows Mountain to flow in a northwesterly direction into Fremont County.

climate

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

In Custer County, summers are cool in most valleys and much cooler in the mountains. Winters are cold in the mountains. Valleys are colder than the lower slopes of adjacent mountains because of cold air drainage. Precipitation occurs in the mountains throughout the year, and a deep snowpack accumulates during winter. Snowmelt usually supplies much more water than can be used for agriculture in the county. In valleys precipitation in summer falls as showers; some thunderstorms occur. In winter the ground is covered with snow much of the time. Chinook winds, which blow downslope and are warm and dry, often melt and evaporate the snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Westcliffe in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 24 degrees F, and the average daily minimum temperature is 7.2 degrees. The lowest temperature on record, which occurred at Westcliffe on February 1, 1951 is -45 degrees. In summer the average temperature is 60.7 degrees, and the average daily maximum temperature is

79.1 degrees. The highest recorded temperature, which occurred at Westcliffe on June 24, 1954, is 94 degrees.

Growing degree 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 15.11 inches. Of this, 9.99 inches, or 66 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 7.21 inches. The heaviest 1-day rainfall during the period of record was 3.81 inches at Westcliffe on May 18, 1955. Thunderstorms occur on about 44 days each year, and most occur in summer.

Average seasonal snowfall is 92 inches. The greatest snow depth at any one time during the period of record was 32 inches. On an average of 14 days, 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 41 percent. Humidity is higher at night, and the average at dawn is about 66 percent. The sun shines 77 percent of the time possible in the summer and 72 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 10.4 miles per hour, in April.

natural resources

Soil and water are the most important natural resources in Custer County Area. Livestock, grass, hay, and timber are the principal products. About half of the Area is used for some type of timber. The total commercial forest land in private ownership is about 47,000 acres. Commercial timber in private ownership is about equally divided between pole-timber and sawtimber with the exception of a small acreage which is classified as seedling and sapling (*3*).

Approximately 164,000 acres of National Forest and 21,000 acres of public domain lands are in the survey area. Much of this acreage is important for recreation.

There are active mines in the Area from which obsidian, pearlite, gravel, and several other types of rock are obtained.

water supply

Grape Creek is the principal source of surface and underground water in the Custer County Area. Other streams are Texas Creek, Oak Creek, and Hardscrabble Creek. Tributaries of the Saint Charles River drain a small area in the eastern part of the survey area. Snowmelt, particularly from the Sangre De Cristo Range and also from the Wet Mountain Range, yields a continuous flow to Grape Creek.

The Wet Mountain Valley is a sediment-filled basin in which deposits cover about 233 square miles. South of Westcliffe the sediment is at least 6,700 feet thick. An estimated 1.5 million acre feet of underground water is stored within the upper 100 feet of saturated fill sediment in the basin and apparently does not seep out. Artesian conditions exist in some places and there are several flowing wells.

The De Weese Reservoir is the only reservoir in the survey area. It provides about 200 acres of open water. It was formed by damming Grape Creek where it leaves the Wet Mountain Valley. Water stored in this reservoir is released, on call, for irrigation at Canon City in Fremont County.

Nearly all of the irrigation water in Custer County Area comes from streams. Flooding from contour ditches is the most common method of irrigation. About 10 irrigation wells have been drilled and are used intermittently for supplemental irrigation.

agriculture

By Evain E. Brune, district conservationist, Soil Conservation Service.

The early settlers raised dairy and beef cattle, hogs, sheep, chickens, hay, and small grains. With the completion of the Denver and Rio Grande Railroad in 1881, livestock and small amounts of hay and grain were shipped out of the county. In 1889, however, cloudbursts and heavy rains washed out the railroad, leaving the county with no transportation except freight wagons. In 1900 another Denver and Rio Grande Railroad was constructed from Texas Creek to Westcliffe and once again livestock, hay, and grain were shipped from the county.

Vegetable growing on a commercial scale began around 1928. Frost-tolerant, short-season vegetables such as potatoes, lettuce, peas, cauliflower, and cabbage were the main crops. Sugar beets were tried for a few years. They had a high sugar content, but the beets were small. These crops were shipped out of the county by railroad. Ice ponds and ice houses were constructed in 1929 to facilitate the shipping of perishable vegetables. During the early 1930's the main shipping points for potatoes, lettuce, and peas were Westcliffe and Hillside. During the peak harvest 5 to 6 carloads were shipped daily from the three lettuce sheds in the area. Nonirrigated potatoes were grown extensively on the south end of the Wet Mountain Valley. Irrigated lettuce, peas, and cabbage were grown in the central part of the valley and cauliflower on the north end.

Because drought was common during the early thirties and dust storms were common by the mid thirties, potato and other vegetable farming declined. Many farmers left the Wet Mountain Valley and were relocated by the Government in the San Luis Valley. With the closing of the railroad in 1937, all vegetable production ceased

except for family use. Small patches of potatoes and vegetables are still grown in the valley, but not on a commercial scale.

With the decline of vegetable production, more oats, wheat, and barley were grown. Much of the barley was used by a brewery south of Westcliffe, the remainder was mostly fed to livestock, and very little was shipped out of the county. Production of these grain crops was poor because of the short frost-free season.

Hogs, sheep, and dairy cattle were common in the valley through the early 1950's. Sheep raising declined when the Forest Service reduced the number of grazing permits issued along the Sangre De Cristo Mountains. The number of hogs diminished in the late forties because feed prices were high and hog prices were low. Dairies, once common in the Wet Mountain Valley, decreased in number because sanitation regulations became more stringent and marketing conditions were poor.

Beef cattle have grown in importance and numbers since the settlement of the Wet Mountain Valley and are now the only livestock raised on a commercial scale. Grass hay is now the only commercial crop.

The Custer County-Divide Soil Conservation District was organized in May 1939 to assist farmers and ranchers in the many common problems caused by the drought. At the present it assists in the use and management of all natural resources in the county.

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. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

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. Leadville-Troutville-Ula

Moderately deep and deep, well drained and somewhat excessively drained, gently sloping to extremely steep soils; on benches, fans, foot slopes, mountainsides, and stream terraces

This map unit is on benches, fans, foot slopes, mountainsides, and stream terraces along the Sangre de Cristo Mountains. The soils formed in glacial outwash, glacial till, and residuum from conglomeratic sandstone. A average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The unit makes up about 5 percent of the survey area. It is about 30 percent Leadville soils, 25 percent Troutville soils, and 25 percent Ula soils. The remaining 20 percent is minor soils.

The Leadville soils are on fans and mountainsides. They are moderately sloping to very steep, deep, and well drained. Their surface layer is very cobbly sandy loam. The subsoil is very cobbly sandy clay loam over extremely gravelly sandy clay loam.

The Troutville soils are on stream terraces and mountainsides. They are gently sloping to extremely steep, deep, and somewhat excessively drained. Their surface layer is extremely stony sandy loam. The subsoil is extremely stony sandy loam or extremely stony loamy sand with sandy loam and sandy clay loam bands or pockets.

The Ula soils are on benches, foot slopes, and mountainsides. They are gently sloping to extremely steep, moderately deep, and well drained. Their surface layer is cobbly sandy loam. The subsoil is cobbly sandy clay loam resting on weathered sandstone.

The minor soils in this unit are in the Coutis, Tripit, and Splitro series. These soils are all well drained. The Coutis soils are in narrow bands on foot slopes and along drainageways.

Most of this unit is used for livestock grazing, woodland, wildlife, and recreation.

Woodland wildlife, such as grouse, snowshoe hare, mountain lion, and black bear, is best adapted to this unit. Wildlife species such as mule deer and elk use it in summer.

The less sloping areas are well suited as homesites. Large stones and slope are the main limitations to use of the Leadville and Troutville soils. Slope and depth to bedrock are the main limitations to use of the Ula soils as homesites.

Summer homesites are common on the less sloping Leadville and Ula soils. Excavation for foundations, roads, utility lines, and septic tank absorption fields is difficult because these soils contain large stones and, in some places, because of the depth to rock of the Ula soils. Less sloping areas are well suited to timber production. Numerous small streams provide water for wildlife and livestock. Most of the unit is suitable for recreational activities such as hiking and nature study.

2. Norriston-Gelkie-Libeg

Deep, well drained and somewhat excessively drained, gently sloping to very steep soils; on fans and terraces

This map unit is on fans and terraces in the western part of the Wet Mountain Valley. The soils formed in glacial outwash and alluvium. The average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

The unit makes up about 16 percent of the survey area. It is about 40 percent Norriston soils, 25 percent Gelkie soils, and 15 percent Libeg soils. The remaining 20 percent is minor soils.

The Norriston soils are on fans and terraces. They are gently sloping to very steep, deep, and somewhat excessively drained. Their surface layer is extremely cobbly or very cobbly sandy loam. The subsoil is extremely gravelly sandy loam.

The Gelkie soils are on fans and terraces. They are gently sloping to moderately sloping, deep, and well drained. The surface layer is sandy loam, and the subsoil is cobbly sandy clay loam.

The Libeg soils are on fans and terraces. They are gently sloping to moderately sloping, deep, and well drained. The surface layer is extremely cobbly sandy loam, and the subsoil is very cobbly sandy clay loam.

The minor soils in this unit are in the Alvarado and Coutis series. The Alvarado soils are somewhat poorly drained, and the Coutis soils are well drained. The Coutis soils are in narrow bands on foot slopes and along drainageways.

Most of this map unit is used as rangeland. A few areas of the more gently sloping Norriston soils from which the cobbles have been removed are used as irrigated hayland or pasture. Rock fragments and a short growing season limit the use of irrigated areas to grass hay or pasture.

Rangeland wildlife, such as antelope, cottontail, and coyote, is best adapted to this unit. Wildlife species such as mule deer and elk may use this area in winter. Plants, especially shrubs and occasional trees, are in the many drainageways where additional moisture is available for growth. They are heavily used by wildlife for food and cover.

This unit is well suited to urban development. On moderately steep to very steep fans and terraces, slope is the main limitation for engineering uses. Gently sloping to moderately sloping fans and terraces have only slight limitations. Community sewage systems are needed in areas of high population density because there is a hazard of polluting the ground water. Excavation for foundations, roads, utility lines, and septic tank absorption fields is difficult because these soils contain many small stones. They are a good source of roadfill material.

3. Venable-Alvarado

Deep, somewhat poorly drained and poorly drained, nearly level to moderately steep soils; on fans, terraces, and foot slopes and in swales and drainageways

This map unit is on low terraces, fans, foot slopes, and swales along Grape Creek and Texas Creek and their tributaries. The soils formed primarily in alluvium. The average annual air temperature is 38 to 44 degrees F, and the frost-free season is 40 to 75 days.

The unit makes up about 10 percent of the survey area. It is about 40 percent Venable and similar soils and 35 percent Alvarado and similar soils. The remaining 25 percent is minor soils.

The Venable and similar soils are on terraces, fans, and foot slopes and in swales and drainageways. The Venable soils are nearly level to moderately steep, deep, and poorly drained. Their surface layer is peat, loam, or very cobbly sandy loam, and the subsoil is loam or very cobbly sandy clay loam. Similar soils are in the Novary and Wichup series.

The Alvarado and similar soils are on fans and terraces. The Alvarado soils are nearly level to gently sloping, deep, and somewhat poorly drained. Their surface layer is very cobbly sandy loam or gravelly loam, and the subsoil is very cobbly sandy clay loam or very gravelly sandy clay loam. Similar soils are in the Becks series.

Of minor extent in this unit are the well drained Coutis soils on foot slopes and along drainageways.

Most of this unit is used as irrigated hayland and pasture. Some areas are used as rangeland. Mixtures of brome, orchardgrass, and timothy are commonly grown. Proper use of water and maintaining soil fertility are the main management concerns in irrigated areas. Flooding from contour ditches is the most common method of irrigation. Irrigation by border, corrugations, and sprinklers is also suitable. Land leveling and irrigation water management are generally needed to obtain uniform distribution of water and to prevent losses of tailwater. Land leveling may be obstructed by wetness and rock fragments. Where outlets can be established, drainage systems can be used to reduce wetness in the root zone. Applications of manure and commercial fertilizer containing nitrogen and phosphorus are needed to maintain soil fertility. With good management, soils of this unit produce from 2 to 5 tons of irrigated grass hay or pasture per acre.

Wetland wildlife, especially waterfowl, utilize some areas of this unit for food and cover. The soils have sufficient moisture to produce wetland plants that provide nesting and protective cover. Management for wildlife includes prevention of overgrazing, particularly along streams, so that vegetative cover used by wildlife is not destroyed.

The poorly drained areas of this unit are poorly suited for use as homesites. The main limitations are the hazard of flooding and the high water table. Areas within this unit of somewhat poorly drained soils are suited to homes without basements. Features that may be somewhat limiting are the moderate frost action potential and seasonally high water table. Community sewage systems should be provided to avoid contaminating the ground water. Septic tank absorption fields will not function properly over much of the area because of the high water table.

4. Feltonia-Coutis-Silvercliff

Deep, well drained, gently sloping to very steep soils; on fans, terraces, foot slopes, and terrace edges and in drainageways

This map unit is on fans, terraces, foot slopes, and terrace edges and in drainageways that slope westward from the Wet Mountains. The soils formed in alluvium and colluvium. The average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

The unit makes up about 20 percent of the survey area. It is about 45 percent Feltonia soils, 20 percent

Coutis soils, and 15 percent Silvercliff soils. The remaining 20 percent is minor soils.

The Feltonia soils are on fans and terraces. They are gently sloping to moderately steep, deep, and well drained. Their surface layer is sandy loam, and the subsoil is gravelly sandy loam.

The Coutis soils are on foot slopes and in drainageways. They are gently sloping to moderately steep, deep, and well drained. Their surface layer is sandy loam, and the underlying material is also sandy loam.

The Silvercliff soils are on fans and terrace edges. They are gently sloping to very steep, deep, and well drained. Their surface layer is very cobbly sandy loam, cobbly sandy loam, or gravelly sandy loam. The subsoil is gravelly loam or very gravelly sandy loam.

The minor soils in this unit are the well drained Hoodle and Martinsdale soils.

Most of this unit is used as summer rangeland. Some areas of gently sloping Coutis and Silvercliff soils are used for irrigated hay or pasture. The short growing season limits irrigated areas to hay or pasture. The gently sloping soils on terraces are irrigated with water diverted from Grape creek and its tributaries. Mixtures of brome, orchardgrass, pubescent wheatgrass, and timothy are commonly grown. The main management concerns in irrigated areas are proper use of water, maintenance of fertility, and reduction of soil erosion. Severe water erosion can occur if these soils are unprotected. Mechanical seeding is possible on most rangeland. Seed should be drilled into a well prepared, firm, weed-free seed bed.

Rangeland wildlife such as antelope, cottontail, and coyote is best adapted to this map unit. Wildlife species such as mule deer and elk may use this area in winter. Plants, especially shrubs and occasional trees, are in the many drainageways where additional moisture is available. These drainageways are used heavily by wildlife for food and cover.

This unit is well suited to urban development. Slope is the main limitation for engineering uses. On fans and terraces, for the most part, there are only slight limitations to engineering use. Stock tanks used in conjunction with pipelines are well suited to watering livestock. Ponds are difficult to seal because the substratum of these soils is moderately rapidly to very rapidly permeable.

During construction on this unit, good ground cover should be maintained to reduce the hazard of erosion. In areas of high population density, community sewage systems are needed because of the hazard of polluting the ground water. The towns of Westcliffe and Silver Cliff are in this unit.

5. Rogert-Woodhall-Boyle

Shallow and moderately deep, well drained, gently sloping to very steep soils that have a dark colored surface layer; on hills, hilltops, uplands, ridges, and mountainsides

This map unit is on hills, ridges, and mountainsides in the eastern part of the survey area. The soils formed in residuum and colluvium from igneous rock, primarily from granite. Vegetation is mainly grass and shrubs. The average annual temperature is 38 to 44 degrees F, and the frost-free season is 40 to 90 days.

The unit makes up about 27 percent of the survey area. It is about 30 percent Rogert soils, 20 percent Woodhall soils, and 15 percent Boyle soils. The remaining 35 percent is minor soils.

The Rogert soils are on hills, ridges, and mountainsides. They are gently sloping to very steep, shallow, and well drained. The surface layer is extremely cobbly or very cobbly sandy loam.

The Woodhall soils are also on hills, ridges, and mountainsides. They are gently sloping to very steep, moderately deep, and well drained. Their surface layer is extremely cobbly sandy loam, and the subsoil is very cobbly clay loam.

The Boyle soils are on hills, ridges, and mountainsides. They are moderately sloping to very steep, shallow, and well drained. Their surface layer is very gravelly or very cobbly sandy loam, and the subsoil is extremely gravelly or very cobbly sandy clay loam.

The minor soils in this unit are well drained Troutdale, Mayoworth, Lamphier, and Skutum soils.

Most of this unit is used as summer rangeland. Very steep slopes somewhat limit accessibility for livestock. Seeding the steeper areas of this unit is limited to broadcasting because of the high amount of rock fragments on the surface, outcrops of rock, and steep slopes.

Wildlife such as mule deer, coyotes, grouse, and turkey are best adapted to this unit. These species utilize ponderosa pine and Gambel oak as well as various grasses and shrubs for food and cover. Other species such as elk use this area in winter.

This unit is poorly suited to urban development. Limiting features are slope, depth to bedrock, and rock fragments. Excavation for roads, utility lines, foundations, and septic tank absorption fields is difficult.

The less sloping areas of this unit are more suitable than others for homesites. The shallow to moderate depth to rock and large number of rock fragments make excavation somewhat difficult. Conventional septic tank absorption fields will not function properly over most of the area. Special sewage systems may be required.

6. Redfeather-Wix

Shallow and moderately deep, well drained, gently sloping to very steep soils that have a light colored subsurface layer; on hilltops, side slopes, and mountainsides

This map unit is on hilltops, side slopes, and mountainsides where the vegetation is mainly coniferous trees. The soils formed in residuum from granite. The average annual air temperature is 40 to 44 degrees F, and the frost-free season is 40 to 60 days.

The unit makes up about 10 percent of the survey area. It is about 45 percent Redfeather soils and 15 percent Wix soils. The remaining 40 percent is minor soils.

The Redfeather soils are on hilltops and side slopes. They are gently sloping to very steep, shallow, and well drained. The surface layer is stony sandy loam. The subsoil is extremely gravelly sandy loam or gravelly sandy clay loam.

The Wix soils are on hilltops and mountainsides. They are gently sloping to moderately steep, moderately deep, and well drained. The surface layer is sandy loam. The subsoil is sandy clay loam.

The minor soils in this unit are well drained Coutis, Rogert, and Woodhall soils.

Most of this unit is used for livestock grazing, woodland, wildlife habitat, and recreation.

Woodland wildlife, such as elk, mule deer, wild turkey, and grouse, is best adapted to this unit. These species utilize ponderosa pine and Gambel oak as well as various grasses and shrubs for food and cover.

The main limitations to urban development of this unit are slope and depth to bedrock. Because conventional septic tank absorption fields will not function properly over most of this unit, special sewage systems may be needed. Community sewage systems are needed in areas of high population density.

Excavation for utilities, foundations, and roads is difficult over much of the area because it is shallow to rock. However, bedrock over parts of the unit can be dug 1 to 3 feet with backhoe equipment.

7. Granile-Peeler-Lake Creek

Moderately deep and deep, well drained, moderately sloping to extremely steep soils; on mountainsides and mountain foot slopes

This map unit is on mountainsides and mountain foot slopes in the eastern part of the survey area. The soils formed in residuum and colluvium from granite. The average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The unit makes up about 12 percent of the survey area. It is about 25 percent Granile soils, 20 percent Peeler soils, and 10 percent Lake Creek soils. The remaining 45 percent is minor soils.

The Granile soils are on mountainsides. They are moderately steep to very steep, deep, and well drained. Their surface layer is cobbly sandy loam. The subsoil is very cobbly sandy clay loam.

The Peeler soils are on mountain foot slopes. They are moderately sloping to very steep, deep, and well drained. Their surface layer is sandy loam. The subsoil is gravelly sandy clay loam or sandy clay loam.

The Lake Creek soils are on mountainsides. They are very steep to extremely steep, moderately deep, and well drained. Their surface layer is very stony sandy loam. The subsoil is very stony sandy clay loam.

The minor soils in this unit are well drained Lamphier, Northwater, Rogert, and Woodhall soils.

Most of this unit is used for woodland, livestock grazing, and recreation. It is suited to limited production of Douglas-fir and quaking aspen.

Woodland wildlife, such as snowshoe hare, mountain lion, black bear, and grouse, is best adapted to this unit. Mule deer and elk may use this area in summer.

The major limitation to development of homesites on this unit is slope. In some areas excavation for septic tank absorption fields, roads, foundations, and utilities is difficult because of depth to rock.

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, Norriston very cobbly sandy loam, 2 to 6 percent slopes, is one of several phases in the Norriston series.

Some map units are made up of two or more major soils. 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. Granile-Peeler complex, 25 to 50 percent slopes, is an example.

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.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop 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.

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

1—Alvarado very cobbly sandy loam, 2 to 5 percent slopes. This is a deep, somewhat poorly drained soil on fans and low terraces. It formed in alluvium and glacial outwash. Elevation is 7,700 to 8,400 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is very cobbly sandy loam 12 inches thick. The upper 7 inches is brown, and the lower part is dark brown. The subsoil is mottled, brown very cobbly sandy clay loam 29 inches thick. The substratum is mottled, light brown very cobbly sandy loam to a depth of 60 inches or more. The soil is slightly acid to a depth of 12 inches, neutral to a depth of 41 inches, and mildly alkaline below that depth.

Included with this soil in mapping are areas of Norriston very cobbly sandy loam along low ridges. These included areas make up about 15 percent of the map unit.

Permeability of this Alvarado soil is moderate, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the hazard of erosion is slight. In most years a seasonal high water table is at a depth of 3 to 4 feet between March 1 and June 30 and is at a depth of more than 4 feet or absent the rest of the year.

This soil is used for irrigated hay, irrigated pasture, and range. Mixtures of brome, orchardgrass, intermediate wheatgrass, and timothy are commonly grown. Most areas are used for irrigated pasture because the very cobbly plow layer limits the use of machinery.

Where this soil is irrigated, the proper use of water and maintenance of soil fertility are the main management concerns. Flooding from contour ditches is

the most common method of irrigation. Sprinkling is also suitable. Corrugations are difficult to establish because of the very cobbly plow layer. Irrigation needs to be regulated to obtain efficient use and uniform distribution of water. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. With good management this soil is capable of producing 4.5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly Arizona fescue, western wheatgrass, needleandthread, and Baltic rush. As the range deteriorates, blue grama, slimstem muhly, granite gilia, fringed sage, and rabbitbrush increase. The use of deferred and rotation grazing, along with cross fencing, brush control, and livestock water developments, helps to prevent range deterioration and to promote the production of the more desirable plants. Seeding is generally inadvisable on this soil because of the large amount of rock fragments in the surface layer.

This soil is well suited to homesites without basements. It is somewhat limited, however, by large stones and a seasonally high water table. Shallow overflow is common near drainageways. Excavation of foundations and utility lines is difficult because of the large amount of rock fragments in the soil. Community sewage systems, aerobic or similar types, should be provided to avoid contaminating the ground water.

This soil is in capability subclasses VIIs, nonirrigated, and Vsw, irrigated.

2—Becks gravelly loam, 1 to 5 percent slopes. This is a deep, somewhat poorly drained soil on low terraces and fans. It formed in alluvium. Elevation is 7,800 to 8,400 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown and pale brown gravelly loam 15 inches thick. The subsoil is pinkish gray very gravelly sandy clay loam 4 inches thick. The substratum is 18 inches of mottled, pinkish gray extremely gravelly loamy sand over mottled, light brown extremely gravelly sand that extends to a depth of 60 inches or more. The soil is mildly alkaline and calcareous.

Included with this soil in mapping, and making up about 10 percent of the acreage, are areas of Venable loam on low terraces that are farther from stream channels than the Becks soil. Also included are areas of Alvarado very cobbly sandy loam in the more sloping convex areas. They make up 5 percent of the acreage.

Permeability of this Becks soil is moderate, and the available water capacity is low. The effective rooting depth is somewhat limited by a seasonally high water table at a depth of 2 to 4 feet. Surface runoff is slow, and the hazard of erosion is slight.

Most of the acreage is used as irrigated hayland and pasture. Mixtures of brome, orchardgrass, intermediate wheatgrass, and timothy are commonly grown.

Where this soil is irrigated, the proper use of water and maintainance of soil fertility are the main management concerns. Flooding from contour ditches is the most common method of irrigation. Sprinklers are also suitable. Land leveling is not generally recommended because of the large amount of rock fragments throughout the profile. Light irrigation will keep the profile moist above the water table and prevent excessive loss of water. Applications of fertilizer containing nitrogen and phosphorus are needed to maintain soil fertility and high yields. With good management this soil is capable of producing 3.5 tons of hay per irrigated acre.

The potential native vegetation is mainly Arizona fescue, sedge, and bluegrass. As the range deteriorates, bluegrass, iris, Baltic rush, sedge, and cinquefoil increase. Renovating, use of deferred and rotation grazing, and cross fencing help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are reed canarygrass, timothy, and Garrison creeping foxtail.

This soil is well suited to buildings without basements. The high water table precludes its use for buildings with basements. Excavation for foundations and utility lines may be somewhat difficult because the cutbanks may be unstable and there are large amounts of rock fragments in the soil. Septic tank absorption fields will not function properly because of the high water table, and alternative sewage systems are needed.

This soil is in capability subclasses VIw, nonirrigated, and VIw, irrigated.

3—Boyle very gravelly sandy loam, warm, 4 to 25 percent slopes. This is a shallow, well drained soil on hills, ridges, and mountainsides. It formed residually from igneous rock, mainly granite. The average annual precipitation is 12 to 15 inches. The average annual air temperature is 40 to 44 degrees F, and the frost-free season is 70 to 90 days.

Typically, the surface layer is dark grayish brown very gravelly sandy loam 8 inches thick. The subsoil extends to a depth of 14 inches. It is grayish brown extremely gravelly sandy clay loam. Soft granite bedrock is below this and is underlain by hard granite bedrock at a depth of 22 inches. The soil is neutral.

Included with this soil in mapping are areas of Troutdale sandy loam on upland swales that make up about 10 percent of the acreage. Areas of Martinsdale sandy loam on foot slopes and drainageways make up 5 percent. Also included, and making up about 10 percent of the map unit, are areas of Rock outcrop on hilltops and side slopes.

Permeability of this Boyle soil is moderate, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is slight.

Most areas are used for livestock grazing, woodland, and wildlife habitat.

The potential native vegetation is mainly pinyon and oneseed juniper. The sparse understory is dominantly Scribner needlegrass, Indian ricegrass, needleandthread, muttongrass, western wheatgrass, blue grama, mountainmahogany, and sideoats grama. As the understory deteriorates, blue grama, sand dropseed, threeawn, slimstem muhly, skunkbush sumac, rabbitbrush, snakeweed, pinque, and fringed sage increase.

A planned system of grazing is most important on this soil. Cross fencing, livetock water developments, and erosion control structures are generally needed. Seeding is not advisable on this soil because of the dense tree cover, shallow root zone, and rough, broken topography.

This soil produces such woodland products as firewood, fenceposts, Christmas trees, and pinyon nuts.

This soil is poorly suited to use as homesites. The main limitation is the shallow depth to bedrock.

This soil is in capability subclass VIIs, nonirrigated.

4—Boyle-Rock outcrop complex, warm, 25 to 55 percent slopes. This complex is on hills, ridges, and mountainsides at an elevation of 7,300 to 8,300 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 70 to 90 days.

The Boyle soil makes up about 75 percent of this complex, and Rock outcrop, about 25 percent. The Boyle soil is on side slopes, and the Rock outcrop is on hilltops and ridges.

The Boyle soil is shallow and well drained. It formed in residuum from granite. Typically, the surface layer is dark grayish brown very cobbly sandy loam 3 inches thick. The subsoil extends to a depth of about 12 inches. It is dark brown very cobbly sandy clay loam in the upper 4 inches and brown very cobbly sandy clay loam below. Weathered granite bedrock is at a depth of 12 inches, and hard granite bedrock is at 23 inches. The soil is neutral in reaction.

Permeability of this Boyle soil is moderate, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is slight.

Most areas are used for wildlife habitat, woodland, and livestock grazing. Steep slopes and rough, broken topography limit use by livestock.

The potential native vegetation is mainly pinyon and oneseed juniper. The sparse understory is dominantly Scribner needlegrass, Indian ricegrass, needleandthread, and blue grama. As the range deteriorates, blue grama and slimstem muhly increase.

This soil produces such woodland products as firewood, fenceposts, Christmas trees, and pinyon nuts; although the steep slopes and rough topography severely limit the access of machinery. With only a small portion of this unit easily accessible, commercial opportunities are very poor.

This soil is poorly suited as homesites. The main limitations are slope and depth to bedrock.

This soil is in capability subclass VIIs, nonirrigated.

5—Buena Vista sandy loam, 3 to 20 percent slopes. This is a moderately deep, well drained soil on low hills. It formed in residuum from trachyte. Elevation is 7,800 to 8,200 feet. The average annual precipitation is 14 to 16 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is brown sandy loam in the upper 10 inches and dark grayish brown extremely channery sandy loam in the lower 5 inches. The subsoil extends to a depth of 26 inches. It is brown extremely channery sandy loam in the upper 4 inches and light yellowish brown extremely flaggy sandy loam below. The substratum is light yellowish brown extremely channery sandy loam 4 inches thick. Trachyte bedrock is at a depth of 30 inches. The soil is neutral to a depth of 19 inches, mildly alkaline to a depth of 26 inches, and moderately alkaline and calcareous below that depth.

Included with this soil in mapping are areas of Coutis sandy loam on foot slopes and drainageways. They make up about 15 percent of the map unit.

Permeability of this Buena Vista soil is moderately rapid, and the available water capacity is very low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

Most of the acreage is rangeland.

The potential native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and Indian ricegrass. As the range deteriorates, blue grama, sleepygrass, fringed sagebrush, pinque, and rabbitbrush increase. Renovating and using deferred and rotation grazing, cross fencing, erosion control structures, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well-prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, Nordan crested wheatgreass, and Russian wildrye.

Limiting features for the use of this soil as homesites are slope and depth to rock. Design modifications are needed for foundations and septic absorption fields in the steeper areas. Excavation may be difficult because of the large amount of rock fragments in the soil, and deep excavation for basements and utility lines may require blasting. Septic tank absorption fields on this soil have limited filtering capacity and may contaminate the ground water because bedrock is only moderately deep.

This soil is in capability subclass VIe, nonirrigated.

6—Buffork sandy loam, warm, 5 to 12 percent slopes. This is a moderately deep, well drained soil on uplands. It formed in residuum from igneous rocks,

primarily granite. Elevation is 8,500 to 9,200 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown sandy loam 4 inches thick. The subsoil extends to a depth of 19 inches. It is dark grayish brown sandy loam in the upper 4 inches and light yellowish brown sandy clay loam in the lower 11 inches. The substratum is light yellowish brown sandy clay loam. Weathered granite bedrock is at a depth of 30 inches. The soil is neutral to a depth of 24 inches and mildly alkaline and calcareous below that depth.

Included with this soil in mapping are areas of Coutis sandy loam on foot slopes and in drainageways. These areas make up about 20 percent of the map unit.

Permeability of this Buffork soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is very high.

Most areas are used as rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly, western wheatgrass, and Parry oatgrass. As the range deteriorates, blue grama, pinque, fringed sagebrush, snakeweed, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, nodding brome, and Arizona fescue.

This soil is well suited to use as homesites. Features that are somewhat limiting are slope, depth to rock, and moderate shrinking and swelling of the subsoil. The bedrock can be dug 1 to 3 feet with a light backhoe. Septic tank absorption fields will function over much of the area if they are not too closely spaced. Depth to bedrock limits the amount of effluent that the soil can adequately filter.

This soil is in capability subclass VIe, nonirrigated.

7—Buffork Variant cobbly sandy loam, 20 to 40 percent slopes. This is a moderately deep, well drained soil on side slopes along drainageways. It formed in residuum from conglomeratic tuff. The average annual precipitation is 16 to 18 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is very dark grayish brown cobbly sandy loam 2 inches thick. The subsoil extends to a depth of 14 inches. It is dark grayish brown sandy clay loam in the upper 6 inches and brown gravelly sandy clay loam in the lower 6 inches. The substratum is light gray very gravelly loamy coarse sand 7 inches thick. Weathered conglomerate is at a depth of 21 inches. The soil is neutral.

Included with this soil in mapping are areas of Coutis sandy loam on foot slopes and in drainageways. They make up about 15 percent of the unit. Also included, and making up about 5 percent, are areas of Libeg extremely cobbly sandy loam on ridgetops.

Permeability of this Buffork soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is very high.

All of the acreage is used as rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly, pine dropseed, and mountainmahogany. As the range deteriorates, blue grama, slimstem muhly, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Seeding is somewhat restricted by slope and cobbles on the surface and is advisable only on the more gentle slopes. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, Nordan crested wheatgrass, western wheatgrass, and Arizona fescue.

This soil is poorly suited to use as homesites. Limiting features are slope and depth to rock. Excavation and construction of roads, utility lines, and foundations is difficult because slopes are steep. Septic tank absorption fields will not function properly because slopes are steep and bedrock is at a depth of 20 to 40 inches.

This soil is in capability subclass VIIe, nonirrigated.

8—Coutis sandy loam, 2 to 5 percent slopes. This is a deep, well drained soil in drainageways and on foot slopes. It formed in mixed alluvium. Elevation is 7,800 to 8,800 feet. The average annual precipitation is 14 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is dark brown sandy loam 11 inches thick. It is underlain by dark brown sandy loam 37 inches thick. The substratum is brown gravelly loam to a depth of 60 inches or more. The soil is slightly acid to a depth of 11 inches and neutral below that depth.

Included with this soil in mapping, and making up about 5 percent of the unit, are areas of Venable loam on low stream terraces and in depressions.

Permeability of this Coutis soil is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is used as rangeland and irrigated hayland. Mixtures of brome, orchardgrass, pubescent wheatgrass, and timothy are commonly grown.

Where this soil is irrigated, the main management concerns are proper use of water, maintenance of soil fertility, and reduction of soil erosion. Flooding is the common method of irrigation. Corrugation is also a suitable method. Sprinklers and contour ditches are suitable if the irrigated area is large enough. The land

needs to be leveled and irrigation water managed to obtain uniform distribution of water, control erosion, and prevent large losses of water. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. Water erosion can occur if this soil is unprotected. With good management this soil is capable of producing about 5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly Arizona fescue, mountain muhly, western wheatgrass, and Parry oatgrass. As the range deteriorates, blue grama, sleepygrass, fringed sage, slimstem muhly, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

This soil is well suited to use as homesites. However, included areas of Venable soil adjacent to streams are subject to ponding or flooding. This Coutis soil is a good source of topsoil.

This soil is in capability subclasses VIe, nonirrigated, and Vc, irrigated.

9—Coutis sandy loam, 5 to 15 percent slopes. This is a deep, well drained soil along upland drainageways and on foot slopes and stream terraces. It formed in mixed alluvium. Elevation is 7,800 to 8,800 feet. The average annual precipitation is 14 to 20 inches, the average annual air temperature 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is dark brown sandy loam 11 inches thick. It is underlain by dark brown sandy loam 37 inches thick. The substratum is brown gravelly loam to a depth of 60 inches or more. The soil is slightly acid to a depth of 11 inches and neutral below that depth.

Included with this soil in mapping are areas of Norriston extremely cobbly sandy loam on the steeper terrain and areas of Venable loam on low stream terraces and in depressions. The Norriston soil makes up about 15 percent of the map unit, and the Venable soil makes up 5 percent.

Permeability of this Coutis soil is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high to very high.

Most of the acreage is used as rangeland and irrigated hayland. Mixtures of brome, orchardgrass, pubescent wheatgrass, and timothy are commonly grown.

Where this soil is irrigated, the main management concerns are proper use of water, maintenance of soil fertility, and reduction of soil erosion. Flooding is the common method of irrigation, but sprinklers and contour ditches are also suitable methods. The land needs to be leveled and irrigation water managed to obtain uniform distribution of irrigation water, control erosion, and prevent large losses of water. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. Severe water erosion can occur if this soil is unprotected (fig. 1). With good management this soil is capable of producing about 4.5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly Arizona fescue, mountain muhly, western wheatgrass, and Parry oatgrass. As the range deteriorates, blue grama, sleepygrass, fringed sage, slimstem muhly, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

Slope is the main limitation to use of this soil as homesites. Designs should be modified for foundations and septic tank absorption fields in the steeper areas. This soil is a good source of topsoil.

This soil is in capability subclasses VIe, nonirrigated, and VIe, irrigated.

10—Feltonia sandy loam, 2 to 6 percent slopes. This is a deep, well drained soil on terraces and fans (fig. 2). It formed in alluvium. Elevation is 7,800 to 8,500 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown sandy loam 8 inches thick. The subsoil is dark grayish brown gravelly sandy loam 11 inches thick. The substratum is light brownish gray gravelly sandy loam in the upper 13 inches and is white very gravelly sandy loam to a depth of 60 inches or more. The soil is mildly alkaline to a depth of 19 inches and is moderately alkaline and calcareous below that depth.

Included with this soil in mapping are areas of Coutis sandy loam along foot slopes and drainageways and Silvercliff gravelly sandy loam along terrace edges. The Coutis soil makes up about 20 percent of the map unit, and the Silvercliff soil makes up 10 percent.

Permeability of this Feltonia soil is moderate, and the available water capacity is low. The effective rooting depth is 60 inches or more. Root growth is somewhat restricted by high amounts of calcium carbonate at a depth of more than 32 inches. Surface runoff is medium, and the hazard of erosion is moderate to high.

Most areas of this soil are used as rangeland.

The potential native vegetation is mainly needleandthread, western wheatgrass, mountain muhly, and Arizona fescue. As the range deteriorates, blue grama, gray horsebrush, rabbitbrush, sleepygrass, slimstem muhly, and snakeweed increase. Renovating and using a planned grazing system, cross fencing, and

Figure 1.—Formerly gullied area of Coutis sandy loam, 5 to 15 percent slopes, backsloped and seeded to pubescent wheatgrass, western wheatgrass, and clover.

livestock water developments help to prevent range deterioration and promote production of the more desirable plant species. In renovating, seed should be drilled into a well-prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

The soil is well suited to use as homesites. The towns of Westcliffe and Silver Cliff are on this soil.

This soil is in capability subclass VIe, nonirrigated.

11—Feltonia-Coutis sandy loams, 6 to 15 percent slopes. This complex is on fans and terraces. Elevation is 7,800 to 8,500 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

The Feltonia soil makes up 50 percent of this complex, and the Coutis soil makes up 35 percent. The Feltonia soil is on the tops of rolling terraces, and the Coutis soil is on foot slopes along drainageways.

Included with this complex in mapping are areas of Silvercliff cobbly sandy loam along terraces edges. They make up about 15 percent of the complex.

The Feltonia soil is deep and well drained. It formed in alluvium. Typically, the surface layer is grayish brown sandy loam 8 inches thick. The subsoil is dark grayish brown gravelly sandy loam 11 inches thick. The substratum is light brownish gray gravelly sandy loam in the upper 13 inches and is white very gravelly sandy loam to a depth of 60 inches or more. The soil is mildly alkaline to a depth of 19 inches and moderately alkaline and calcareous below that depth.

Permeability of this Feltonia soil is moderate, and the available water capacity is low. The effective rooting depth is 60 inches or more. Root growth is somewhat restricted by the high content of calcium carbonate at a

depth of more than 32 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

The Coutis soil is deep and well drained. It formed in alluvium and colluvium. Typically, the surface layer is dark brown sandy loam 11 inches thick. The underlying material is dark brown sandy loam 37 inches thick. The substratum is brown gravelly loam to a depth of 60 inches or more. The soil is slightly acid to a depth of 11 inches and neutral below that depth.

Permeability of the Coutis soil is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high.

Most of the acreage of this complex is rangeland.

The potential native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and mountain muhly. As the range deteriorates, blue grama, gray horsebrush, sleepygrass, slimstem muhly, rabbitbrush, and snakeweed increase. Renovating and using a planned grazing system and cross fencing help to prevent range deterioration and promote the production of the more desirable plant species. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed.

The main limitation for homesites is slope. Designs need to be modified for septic tank absorption fields. Good ground cover should be maintained during construction to limit the risk of erosion. The Coutis soil is a good source of topsoil.

This complex is in capability subclass VIe, nonirrigated.

12—Gelkie sandy loam, 1 to 10 percent slopes. This is a deep, well drained soil on fans and terraces. It formed in alluvium (fig. 3). Elevation is 7,900 to 9,300 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is dark brown sandy loam 13 inches thick. The subsoil is brown sandy clay loam 2 inches thick over brown cobbly sandy clay loam 25 inches thick. The substratum is pink very gravelly sandy loam to a depth of 60 inches or more. The soil is neutral to a depth of 28 inches and moderately alkaline and calcareous below that depth.

Included with this soil in mapping are areas of Libeg extremely cobbly sandy loam on terrace edges. They make up about 10 percent of the map unit.

Figure 2.—Feltonia sandy loam, 2 to 6 percent slopes, in Mountain Loam range site on fan along east side of Wet Mountain Valley. Sangre de Christo Range is in background.

Figure 3.—Profile of Gelkie sandy loam, 1 to 10 percent slopes. Arrows indicate surface layer, subsoil, and very cobbly substratum.

Permeability of this Gelkie soil is moderate, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is moderate to very high.

Most of the acreage is used as rangeland and irrigated hayland.

Where this soil is irrigated, the main management concerns are proper use of water, maintenance of soil fertility, and reduction of soil erosion. Flooding and corrugation are suitable irrigation methods in nearly level areas. Contour ditches and sprinklers are suitable methods in steeper areas. The land needs to be leveled and irrigation water managed to obtain uniform water distribution, control erosion, and prevent large losses of water. Applications of manure and commerical fertilizer containing nitrogen and phosphorus help maintain soil fertility. With good management, this soil is capable of producing 5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly Arizona fescue, mountain muhly, and Parry oatgrass. As the range deteriorates, blue grama, bluegrass, slimstem muhly, sleepygrass, fringed sage, pingue, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, mountain brome, and Arizona fescue.

This soil is well suited for use as homesites. The main limitation is moderate shrink-swell potential. Design modifications should be made for foundations to compensate for this limitation. Cobbles and gravel in the substratum make deep excavation somewhat difficult.

This soil is in capability subclasses VIe, nonirrigated, and VIe, irrigated.

13—Granile-Peeler complex, 25 to 50 percent slopes. This complex is on mountainsides. Elevation is 8,500 to 10,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The Granile soil makes up 60 percent of this complex, and the Peeler soil makes up 30 percent. The Granile soil is in the steeper areas, the the Peeler soil is near the base of slopes.

Included with this complex in mapping are areas of Rogert extremely cobbly sandy loam on ridges and hilltops. They make up about 10 percent of the complex.

The Granile soil is deep and well drained. It formed in colluvium from granite. Typically, the surface is covered by a 3-inch mat of decomposed and undecomposed needles, leaves, and twigs. The subsurface layer is very pale brown very cobbly sandy loam 14 inches thick. The subsoil is mainly brown and yellowish brown very cobbly sandy clay loam 35 inches thick. The substratum is brown very cobbly sandy loam to a depth of 60 inches or more. The soil is neutral.

Permeability of the Granile soil is moderate, and the available water capacity is low. The effective rooting depth is more than 60 inches. Surface runoff is medium, and the hazard of erosion is moderate.

The Peeler soil is deep and well drained. It formed in colluvium from granite. Typically, the surface is covered by an organic mat of partially decomposed needles and twigs 1 inch thick. Beneath this, the subsurface layer is pinkish gray sandy loam 14 inches thick. The subsoil is mainly light brown gravelly sandy clay loam 30 inches thick. The substratum is gravelly coarse sandy loam to a depth of 60 inches. The soil is neutral.

Permeability of the Peeler soil is moderate, and the available water capacity is moderate. The effective rooting depth is 40 to 60 inches. Surface runoff is medium, and the hazard of erosion is very high.

These areas are used for livestock grazing, woodland, wildlife habitat, and recreation.

The potential native overstory vegetation is mainly Douglas-fir and white fir and some quaking aspen and ponderosa pine. The understory is sparse and is mainly common juniper, buffaloberry, Oregon grape, kinnikinnick, vaccinium, and elk sedge.

Areas of dominantly quaking aspen are small but provide quality seasonal livestock grazing. The potential understory vegetation is Parry oatgrass, elk sedge, Arizona fescue, mountain muhly, and big bluegrass.

This complex is suited to the limited production of Douglas-fir. The average site index is about 50, or low. About 3,800 cubic feet, or 11,900 board feet (International rule), of merchantable wood per acre can be produced from a fully stocked stand of trees cut on a 30 year cycle with a rotation age of 120. Steep slopes are the main limitation.

Conventional harvesting methods are limited to slopes of less than 40 percent. Logging roads, skid trails, and landings should be carefully located to minimize soil erosion. To stabilize grades and cut and fill slopes and keep soil losses to a minimum, waterbar and reseed roads after harvest. Chisel or otherwise break up roads to prepare an adequate seedbed, and broadcast late in fall to assure adequate soil moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrass.

This complex is poorly suited to development of homesites. The main limitation is slope.

This soil is in capability subclass VIIe, nonirrigated.

14—Hoodle cobbly sandy loam, 1 to 5 percent slopes. This is a deep, well drained soil on terraces and fans. It formed in alluvium. Elevation is 8,200 to 8,700 feet. The average annual precipitation is 16 to 18 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown cobbly sandy loam 3 inches thick. The subsoil extends to a depth of 23 inches. It is brown very cobbly sandy clay loam in the upper 9 inches, brown very cobbly clay loam in the middle 5 inches, and pale brown very gravelly loam in the lower 6 inches. The substratum is white very gravelly loam in the upper 22 inches and pinkish gray very gravelly sandy loam in the next 15 inches. The soil is mildly alkaline to a depth of 17 inches and is moderately alkaline and calcareous to a depth of 60 inches.

Included with this soil in mapping are areas of Coutis sandy loam in drainageways. They make up about 5 percent of the map unit.

Permeability of this Hoodle soil is moderate, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the hazard of erosion is slight.

Most of the acreage is rangeland.

The potential native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and mountain muhly. As the range deteriorates, blue grama, sleepygrass, gray horsebrush, snakeweed, pingue, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Only broadcast seeding is generally advisable because a large number of rock fragments are near the surface.

This soil is well suited to use as homesites. Excavation for foundations, utility lines, roads, and septic tanks is somewhat difficult because of the many rock fragments. Also, cut banks may be unstable.

This soil is in capability subclass VIIs, nonirrigated.

15—Lake Creek-Rock outcrop complex, 35 to 65 percent slopes. This complex is on mountainsides. Elevation is 9,000 to 11,000 feet. The average annual precipitation is 20 to 25 inches, average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The Lake Creek soil makes up about 50 percent of the complex, and Rock outcrop makes up about 30 percent. The Lake Creek soil is on steep side slopes, and the Rock outcrop is on nearly vertical escarpments along ridges.

Included with this unit in mapping are areas of Granile cobbly sandy loam on foot slopes. They make up about 20 percent of the complex.

The Lake Creek soil is moderately deep and well drained. It formed in residuum and colluvium from granite. Typically, there is a layer of partially decomposed needles and twigs on the surface 1 inch thick. The surface layer is dark brown very bouldery sandy loam 2 inches thick. The subsurface layer is pale brown very stony sandy loam 13 inches thick. Below that is a layer mixed with subsoil that is pale brown and yellowish brown very stony sandy clay loam 9 inches thick. It overlies granite at a depth of 32 inches. The soil is neutral.

Permeability of the Lake Creek soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the hazard of erosion is slight.

Rock outcrop consists of nearly barren areas of granite.

Most areas of this complex are used for woodland and for wildlife habitat. The potential native vegetation is mainly Douglas-fir and white fir and some ponderosa pine. The understory is elk sedge, vaccinium, kinnikinnick, common juniper, and buffaloberry.

This complex is suited to the production of Douglas-fir. The average site index is about 50, or low. About 3,800 cubic feet, or 11,900 board feet (International rule), of merchantable timber per acre can be produced from a fully stocked stand of trees cut on a 30 year cycle with a rotation age of 120. Harvesting is severely restricted by

the steep slopes—conventional harvesting methods are generally not acceptable. Tractor yarding causes significant disturbance of the surface and accelerates soil losses. Unless a high-lead or other elevated cable system can be used, severe soil erosion can be expected. Most areas are probably best left undisturbed to protect esthetic, wildlife, and watershed values.

This complex is poorly suited to homesite development. The main limitations are slope and depth to rock. Excavation is very difficult.

This complex is in capability subclass VIIs, nonirrigated.

16—Lamphier loam, 4 to 20 percent slopes. This is a deep, well drained soil on foot slopes and fans and in upland drainageways. It formed in mixed alluvium. Elevation is 7,800 to 9,200 feet. The average annual precipitation is 17 to 23 inches, the average annual air temperature is 38 to 44 degrees F, and the frost-free season is 40 to 75 days.

Typically, the surface layer is dark reddish gray loam 14 inches thick. The next layer is dark reddish gray clay loam 34 inches thick. The substratum is brown sandy clay loam to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping are areas of Venable loam on low stream terraces and in depressions. They make up about 10 percent of the map unit.

Permeability of this Lamphier soil is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high to very high.

Most of the acreage is used as rangeland and irrigated hayland. Mixtures of brome, orchardgrass, pubescent wheatgrass, and timothy are commonly grown.

Where this soil is irrigated, the main management concerns are proper use of water, maintenance of soil fertility, and reduction of soil erosion. Flooding is the common method of irrigation. Sprinklers and contour ditches are also suitable methods. The land needs to be leveled and the irrigation water managed to obtain uniform distribution of water, control erosion, and prevent large losses of water. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. Severe water erosion can occur if this soil is unprotected. With good management it is capable of producing 4.5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly Arizona fescue, mountain muhly, and Parry oatgrass. As the range deteriorates, blue grama, sleepygrass, fringed saga, slimstem muhly, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

This soil is well suited to use as homesites. Limiting features are slope and moderate shrinking and swelling. Designs should be modified for foundations and septic tank absorption fields in the steeper areas. Areas of the included Venable soil are subject to occasional ponding of surface runoff water. This Lamphier soil is a good source of topsoil.

This soil is in capability subclasses VIe, nonirrigated, and VIe, irrigated.

17—Larand Variant very stony sandy loam, 4 to 25 percent slopes. This is a deep, well drained soil on mountaintops. It formed in granite colluvium. Elevation is 9,500 to 10,500 feet. The average annual precipitation is 20 to 25 inches, the average annual temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by an organic mat 1 inch thick of partially decomposed needles, twigs, and leaves. Beneath this, the subsurface layer is pale brown very stony sandy loam 16 inches thick. Next is a layer of mixed pale brown and brown very stony sandy loam 3 inches thick. The subsoil extends to a depth of 31 inches. It is dark brown extremely stony sandy clay loam in the upper 5 inches and is brown extremely stony sandy loam in the lower 7 inches. The substratum is pinkish gray extremely stony loamy sand to a depth of 60 inches or more. The soil is medium acid.

Included with this soil in mapping are areas of Granile cobbly sandy loam on the steeper terrain and Lake Creek very bouldery sandy loam along steep ridgetops. They each make up about 10 percent of the map unit.

Permeability of this Larand Variant is moderately rapid, and the available water capacity is very low. This effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is slight.

Most areas are used for woodland, wildlife habitat, and recreation. Livestock grazing is severely restricted by the dense coniferous forest overstory.

The potential native vegetation is mainly Engelmann spruce, subalpine-fir and an understory of Oregon grape, elk sedge, vaccinium, heartleaf arnica, and common juniper.

This soil is suited to the limited production of Engelmann spruce. The site index is about 50, or low. About 3,600 cubic feet, or 11,000 board feet (International rule), of merchantable timber per acre can be produced from a fully stocked, managed stand that has a 30 year cutting cycle and a rotation age of 120. The main limiting features are stones on the surface, numerous large stones in the profile, and droughtiness of the surface layer. Stones affect the yarding and felling of trees, and large stones in the profile significantly influence road construction. Droughtiness of the surface layer may influence seedling survival if areas are clearcut.

Logging roads, landings, and skid trails should be located carefully to minimize soil erosion and breakage of machinery. Roads should be waterbarred and reseeded after harvest to stabilize grades and cut and fill slopes and keep soil losses to a minimum. They should be chiseled or otherwise broken up to prepare an adequate seedbed, and the seed should be broadcast late in fall to assure adequate moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrass.

This map unit is poorly suited to homesite development. The main limitations are slope and large stones in the profile. Foundations, sewage systems, and roads may need to be specially designed.

This soil is in capability subclass VIIs, nonirrigated.

18—Leadville very cobbly sandy loam, warm, 8 to 20 percent slopes. This is a deep, well drained soil on fans and mountainsides. It formed in glacial outwash and till. Elevation is 8,500 to 10,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by a layer of undecomposed and partially decomposed needles and twigs. The surface layer is reddish gray very cobbly sandy loam 1 inch thick. The subsurface layer is pinkish gray very cobbly sandy loam 11 inches thick. Below that is a layer of mixed reddish brown and pinkish gray very cobbly sandy loam 10 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is reddish brown extremely cobbly sandy clay loam 8 inches thick over light reddish brown extremely cobbly sandy clay loam 10 inches thick. The lower part is light pinkish gray extremely gravelly sandy loam. The soil is slightly acid in the surface and subsurface layers and neutral in the subsoil.

Included with this soil in mapping are areas of Troutville extremely stony sandy loam at the base of the steeper slopes. They make up about 15 percent of the map unit.

Permeability of this Leadville soil is moderate. The available water capacity is low because of the content of rock fragments. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is slight.

Most areas are used for livestock grazing, woodland, wildlife habitat, and recreation.

The potential native vegetation is ponderosa pine and scattered Douglas-fir and white fir trees. The understory is Gambel oak, mountainmahogany, Arizona fescue, mountain brome, and mountain muhly.

Most areas support an open stand of ponderosa pine with a manageable understory of grass that is well suited to livestock grazing. When the condition of the understory deteriorates, Gambel oak, snowberry, kinnikinnick, and sedges increase. Forage production is quite variable and depends on the age and density of the pine stand, but in normal years it is about 500 pounds per acre air-dry weight.

This soil is suited to the limited production of ponderosa pine. The average site index is 55, or low. About 3,000 cubic feet, or 11,900 board feet (International rule), of wood per acre can be produced from a fully stocked, managed stand of trees, based on a 100-year rotation.

Although this soil has no limitations that preclude its management for forest, machine planting is not practical because a large number of rock fragments are on the surface. Ordinarily the surface is sufficiently broken up during harvest to insure reforestation. Logging roads and skid trails should be carefully located to minimize erosion. To stabilize grades and keep soil losses to a mimimum, waterbar and reseed long slopes after harvest. Chisel or otherwise break up roads to prepare an adequate seedbed, and broadcast the seed late in fall to assure adequate soil moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrass.

This soil is well suited to use as homesites. The major limitations are slope and the content of large stones. In the steeper areas, designs need to be modified for septic tank absorption fields, foundations, and roads. Large stones make excavation difficult. Community sewage systems are needed in areas of high population density because of the risk of polluting the ground water.

This soil is in capability subclass VIIs, nonirrigated.

19—Libeg extremely cobbly sandy loam, 5 to 20 percent slopes (fig. 4). This is a deep, well drained soil on fans and terraces. It formed primarily in glacial outwash. Elevation is 7,900 to 9,100 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is brown extremely cobbly sandy loam 10 inches thick. The subsoil is brown extremely cobbly sandy loam in the upper 7 inches, brown very cobbly sandy clay loam in the next 18 inches, and very gravelly sandy loam to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping are areas of Coutis sandy loam on foot slopes and in low-lying areas and drainageways. Also included are areas of Norriston extremely cobbly sandy loam on the steeper parts of the landscape. Each of these included soils makes up about 10 percent of the unit.

Permeability of this Libeg soil is moderate, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the hazard of erosion is slight.

Most of the acreage is rangeland.

The potential native vegetation is mainly Arizona

Figure 4.—Libeg extremely cobbly sandy loam, 5 to 20 percent slopes, in the Mountain Outwash range site.

fescue, mountain muhly, western wheatgrass, and needleandthread. As the range deteriorates, slimstem muhly, blue grama, bluegrass, sun sedge, fringed sage, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants.

Because of the large amount of rock fragments, broadcasting is the only suitable method of seeding. Suitable grasses for seeding are intermediate wheatgrass and pubescent wheatgrass.

This soil is well suited to use as homesites, particularly in the less sloping areas. Limiting soil features are slope, stoniness, and moderate shrinking and swelling. Designs need to be modified for foundations and septic tank absorption fields in the steeper areas. Excavation for foundations, utility lines, roads, and septic tanks is somewhat difficult because of the large amount of rock fragments.

This soil is in capability subclass VIIs, nonirrigated.

20—Martinsdale gravelly sandy loam, 3 to 12 percent slopes. This is a deep, well drained soil on fans and foot slopes. It formed in alluvium and colluvium from granite. Elevation is 7,500 to 7,900 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 75 to 90 days.

Typically, the surface layer is dark brown gravelly sandy loam 7 inches thick. The subsoil extends to a depth of 20 inches. It is brown sandy clay loam in the upper 10 inches and yellowish brown sandy clay loam in the lower 3 inches. The substratum is light gray sandy loam in the upper 16 inches and is pale brown gravelly sandy loam to a depth of 60 inches or more. The soil is mildly alkaline to a depth of 17 inches, moderately alkaline to a depth of 20 inches, and strongly alkaline below that depth. It is calcareous below a depth of 17 inches.

Included with this soil in mapping are areas of Troutdale sandy loam on side slopes and near the crest

of rolling uplands. They make up about 5 percent of the unit.

Permeability of this Martinsdale soil is moderately slow, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high to very high.

This soil is used as irrigated hayland, irrigated pasture, and rangeland. Mixtures of brome, orchardgrass, pubescent wheatgrss, and timothy are commonly grown.

Where this soil is irrigated, the main management concerns are the efficient use and distribution of water, maintenance of soil fertility, and reduction of soil erosion. Flooding is the common method of irrigation. Contour ditches and sprinklers are also suitable methods. The land needs to be leveled and irrigation water managed to obtain uniform distribution of water, control erosion, and prevent large losses of tailwater. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. With good management this soil is capable of producing 4.5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly needleandthread, western wheatgrass, junegrass, and Indian ricegrass. As the range deteriorates, blue grama, sleepygrass, snakeweed, pingue, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, erosion control structures, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, Nordan crested wheatgrass, and Russian wildrye.

This soil is well suited to use as homesites.

This soil is in capability subclasses VIe, nonirrigated, and VIe, irrigated.

21—Norriston very cobbly sandy loam, 2 to 6 percent slopes. This is a deep, somewhat excessively drained soil on terraces and fans. It formed primarily in glacial outwash. Elevation is 7,900 to 8,600 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is brown very cobbly sandy loam 6 inches thick. The subsoil extends to a depth of 23 inches. It is brown extremely cobbly sandy loam in the upper 5 inches, light brown extremely gravelly sandy loam in the middle 7 inches, and light brown extremely gravelly loamy sand in the lower 5 inches. The substratum is light brown extremely cobbly loamy sand in the upper 11 inches and is light brown extremely cobbly sand to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping are areas of Alvarado very cobbly sandy loam in depressions and Libeg extremely cobbly sandy loam in the less sloping areas. Each of the included soils makes up about 10 percent of the map unit.

Permeability of this Norriston soil is rapid, and the available water capacity is very low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the hazard of erosion is slight.

Most of the acreage is rangeland. A few areas where the cobbles have been removed from the surface are used as irrigated pasture.

Where this soil is irrigated, management concerns are the proper use of water and maintenance of soil fertility. Flooding is the common method of irrigation. Sprinklers and contour ditches are also suitable methods. Frequent light irrigation is needed because the available water capacity is low. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. With good management, this soil is capable of producing 3 tons of pasture per irrigated acre.

The potential native vegetation is mainly Arizona fescue, needleandthread, and mountain muhly. As the range deteriorates, slimstem muhly, blue grama, Kentucky bluegrass, sun sedge, granite gilia, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Seeding, other than broadcasting, is inadvisable because many small stones are near the surface.

This soil is well suited to use as homesites. Excavation for foundations, roads, utility lines, and septic tanks is difficult because of the high content of small stones. Cutbanks are unstable. Effluent from septic tank absorption fields rapidly penetrates the substratum and there is a risk of polluting the ground water. This soil is a good source of roadfill.

This soil is in capability subclasses VIIs, nonirrigated, and VIIs, irrigated.

22—Norriston extremely cobbly sandy loam, 6 to 15 percent slopes. This is a deep, somewhat excessively drained soil on terraces and fans. It formed primarily in glacial outwash. Elevation is 7,900 to 8,600 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is brown extremely cobbly sandy loam 6 inches thick. The subsoil extends to a depth of 23 inches. It is brown extremely cobbly sandy loam in the upper 5 inches, light brown extremely gravelly sandy loam in the middle 7 inches, and light brown extremely gravelly loamy sand in the lower 5 inches. The substratum is light brown extremely cobbly loamy sand in the upper 11 inches and is light brown extremely cobbly sand to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping are areas of Alvarado very cobbly sandy loam in depressions and Libeg extremely cobbly sandy loam along the base of

slopes. Each of these included soils makes up about 10 percent of the map unit.

Permeability of this Norriston soil is rapid, and the available water capacity is very low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the hazard of erosion is slight.

Most of the acreage is rangeland.

The potential native vegetation is mainly Arizona fescue, needleandthread, and mountain muhly. As the range deteriorates, slimstem muhly, blue grama, Kentucky bluegrass, sun sedge, granite gilia, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Broadcasting is the only advisable method of seeding because a large number of rock fragments are near the surface.

The main limitation for homesites is slope. Excavation for foundations, roads, utility lines, and septic tanks is difficult because of the high content of small stones. Cutbanks are unstable. Because effluent from septic tank absorption fields rapidly penetrates the subsurface layers, there is a risk of polluting the ground water. This soil is a good source of roadfill.

This soil is in capability subclass VIIs, nonirrigated.

23—Norriston extremely cobbly sandy loam, 15 to 40 percent slopes. This is a deep, somewhat excessively drained soil on terraces and fans. It formed in glacial outwash. Elevation is 8,400 to 9,000 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is brown very cobbly sandy loam 6 inches thick. The subsoil extends to a depth of 23 inches. It is brown extremely cobbly sandy loam in the upper 5 inches, light brown extremely gravelly sandy loam in the middle 7 inches, and light brown extremely gravelly loamy sand in the lower 5 inches. The substratum is light brown extremely cobbly loamy sand in the upper 11 inches and is light brown extremely cobbly sand to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping are areas of Libeg extremely cobbly sandy loam on less sloping parts of the landscape. They make up about 10 percent of the map unit.

Permeability of this Norriston soil is rapid, and the available water capacity is very low. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is slight.

Most of the acreage is rangeland.

The potential native vegetation is mainly Arizona fescue, needleandthread, and mountain muhly. As the range deteriorates, slimstem muhly, blue grama, Kentucky bluegrass, sun sedge, granite gilia, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water development helps to prevent range deterioration and promotes the production of the more desirable plants. Broadcasting seed is the only practical method, because slopes are steep and a large number of rock fragments are near the surface.

This soil is poorly suited to use as homesites. Slope is the principal limiting feature.

This soil is in capability subclass VIIs, nonirrigated.

24—Northwater very stony loam, 20 to 45 percent slopes. This is a deep, well drained soil on mountainsides. It formed in colluvium from granite. Elevation is 9,500 to 10,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface layer is dark grayish brown very stony loam 7 inches thick over dark brown extremely stony sandy loam 18 inches thick. A mixed layer of subsurface material and subsoil follows. It consists of dark brown and dark yellowish brown extremely stony sandy loam 10 inches thick. The subsoil extends to a depth of 50 inches. It is dark yellowish brown extremely stony sandy clay loam in the upper 9 inches and yellowish brown very stony sandy clay loam in the lower 6 inches. The substratum is yellowish brown very cobbly sandy loam to a depth of 60 inches. The soil is neutral throughout.

Included with this soil in mapping and making up about 10 percent of the unit are areas of Woodhall cobbly sandy loam on the steeper parts of the landscape and areas of Lamphier loam on foot slopes and in drainageways. Also included are areas of Rock outcrop. The Lamphier soil and Rock outcrop each makes up about 5 percent of the unit.

Permeability of this Northwater soil is moderately slow, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is moderate.

Most of the areas are used for livestock grazing, woodland, wildlife habitat, and recreation.

The potential native vegetation is mainly quaking aspen and some Engelmann spruce and Douglas-fir. The understory is Thurber fescue, nodding brome, Parry oatgrass, bearded wheatgrass, and Macoun wildrye.

Much of the area supports a lush stand of quaking aspen and a fairly dense understory that is well suited to livestock grazing. As the understory deteriorates, sheep fescue, bluegrass, snowberry, rose, and elk sedge increase. Under proper woodland grazing, these stands can remain highly productive. Forage production is variable and depends primarily on the age and density of the aspen stand.

This soil is suited to the limited production of quaking aspen. The site index is about 55, or moderate. About 1,600 cubic feet, or 200 board feet, of merchantable wood can be produced from a fully-stocked, even-aged stand of 80-year-old trees. Such low productivity is typical for these areas. To minimize soil erosion and

maintain quality water yields, these areas are best managed for grazing.

This soil is poorly suited to homesite development. The major limiting features are steep slopes and large stones in the soil.

This soil is in capability subclass VIIs, nonirrigated.

25—Novary loam, 0 to 2 percent slopes. This is a deep, poorly drained soil on low terraces. It formed in alluvium. Elevation is 7,700 to 8,200 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown loam 4 inches thick. The subsurface layer is very dark gray silt loam 5 inches thick. The subsoil extends to a depth of 31 inches. It is dark gray loam in the upper 10 inches and mottled, dark gray clay loam in the lower 12 inches. The mottled substratum is dark gray silty clay loam in the upper 9 inches and is greenish gray silt loam to a depth of 60 inches or more. The soil is moderately alkaline and calcareous.

Included with this soil in mapping and making about 10 percent of the unit are areas of Wichup peat in depressions. Also included are areas of Becks gravelly loam along stream channels that make up about 5 percent of the unit.

Permeability of this Novary soil is moderately slow, and the available water capacity is high. The effective rooting depth is somewhat limited by a seasonally high water table within 2 feet of the surface. Surface runoff is slow, and the hazard of erosion is slight. The soil is subject to rare flooding.

Most of the acreage is used for irrigated hay and pasture. Mixtures of brome, orchardgrass, intermediate wheatgrass, and timothy are commonly grown.

Where this soil is irrigated, the proper use of water and maintenance of fertility are the main management concerns. Flooding from contour ditches is the most common method of irrigation. Border, corrugation, and sprinkler irrigation are also suitable methods. Land leveling is needed in some areas to obtain uniform distribution of irrigation water but is not always feasible because of wetness (fig. 5). Where outlets can be established, drainage systems are effective in reducing wetness in the root zone. Applications of manure or commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. With good management this soil is capable of producing 5 tons of grass hay per irrigated acre.

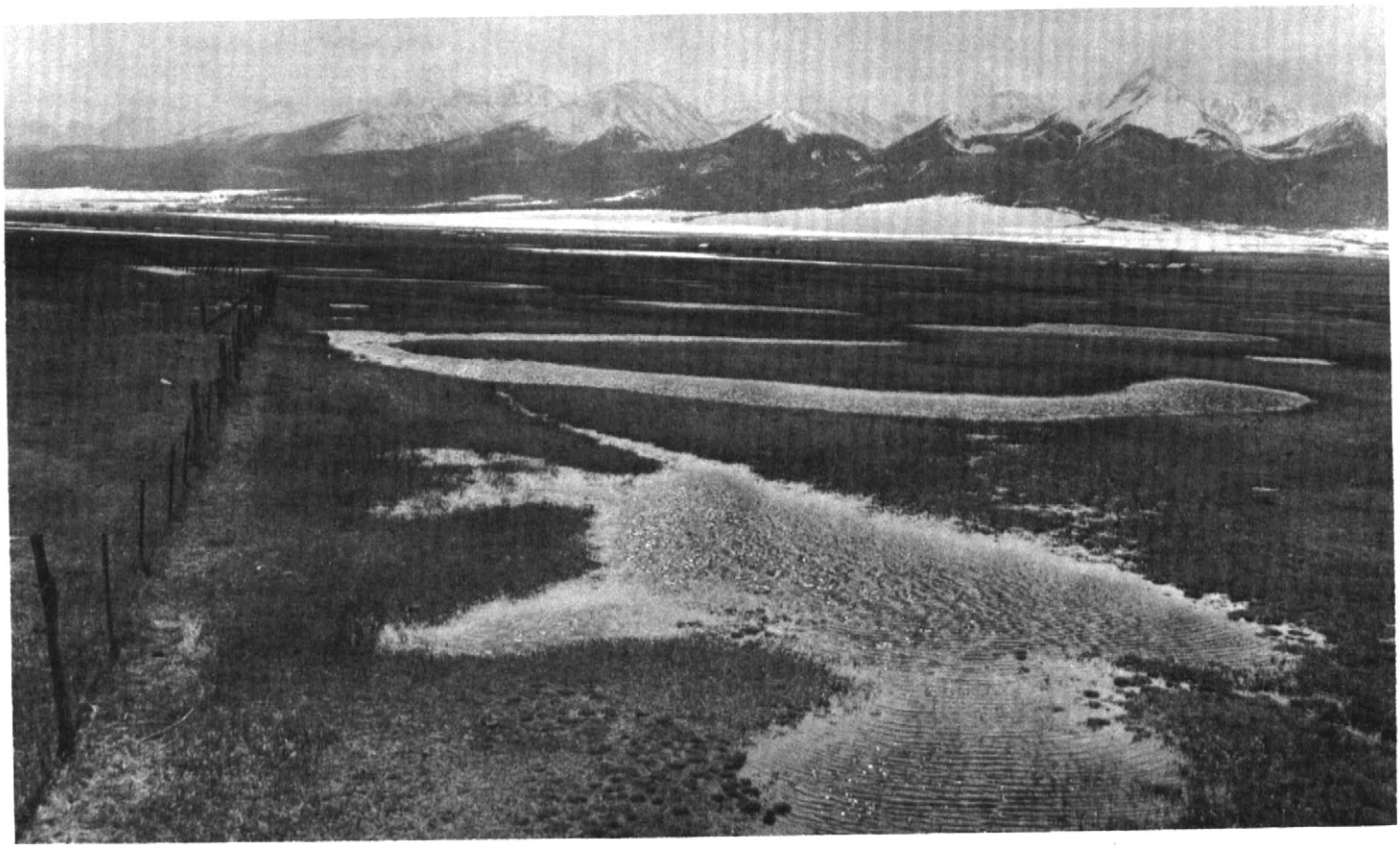


Figure 5.—Water ponded in old oxbows after spring runoff. The soil is Novary loam, 1 to 4 percent slopes, and is irrigated hayland.

The potential native vegetation is mainly tufted hairgrass, red top, and reedgrass. As the range deteriorates, bluegrass, iris, Baltic rush, sedge, willows, and cinquefoil increase. Renovating, using a planned grazing system, and cross fencing help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are reed canarygrass, timothy, and Garrison creeping foxtail.

This soil is poorly suited to use as homesites. The major limiting features are a high water table and flooding.

The soil is in capability subclasses Vw, nonirrigated, and Vw, irrigated.

26—Patent loam, 3 to 10 percent slopes. This is a deep, well drained soil on uplands. It formed in eolian material derived mainly from granite. Elevation is 7,500 to 7,900 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 70 to 90 days.

Typically, the surface layer is pale brown loam 2 inches thick. The substratum is light yellowish brown loam in the upper 5 inches, brown loam in the next 47 inches, and white loam to a depth of 60 inches or more. The soil is neutral to a depth of 7 inches and is moderately alkaline and calcareous below that depth.

Included with this soil in mapping are areas of Troutdale sandy loam in a random pattern on rolling upland crests. They make up about 5 percent of the unit.

Permeability of this Patent soil is moderately slow, and the available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high to very high.

Most of the acreage is rangeland.

The potential native vegetation is mainly needleandthread, western wheatgrass, junegrass, and Indian ricegrass. As the range deteriorates, blue grama, sleepygrass, snakeweed, pingue, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, erosion control structures, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, Nordan crested wheatgrass, and Russian wildrye.

This soil is well suited as homesites.

This soil is in capability subclass VIe, nonirrigated.

27—Peeler sandy loam, 10 to 30 percent slopes. This is a deep, well drained soil on mountain foot slopes. It formed in granite colluvium. Elevation is 8,700 to 10,200 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by an organic mat 1 inch thick of decomposed forest litter consisting of needles, twigs, and leaves. Beneath this the subsurface layer is pinkish gray sandy loam 14 inches thick. Next is a layer of mixed pinkish gray and light brown sandy clay loam 8 inches thick. The subsoil is light brown and brown gravelly sandy clay loam 6 inches thick. Granite bedrock is at a depth of 44 inches. The soil is neutral.

Included with this soil in mapping are areas of Granile cobbly sandy loam on the steeper parts of the landscape and Lamphier loam along drainageways. The Granile soil is about 15 percent of the map unit, and the Lamphier soil is 10 percent.

Permeability of this Peeler soil is moderate, and the available water capacity is moderate. The effective rooting depth is 40 to 60 inches. Surface runoff is medium, and the hazard of erosion is very high.

Most areas are used for woodland, livestock grazing, wildlife habitat, and recreation.

The potential native vegetation is mainly quaking aspen. The understory is Thurber fescue, bearded wheatgrass, nodding brome, Macoun wildrye, and Parry oatgrass.

Much of the area supports a lush stand of quaking aspen that is well suited to livestock grazing. As the understory deteriorates, snowberry, rose, sheep fescue, elk sedge, and bluegrass increase and maintain the site. Forage production is variable and depends on the age and composition of the forest stand.

This soil is suited to the limited production of quaking aspen. The average site index is about 70, or high. About 2,200 cubic feet, or 3,400 board feet, of merchantable timber can be produced from a fully stocked, even-aged stand of 80-year-old trees. Eventually these stands will convert to either a Douglas-fir forest type or an Engelmann spruce forest type, depending on elevation and aspect. The site index of other coniferous species may be higher or lower than the site index for aspen. Intensive management of this soil for aspen forest products is not practicable. Sites are best managed for grazing, wildlife habitat, and watershed protection.

The main limitation of this soil for homesite development is slope. Designs may need to be modified for septic tank absorption fields, foundations, and roads.

This soil is in capability subclass VIe, nonirrigated.

28—Piltz loam, 5 to 20 percent slopes. This is a moderately deep, well drained soil on hilltops and side slopes. It formed in residuum from igneous rock, primarily granite. Elevation is 8,800 to 9,700 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface layer is dark grayish brown loam 14 inches thick. The subsoil extends to a depth of 36 inches. It is pale brown gravelly clay loam in the upper 6 inches and gravelly clay in the lower 16 inches. It is underlain by weathered granite bedrock. The soil is neutral.

Included with this soil in mapping are areas of Skutum fine sandy loam in drainageways and depressions that make up about 15 percent of the map unit. Also included, and making up about 10 percent of the unit, are areas of Woodhall extremely cobbly sandy loam on ridges.

Permeability of this Piltz soil is slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is very high.

Most areas are used as rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly, western wheatgrass, and Parry oatgrass. As the range deteriorates, blue grama, pingue, snakeweed, and rabbitbrush increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, nodding brome, and Arizona fescue.

The main limitations to use of this soil as homesites are moderate shrinking and swelling, slow permeability, and moderate depth to rock. Designs should be modified for foundations and roads to offset the shrinking and swelling of the soil. The top 1 to 3 feet of bedrock can usually be dug with a light backhoe. Depth to rock and slow permeability severely limit the absorption of effluent.

This soil is in capability subclass VIe, nonirrigated.

29—Redfeather-Rock outcrop complex, 5 to 35 percent slopes. This complex is on hilltops and side slopes. Elevation is 7,800 to 9,000 feet. The average annual precipitation is 16 to 21 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 40 to 60 days.

The Redfeather soil makes up about 60 percent of this complex, and Rock outcrop makes up about 20 percent. The Redfeather soil is in gently sloping areas, and the Rock outcrop is along ridgetops.

Included with this complex in mapping are areas of Wix sandy loam on hilltops and Coutis sandy loam on foot slopes and in drainageways. The Wix soil makes up about 15 percent of the complex, and the Coutis soil, about 5 percent.

The Redfeather soil is shallow and well drained. It formed in residuum from granite. Typically, a layer 1 inch thick of partially decomposed needles and twigs is on the surface. The surface layer is grayish brown stony sandy loam 3 inches thick. The subsurface layer is light brownish gray very gravelly sandy loam 4 inches thick. The subsoil is brown extremely gravelly sandy clay loam 7 inches thick. Granite bedrock is at a depth of 14 inches. The soil is slightly acid to a depth of 3 inches and neutral below that depth.

Permeability of the Redfeather soil is moderate, and the available water capacity is low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is slight.

Rock outcrop comprises nearly barren areas of granite.

Most areas of this complex are used for limited livestock grazing, woodland, wildlife habitat, and recreation.

The potential native vegetation is mainly ponderosa pine and an understory of Gambel oak, mountainmahogany, snowberry, kinnikinnik, Arizona fescue, and mountain muhly.

Most areas support an open stand of ponderosa pine and are well suited to livestock grazing. As the understory deteriorates, Gambel oak, snowberry, blue grama, and sedges increase. Forage production is variable, but in most years it is about 225 pounds per acre, air-dry weight.

This soil is suited to the limited production of ponderosa pine. The average site index is about 45, or low. About 2,000 cubic feet, or 6,200 board feet (International rule), per acre can be produced from a fully-stocked, managed stand of 100-year-old trees.

Ordinarily, the surface should be sufficiently broken up during harvest to insure site regeneration, although the low available water capacity of the soil may affect seedling survival. Logging roads, landings, and skid trails should be carefully located. To stabilize grades and cut and fill slopes and keep soil losses to a minimum, roads should be waterbarred and seeded after harvest. They should be chiseled or otherwise broken up to prepare an adequate seedbed and the seed broadcast late in fall to assure adequate soil moisture the next spring. Suitable seeding mixtures include Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrass.

This complex is poorly suited to homesite development. The main limitations of the Redfeather soil are slope and shallowness to bedrock. The shallowness to bedrock and areas of Rock outcrop make excavation difficult.

This complex is in capability subclass VIIs, nonirrigated.

30—Rogert-Rock outcrop complex, 20 to 45 percent slopes. This complex is on mountainsides and hills (fig. 6). Elevation is 7,800 to 9,000 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 50 to 75 days.

Figure 6.—Rogert-Rock outcrop complex, 20 to 45 percent slopes, on hills in background; Martinsdale sandy loam in foreground.

The Rogert soil makes up about 50 percent of this complex, and Rock outcrop, about 30 percent. The Rogert soil is on side slopes and hilltops, and the Rock outcrop is on side slopes and along ridges. Rock outcrop commonly forms steep, vertical ledges.

Included in mapping, and making up about 15 percent of the complex, are areas of Redfeather stony sandy loam on north-facing slopes on which ponderosa pine grow. Also included are areas of Coutis sandy loam on foot slopes. They make up about 5 percent of the complex.

The Rogert soil is shallow and well drained. It formed in residuum from igneous rock, primarily granite. Typically, the surface layer is grayish brown very cobbly sandy loam 5 inches thick. The substratum is brown very gravelly sandy loam 13 inches thick. Granite bedrock is at a depth of 18 inches. The soil is neutral.

Permeability of this Rogert soil is moderately rapid, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is rapid, and the hazard of erosion is slight.

Rock outcrop comprises nearly barren areas of granite.

Most areas of this complex are used as rangeland. The livestock grazing value is adequate, but much of the area is inaccessible because of steep slopes and the Rock outcrop.

The potential native vegetation is mainly Arizona fescue, mountain muhly, pine dropseed, and mountainmahogany. As the range deteriorates, blue grama, snowberry, snakeweed, slimstem muhly, and pingue increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Reseeding by broadcasting is the only practical method because of the Rock outcrop, cobbles on the surface, and steep slopes. Suitable grasses for reseeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

This complex is poorly suited to use as homesites. Limiting features are slope, depth to bedrock, and rock fragments. They make excavation and the construction of roads, utility lines, and foundations difficult. Septic tank absorption fields will not function properly because of the steep slopes and shallowness to bedrock.

This complex is in capability subclass VIIs, nonirrigated.

31—Rogert-Woodhall extremely cobbly sandy loams, 20 to 45 percent slopes (fig. 7). This complex is on mountainsides. Elevation is 8,000 to 10,000 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The Rogert soil makes up about 50 percent of this complex, and the Woodhall soil makes up about 40 percent. The Rogert soil is on ridges and steep side slopes, and the Woodhall soil is on more nearly level side slopes.

Included in mapping, and making up about 10 percent of the complex, are areas of Coutis sandy loam on foot slopes and in narrow drainageways. Also included and making up about 5 percent, are areas of Rock outcrop on ridgetops. This complex also includes areas of Buena Vista soils just north of the town of Silver Cliff on Round Mountain and areas in the White Hills.

The Rogert soil is shallow and well drained. It formed in residuum from igneous rock, primarily granite. Typically, the surface layer is grayish brown extremely cobbly sandy loam 10 inches thick. The substratum is brown extremely gravelly sandy loam 5 inches thick. Granite bedrock is at a depth of 15 inches. The soil is slightly acid.

Permeability of this Rogert soil is moderately rapid, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is slight.

The Woodhall soil is moderately deep and well drained. It formed in residuum and colluvium from granite. Typically, the surface layer is dark grayish brown extremely cobbly sandy loam 6 inches thick. The subsoil extends to a depth of 28 inches. It is dark grayish brown extremely cobbly sandy loam in the upper 4 inches and light brown very cobbly clay loam in the lower 18 inches.

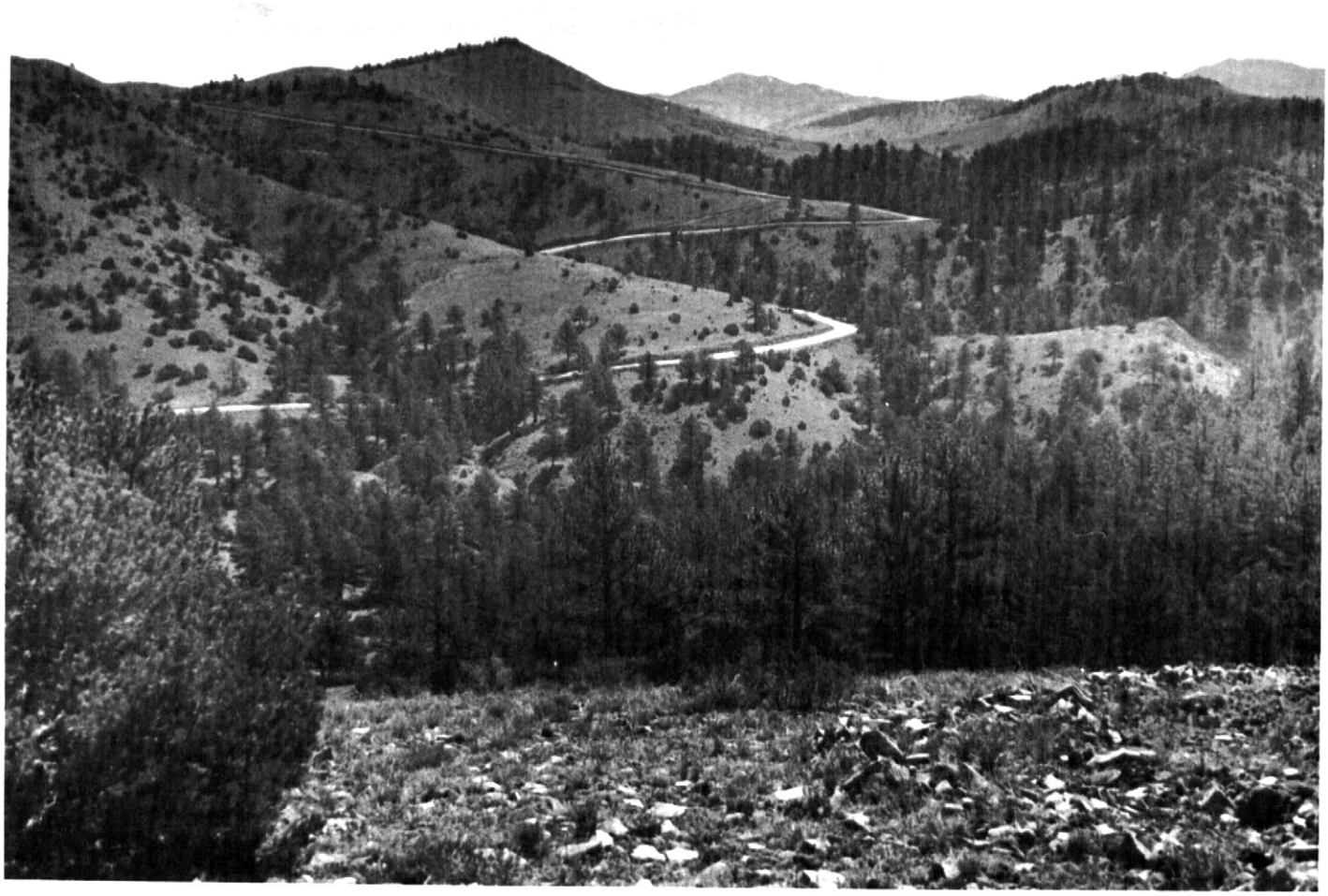


Figure 7.—Landscape of Rogert-Woodhall extremely cobbly sandy loams, 20 to 45 percent slopes, in Shallow Loam range site.

Granite bedrock is at a depth of 28 inches. The soil is slightly acid.

Permeability of this Woodhall soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is slight.

Most areas of this complex are used as rangeland. Very steep slopes somewhat limit accessibility for livestock.

The potential native vegetation is mainly Arizona fescue, mountain muhly, pine dropseed, mountainmahogany, and a few ponderosa pines. As the range deteriorates, blue grama, fringed sage, snakeweed, and slimstem muhly increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Seeding on this site is inadvisable because of the large number of rock fragments on the surface, the outcrops of rock, and the steep slopes.

This soil is poorly suited to use as homesites. Limiting features are slope, depth to rock, and rock fragments. They make excavation for roads, utility lines, foundations, and septic tanks difficult. Septic tank absorption fields will not function properly in most areas because of steep slopes and shallowness to rock.

This complex is in capability subclass VIIs, nonirrigated.

32—Silvercliff gravelly sandy loam, 1 to 4 percent slopes. This is a deep, well drained soil on low terraces and fans. It formed in calcareous alluvium. Elevation is 7,800 to 8,200 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is dark grayish brown gravelly sandy loam 8 inches thick. The subsoil is light brown gravelly loam 13 inches thick. The substratum is reddish brown very gravelly sandy loam in the upper 12 inches, and it is reddish brown very gravelly loamy sand to a depth of 60 inches or more. The soil is moderately alkaline and calcareous.

Included with this soil in mapping are areas of Becks gravelly loam in low lying positions on the landscape and along drainageways. They make up about 10 percent of the map unit.

Permeability of this Silvercliff soil is moderately rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is very slow, and the hazard of erosion is slight.

Most areas are used as rangeland. A few areas are used for irrigated hay or pasture. Mixtures of brome, orchardgrass, pubescent wheatgrass, and timothy are commonly grown.

Flooding is a suitable method of irrigating this soil (fig. 8). If the soil is not protected, however, severe water erosion can result. Land leveling makes irrigation more efficient and reduces erosion. Crops respond well to nitrogen and phosphorus. With good management, this soil is capable of producing about 4 tons of grass hay per irrigated acre.

The potential native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and junegrass. As the range deteriorates, blue grama, sleepygrass, slimstem muhly, and rabbitbrush increase. Renovating and using a planned grazing system and cross fencing help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

This soil is well suited to use as homesites. Community sewage systems are needed in areas of high population density because of the hazard of polluting the ground water. The included areas of Becks soil are limited for this use by a high water table.

The Silvercliff soil is a suitable source of sand and gravel and is a good source of roadfill.

This soil is in capability subclasses VIe, nonirrigated, and Vc, irrigated.

33—Silvercliff cobbly sandy loam, 15 to 35 percent slopes. This is a deep, well drained soil on terrace edges. It formed in calcareous alluvium. Elevation is 8,000 to 9,200 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown cobbly sandy loam 8 inches thick. The subsoil is brown very gravelly sandy loam 6 inches thick. The substratum is stratified very gravelly sandy loam, very gravelly sand, loamy sand, and cobbly loam to a depth of 60 inches. The soil is mildly alkaline to a depth of 14 inches, moderately alkaline and calcareous to a depth of 34 inches, mildly alkaline to a depth of 43 inches, and moderately alkaline and calcareous below that depth.

Included with this soil in mapping, and making up about 15 percent of the unit, are areas of Coutis sandy loam along drainageways and on foot slopes.

Permeability of this Silvercliff soil is moderately rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high.

Most areas are used as rangeland (fig. 9).

The potential native vegetation on this soil is mainly needleandthread, western wheatgrass, and Arizona fescue. As the range deteriorates, the proportion of the more desirable plants decreases and the proportion of the less desirable plants such as threeawn, slimstem muhly, sleepygrass, fringed sage, and rabbitbrush increases. Undesirable weeds, shrubs, and annuals invade and become more abundant as range condition further deteriorates. A planned grazing system helps to

Figure 8.—Irrigation of hayland by flooding. The soil is Silvercliff gravelly sandy loam, 1 to 4 percent slopes.

maintain and improve the plant cover and control erosion. Cross fencing, livestock water developments, salting, and erosion control structures help to prevent range deterioration and promote the production of the more desirable plants. Seeding on this soil is limited to broadcasting because of stoniness. Suitable plants for seeding are intermediate, pubescent, western, and Nordan crested wheatgrasses; Russian wildrye; and Arizona fescue.

This soil is poorly suited to use as homesites. The major limiting features are slope and large amounts of rock fragments.

This soil is in capability subclass VIIe, nonirrigated.

34—Silvercliff very cobbly sandy loam, 30 to 50 percent slopes. This is a deep, well drained soil on terrace edges. It formed in colluvium and alluvium. Elevation is 8,400 to 9,200 feet. The average annual precipitation is 16 to 18 inches, the average annual temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is dark grayish brown very cobbly sandy loam 8 inches thick. The subsoil is brown very cobbly sandy loam 12 inches thick. The substratum is pinkish white very cobbly sandy loam in the upper 30 inches and light brown very gravelly loamy sand to a depth of 60 inches or more.

The soil is mildly alkaline to a depth of 20 inches and moderately alkaline and calcareous below that depth.

Included with this soil in mapping are areas of sandstone Rock outcrop on the steeper parts of the landscape. They make up about 5 percent of the map unit.

Permeability of this Silvercliff soil is moderately rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is high.

Most areas are used for livestock grazing, woodland, and wildlife habitat.

The potential native vegetation is mainly pinyon and Rocky Mountain juniper. The understory is dominantly blue grama, mountain muhly, muttongrass, Arizona fescue, Indian ricegrass, and mountainmahogany. As the understory deteriorates, three-awn, blue grama, rabbitbrush, snakeweed, and pricklypear increase. If properly managed for woodland grazing, these areas retain their maximum productivity.

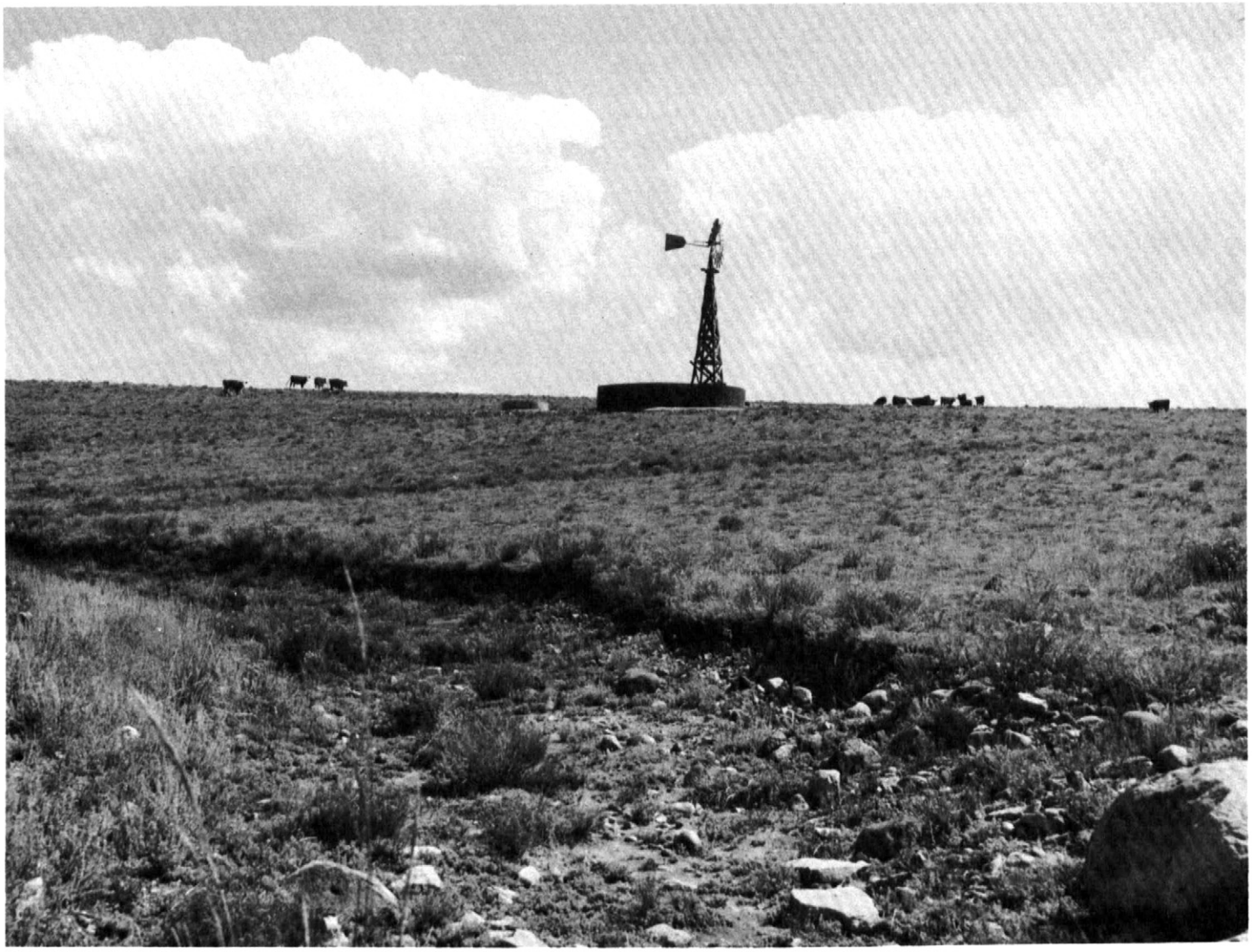


Figure 9.—Silvercliff cobbly sandy loam, 15 to 35 percent slopes, in Mountain Loam range site. Windmill and stock tank were installed under the Soil Conservation Service Great Plains program.

This soil produces trees suitable for firewood, high quality fenceposts, Christmas trees, and pinyon nuts. However, steep slopes limit access to all but a very small portion of this unit, and there is almost no commercial utilization of the timber.

This soil is poorly suited to homesite development. The main limitation is slope.

This soil is in capability subclass VIIs, nonirrigated.

35—Skutum fine sandy loam, 5 to 20 percent slopes. This is a deep, well drained soil on foot slopes. It formed in colluvium from granite. Elevation is 8,800 to 9,600 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface layer is dark grayish brown fine sandy loam 16 inches thick. In small areas, gravel and cobbles are on the surface. The subsoil is mainly brown gravelly clay and very gravelly clay 32 inches thick. The substratum is grayish brown gravelly sandy loam to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping, and making up about 15 percent of the unit, are areas of Piltz loam on the steeper terrain. Also included are areas of Lamphier loam in drainageways. They make up about 5 percent of the unit.

Permeability of this Skutum soil is slow, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is very high.

Most areas are used as rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly, western wheatgrass, and Parry oatgrass. As the range deteriorates, bluegrass, sleepygrass, pingue, snakeweed, and rabbitbrush increase. Renovating and salting and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, mountain brome, and Arizona fescue.

The main limitations to use of this soil as homesites are moderate shrinking and swelling, slow permeability, and slope. Designs should be modified for foundations and roads to offset the shrinking and swelling of the soil. Slow permeability limits the rate at which effluent can be filtered. Bedrock may be less than 40 inches deep in steeper areas.

This soil is in capability subclass VIe, nonirrigated.

36—Splitro-Rock outcrop complex, 25 to 55 percent slopes. This complex is on mountainsides and ridgetops. Elevation is 7,800 to 9,000 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

The Splitro soil makes up about 55 percent of this complex, and Rock outcrop makes up about 30 percent. The Splitro soil is between bands of Rock outcrop.

Included in mapping and making up about 10 percent of the complex, are areas of Tripit sandy loam near the base of slopes. Also included are areas of Coutis sandy loam in drainageways. They make up about 5 percent of the complex.

The Splitro soil is shallow and well drained. It formed in residuum from sandstone. Typically, the surface layer is brown sandy loam 8 inches thick. The subsoil is reddish brown gravelly sandy loam 5 inches thick. Sandstone bedrock is at a depth of 13 inches. The soil is neutral.

Permeability of this Splitro soil is moderately rapid, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is very high.

Rock outcrop comprises interbedded layers of sandstone and siltstone.

Most of the acreage is rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly and mountainmahogany. As the range deteriorates, blue grama, bluegrass, slimstem muhly, fringed sage, pingue, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Seeding is not practical because of steep slopes and the high percentage of Rock outcrop.

This complex is poorly suited to use as homesites. Limiting features are the steep slopes and shallowness to bedrock.

This complex is in capability subclass VIIs, nonirrigated.

37—Stumpp Variant loam, 1 to 4 percent slopes. This is a deep, somewhat poorly drained soil on low terraces. It formed in fine textured alluvial sediments. Elevation is 8,000 to 8,200 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is grayish brown loam 5 inches thick. The subsoil extends to a depth of 19 inches. It is dark brown clay in the upper 7 inches and very pale brown clay below. The substratum is light yellowish brown loam in the upper 30 inches and is light yellowish brown sandy loam to a depth of 60 inches or more. The soil is strongly alkaline to a depth of 40 inches and moderately alkaline below that depth. The profile is calcareous between depths of 12 and 40 inches.

Included with this soil in mapping are slick spots which make up about 15 percent of the unit. These are areas of high salt accumulation that are often void of vegetation.

Permeability of this Stumpp Variant is slow, and the available water capacity is moderate. A high salt content limits the availability of water for plants. The effective rooting depth is 60 inches or more, but it is somewhat restricted by the high salt content in the subsoil and by a water table below 40 inches. A water table is permanently below a depth of 60 inches, but it may rise to 40 inches seasonally. Surface runoff is medium, and the erosion hazard is slight to moderate. Occasional flooding may occur near stream channels and is of short duration.

Most areas are used as rangeland. A few areas are used for hay or pasture.

This soil can be used for irrigated pasture, but it is so alkaline that it is moderately difficult to manage. Gypsum or sulfuric acid can be used to leach alkali out of the soil. Such grasses as tall wheatgrass and Russian wildrye, which are adapted to alkali soils, are suitable for seeding. Suitable irrigation methods are flooding and corrugation. With good management, this soil is capable of producing about 2.5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly western wheatgrass, inland saltgrass, and alkali sacaton. Because the water table is deep, plants such as Baltic rush and sun sedge are common. As the range deteriorates, greasewood, inland saltgrass, Baltic rush, and rabbitbrush increase. The use of a planned grazing system and cross-fencing helps to prevent range deterioration and promotes the production of the more

desirable plant species. Range reseeding is advisable only in very poor areas because of the high alkalinity and the poor chance of getting a good stand. Seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable species for reseeding are tall wheatgrass and western wheatgrass.

This soil is poorly suited to homesite development. The main limitations are high shrinking and swelling and the hazard of flooding.

This soil is in capability subclass VIe, nonirrigated, and VIs, irrigated.

38—Terric Borosaprists, nearly level. These are deep, very poorly drained soils that formed in alluvium on low stream terraces. Slope is 0 to 3 percent. Seepage of water from higher adjacent areas and from stream channels has slowed the normal decay of plant materials and caused organic matter to accumulate on these soils. Elevation is 7,500 to 10,000 feet. The average annual precipitation is 14 to 23 inches, the average annual temperature is 38 to 44 degrees F, and the frost-free season is 40 to 75 days.

These soils are somewhat variable in texture and horizon thickness. In one of the most common profiles, black highly decomposed organic material 20 inches thick is underlain by black mucky silty clay loam 20 inches thick. Below this, the underlying material is black silty clay to a depth of 60 inches or more. The profile is mildly alkaline to a depth of 10 inches, neutral to a depth of 20 inches, and mildly alkaline below that depth.

Included with these soils in mapping are areas of Wichup peat on small, convex mounds. These included areas make up about 15 percent of the map unit.

Permeability of the most common Terric Borosaprists is slow. Available water capacity is high. The effective rooting depth is limited by a seasonally high water table within 1 foot of the surface. Surface runoff is very slow, and the hazard of erosion is slight.

Most of the acreage is used as rangeland. A few small areas are within irrigated pastures. Native grasses such as tufted hairgrass, redtop, and purple reedgrass are commonly grown because the soil is generally too wet for mechanical seeding or harvesting.

The potential native vegetation is mainly tufted hairgrass, sedges, redtop, and reedgrass, When the range deteriorates, bluegrass, iris, willows, Baltic rush, ovalhead sedge, and cinquefoil increase. Using a planned grazing system and fencing help to prevent range deterioration and promote the production of the more desirable plants. The native vegetation is so dense that broadcasting seed into it is of little value.

These soils are very poorly suited to use as homesites. Limiting features are the shallow ground water table, occasional flooding, and low soil strength.

These soils are in capability subclass Vw, nonirrigated.

39—Tripit, warm-Splitro sandy loams, 5 to 20 percent slopes (fig. 10). This complex is on uplands. Elevation is 7,800 to 9,000 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

The Tripit soil makes up about 60 percent of this complex, and the Splitro soil makes up about 30 percent. The Tripit soil is in the less sloping areas, and the Splitro soil is on long narrow ridges and steeper areas.

Included in mapping and making up about 5 percent of this complex, are areas of Coutis sandy loam in drainageways. Another 5 percent of the complex consists of Rock outcrop on ridges.

The Tripit soil is moderately deep and well drained. It formed in residuum from siltstone. Typically, the surface layer is dark reddish gray sandy loam 8 inches thick. The subsurface layer is reddish brown sandy loam 10 inches thick. The subsoil is red gravelly light clay loam 10 inches thick. Red, fractured siltstone bedrock is at a depth of 28 inches. The soil is neutral.

Permeability of this Tripit soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

The Splitro soil is shallow and well drained. It formed in residuum from sandstone. Typically, the surface layer is brown sandy loam 8 inches thick. The underlying material is reddish brown gravelly sandy loam 5 inches thick. Sandstone bedrock is at a depth of 13 inches. The soil is neutral.

Permeability of this Splitro soil is moderately rapid and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

Most of the acreage of this complex is rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly, slender wheatgrass, and Parry oatgrass on the Tripit soil and is Arizona fescue, mountain muhly, and mountainmahogany on the Splitro soil. As the range deteriorates, blue grama, sleepygrass, bluegrass, slimstem muhly, fringed sage, pingue, and rabbitbrush increase.

Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. Seeding may be somewhat restricted by Rock outcrop and is advisable only in the more favorable areas of deeper soil. Seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

Major limiting features for use of the complex as homesites are slope and depth to rock. Areas of Tripit soil are favorable for homesites. Designs for foundations and septic tank absorption fields need to be modified in the steeper areas. Septic tank absorption fields will not function properly, particularly on the Splitro soils, because they are shallow to bedrock.

Figure 10.—Landscape of Tripit, warm-Splitro complex, 5 to 20 percent slopes.

This complex is in capability sublass VIe, nonirrigated.

40—Troutdale-Rogert complex, 5 to 15 percent slopes. This complex is on uplands. Elevation is 7,300 to 9,000 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 85 days.

The Troutdale soil makes up about 65 percent of this complex, and the Rogert soil makes up about 20 percent. The Troutdale soil is on side slopes, and the Rogert soil is adjacent to Rock outcrop on rolling upland ridges.

Included in mapping, and making up about 10 percent of this complex, are areas of Coutis sandy loam in drainageways. Also included are areas of Rock outcrop in a striated pattern on ridges and side slopes. The Rock outcrop is usually granite but sometimes schist or gneiss. It makes up 5 percent of the complex.

The Troutdale soil is moderately deep and well drained. It formed in residuum from micaceous schist. Typically, the surface layer is grayish brown sandy loam 8 inches thick. The subsoil extends to a depth of 30 inches. It is grayish brown sandy loam in the upper 6 inches and brown gravelly sandy clay and loam in the lower 16 inches. The substratum is brown sandy loam. Weathered micaceous schist is at a depth of 35 inches. The soil is slightly acid to a depth of 14 inches and is neutral below that depth.

Permeability of this Troutdale soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is very high.

The Rogert soil is shallow and well drained. It formed

in residuum from igneous rock, primarily granite. Typically, the surface layer is dark grayish brown gravelly sandy loam in the upper 2 inches and dark brown gravelly sandy loam in the lower 6 inches. Below this is dark brown very gravelly sandy loam. Granite bedrock is at a depth of 15 inches. The soil is neutral.

Permeability of this Rogert soil is moderately rapid, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is moderate.

These soils are used mainly as rangeland.

The potential native vegetation is mainly needleandthread, western wheatgrass, and Arizona fescue. As the range deteriorates, blue grama, rabbitbrush, and snakeweed increase. Renovating and using a planned grazing system, cross fencing, and livestock water developments help to prevent range deterioration and promote the production of the more desirable plants. Seeding may be somewhat restricted by Rock outcrop and is advisable only in the more favorable areas of the deeper soil. Seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are western wheatgrass, intermediate wheatgrass, pubescent wheatgrass, Nordan crested wheatgrass, Russian wildrye, and Arizona fescue.

The primary features limiting use of the soil as homesites are depth to rock and slope. Excavation and construction of foundations, roads, and septic tanks should be avoided near Rock outcrop. The bedrock immediately under Troutdale soils can be dug into 1 to 3 feet with light backhoe equipment.

This soil is in capability subclass VIe, nonrrigated.

41—Troutville extremely cobbly sandy loam, 4 to 15 percent slopes. This is a deep, somewhat excessively drained soil on stream terraces. It formed in glacial outwash and till. Elevation is 8,200 to 9,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by a layer 1 inch thick of partially decomposed needles, twigs, and leaves. Below this, the subsurface layer is pinkish gray extremely cobbly sandy loam 15 inches thick. The next layer is 14 inches of pinkish gray and pink extremely stony loamy sand with sandy loam lenses. The subsoil is variable in color but is mainly pink. It is extremely stony loamy sand with sandy clay loam lenses in the upper 24 inches and is extremely cobbly sandy loam to a depth of 60 inches or more. The soil is slightly acid in the subsurface layer and the upper part of the subsoil and is neutral in the lower part of the subsoil.

Included with this soil in mapping are areas of Venable loam along low stream terraces. They make up about 10 percent of the map unit.

Permeability of this Troutville soil is moderately rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is very slow, and the hazard of erosion is slight. The water table is commonly within 6 or 7 feet of the surface.

Most areas are used for livestock grazing, woodland, wildlife habitat, and recreation.

The potential native vegetation is mainly quaking aspen and some white fir and Douglas-fir. The understory is Thurber fescue, nodding brome, Macoun wildrye, Parry oatgrass, and bearded wheatgrass.

Most of the area supports a lush stand of aspen and a fairly dense understory that is well suited to livestock grazing. As the understory deteriorates, snowberry, sheep fescue, elk sedge, and bluegrass increase. With proper grazing management, these stands can remain very productive. Forage production is variable and depends on the age and density of the aspen stand.

This soil is suited to the limited production of quaking aspen. The average site index is about 70, or high. About 2,200 cubic feet of cordwood or 3,400 board feet or merchantable sawtimber can be produced per acre from a fully-stocked stand of 80-year-old trees. Aspen regenerates best under full sunlight and from root suckers. Stands of aspen should be clearcut and grazed lightly for a full year following harvest before the next crop is established. If Douglas-fir seedlings are planted, the low water holding capacity may influence seedling survival. The most forage is produced by older stands.

This soil is well suited to homesite development. The major limitation is the content of large stones, which may present a problem during excavation. Community sewage systems should be provided in areas of high population density because of the risk of polluting the ground water.

This soil is in capability subclass VIIs, nonirrigated.

42—Troutville extremely stony sandy loam, 25 to 60 percent slopes. This is a deep, somewhat excessively drained soil on mountainsides. It formed in glacial till. Elevation is 8,300 to 9,600 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by a layer of partially decomposed needles, twigs, and leaves 1 inch thick. Below that is a subsurface layer of pinkish gray extremely stony sandy loam 15 inches thick. Next is a mixed subsurface and subsoil layer that is pinkish gray and pink extremely stony loamy sand 14 inches thick. The subsoil is variable in color in the upper part, but it is mainly pink extremely stony loamy sand with lamellae and discontinuous clay pockets of sandy clay loam. The lower part of the subsoil is extremely cobbly sandy loam to a depth of 60 inches or more. The soil is slightly acid in the subsurface layer and upper part of the subsoil and neutral in the lower part of the subsoil.

Included with this soil in mapping are areas of Peeler sandy loam on foot slopes. They make up about 10 percent of the map unit.

Permeability of this Troutville soil is moderately rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is very slow, and the hazard of erosion is slight.

Most areas are used for woodland, wildlife habitat, and recreation.

The potential native vegetation is mainly Douglas-fir and white fir and some lodgepole pine. The understory is sparse. Elk sedge, buffaloberry, vaccinium, heart-leaf arnica, and Oregon grape are the major plants.

This soil is suited to the limited production of Douglas-fir or lodgepole pine. The Douglas-fir site index is 35, or very low. The lodgepole pine site index is 53 or low. This soil is capable of producing about 3,800 cubic feet, or 11,900 board feet (International rule), or lodgepole pine timber from a fully-stocked, managed stand of 120-year-old trees cut on a 30-year cycle. Early entries in these stands produce Christmas trees in precommercial thinnings. As the stand matures, coral poles, fence posts, and building poles are harvested along with the sawtimber.

The primary limiting features of this soil are low available water capacity and steep slopes. Conventional harvesting methods are generally limited to slopes of less than 40 percent. Surface stones influence felling and yarding of trees.

Landings, roads, and skid trails should be carefully located to minimize soil erosion. To stabilize grades and cut and fill slopes and keep soil losses to a miminum, waterbar and reseed roads after harvest. Chisel or otherwise break up roads to prepare an adequate seedbed, and broadcast the seed late in fall to assure adequate soil moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrass.

This soil is poorly suited to homesite development. The main limitations are slope and the content of large stones.

This soil is in capability subclass VIIs, nonirrigated.

43—Ula cobbly sandy loam, 5 to 20 percent slopes. This is a moderately deep, well drained soil on mountain benches and foot slopes. It formed in residuum of conglomeratic sandstone. Elevation is 8,200 to 9,500 feet. The average annual precipitation is 20 to 25 inches. The average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by a layer of partially decomposed oak leaves and pine needles 1 inch thick. The surface layer is reddish gray cobbly sandy loam 5 inches thick. The subsurface layer is light reddish brown cobbly sandy loam 7 inches thick. The subsoil extends to a depth of 37 inches. The upper part is light reddish brown cobbly sandy loam 5 inches thick over reddish brown cobbly sandy clay loam 16 inches thick. The lower part is yellowish red cobbly sandy clay loam. Weathered conglomeratic sandstone is at a depth of 37 inches. The soil is neutral to a depth of 17 inches and slightly acid below that depth.

Included with this soil in mapping are areas of Libeg extremely cobbly sandy loam and Leadville very cobbly sandy loam at the base of the steeper slopes and Coutis sandy loam in drainageways. Each of these included soils makes up about 10 percent of the map unit.

Permeability of this Ula soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

Most areas are used for livestock grazing, woodland, wildlife, and recreation.

The potential native vegetation is mainly ponderosa pine and occasional white fir and aspen trees. The understory is Gambel oak, mountainmahogany, Arizona fescue, mountain muhly, Parry oatgrass, mountain brome, and junegrass. As the understory deteriorates, Gambel oak, rose, snowberry, bluegrass, and sedges increase and dominate the understory. Much of the area supports an open stand of ponderosa pine that is well suited to livestock grazing. Forage production varies and is dependent on the age and density of the pine stand. The best forage is produced in open stands of old growth.

This soil is suited to the limited production of ponderosa pine. The average site index is about 45, or low. About 2,000 cubic feet, or 6,200 board feet (International rule), of merchantable wood per acre can be produced from an even-age stand of 100-year-old trees. The main limitations are the moderate depth to bedrock and the erosion hazard. The low water holding capacity of the soil could influence seedling survival.

Ordinarily, the surface should be sufficiently broken up during harvest to assure site regeneration. Logging roads and skid trails should be carefully located to minimize erosion. To stabilize grades and cut and fill slopes and keep soil losses to a minimum, waterbar and reseed roads. Chisel or otherwise break up the roads to prepare an adequate seedbed, and broadcast the seed late in fall to assure adequate moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrasses. Pine seedlings suitable for transplanting may also be planted in these areas, although cobblestones in the soil may interfere with the use of tree spades.

Where this soil is used for homesites or other urban developments, the main limitations are slope and depth to rock. Special sewage systems, foundation designs, and road locations may be needed.

This soil is in capability subclass VIe, nonirrigated.

44—Ula-Leadville complex, 25 to 60 percent slopes. These soils are on mountainsides at elevations of 8,500 to 10,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The Ula soil makes up about 50 percent of the complex, and the Leadville soil about 30 percent. The Ula soil is on mountainsides, and the Leadville soil is at the base of slopes.

Included in mapping are areas of Rock outcrop along ridges and Splitro sandy loam on the steeper mountainsides. Each of these makes up about 10 percent of the complex.

The Ula soil is moderately deep and well drained. It formed in residuum from conglomeratic sandstone. Typically, the surface is covered by a layer of partially decomposed oak leaves and pine needles 1 inch thick. The surface layer is reddish gray cobbly sandy loam 5 inches thick. The subsurface layer is light reddish brown cobbly sandy loam 7 inches thick. The subsoil extends to a depth of 37 inches. The upper part is light reddish brown cobbly sandy loam 5 inches thick over reddish brown cobbly sandy clay loam 16 inches thick. The lower part is yellowish red cobbly sandy clay loam. Weathered congolomeratic sandstone is at a depth of 37 inches. The soil is neutral to a depth of 17 inches and slightly acid below that depth.

Permeability of this Ula soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is very high.

The Leadville soil is deep and well drained. It formed in glacial till. Typically, the surface is covered by a layer of undecomposed and partially decomposed needles and twigs 1 inch thick. The surface layer is reddish gray very cobbly sandy loam 1 inch thick. The subsurface layer is pinkish gray very cobbly sandy loam 11 inches thick underlain by a mixed layer of reddish brown and pinkish gray very cobbly sandy loam 10 inches thick. The subsoil extends to a depth of 60 inches or more. It is reddish brown extremely cobbly sandy clay loam 8 inches thick over light reddish brown extremely gravelly sandy clay loam 10 inches thick. Below that it is light pinkish gray extremely gravelly sandy loam. The soil is slightly acid in the surface and subsurface layers and neutral in the subsoil.

Permeability of the Leadville soil is moderate. The available water capacity is low because the soil contains rock fragments. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of erosion is slight.

Most areas of this complex are used for livestock grazing, woodland, wildlife, and recreation.

The potential native vegetation is mainly ponderosa pine and occasional Douglas-fir and pinyon. The understory is Gambel oak, mountainmahogany, Arizona fescue, mountain muhly, and mountain brome. As the understory deteriorates, Gambel oak, snowberry, rose, bluegrass, and sedges increase and become dominant. Most areas that are well suited to livestock grazing support an open stand of ponderosa pine. Forage production of the understory varies and is dependant on the age and density of the pine stand. The best forage is produced in stands of old growth. Slope, however, limits growth in the steepest part of the complex.

The soils of this complex are suited to the limited production of ponderosa pine. The average site index is about 45, or low. About 2,000 cubic feet, or 6,200 board feet (International rule), of merchantable wood per acre can be produced from an even-aged stand of 100-year-old trees. The main limitations are moderate depth to bedrock and the erosion hazard. The low water holding capacity could influence seedling survival.

Ordinarily, the surface should be sufficiently broken up during harvest to assure site regeneration. Logging roads and skid trails should be carefully located to minimize soil erosion. To establish grades and cut and fill slopes and keep soil losses to a minimum, waterbar and reseed roads. Chisel or otherwise break up the roads to prepare an adequate seedbed, and broadcast the seed late in fall to assure adequate moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrass.

This complex is poorly suited as homesites. The main limitations are steep slopes and moderate depth to rock.

This complex is in capability subclass VIIe, nonirrigated.

45—Ula-Splitro complex, 5 to 20 percent slopes. This complex is on mountainsides at elevations of 8,500 to 10,000 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

The Ula soil makes up about 45 percent of the complex and the Splitro soil about 40 percent. The Ula soil is in the more level areas, and the Splitro soil is on ridges and steep side slopes.

Included with this complex in mapping are areas of Leadville very cobbly sandy loam on steep foot slopes and Coutis sandy loam in swales and along drainageways. The Leadville soil makes up about 10 percent of the complex, and the Coutis soil makes up 5 percent.

The Ula soil is moderately deep and well drained. It formed in residuum from conglomeratic sandstone. Typically, the surface is covered by a layer of partially decomposed oak leaves and pine needles 1 inch thick. The surface layer is reddish gray cobbly sandy loam 5 inches thick. The subsurface layer is light reddish brown cobbly sandy loam 7 inches thick. The subsoil extends to a depth of 37 inches. The upper part is light reddish brown cobbly sandy loam 5 inches thick over reddish brown cobbly sandy clay loam 16 inches thick. The lower part is yellowish red cobbly sandy clay loam. Weathered conglomeratic sandstone is at a depth of 37 inches. The soil is neutral to a depth of 17 inches and slightly acid below that depth.

Permeability of the Ula soil is moderate, and the available water capacity is low. The effective rooting

depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

The Splitro soil is shallow and well drained. It formed in residuum from sandstone. Typically, the surface layer is brown sandy loam 4 inches thick over reddish gray channery sandy loam 4 inches thick. The substratum is reddish brown channery sandy loam. Fractured sandstone bedrock is at a depth of 16 inches. The soil is neutral.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is less than 20 inches. Surface runoff is medium, and the hazard of erosion is high to very high.

Most areas of this complex are used for livestock grazing, woodland, wildlife, and recreation.

The potential native vegetation is mainly ponderosa pine and occasional Douglas-fir and pinyon. The understory is Gambel oak, mountainmahogany, Arizona fescue, mountain muhly, and mountain brome. As the understory deteriorates, Gambel oak, snowberry, rose, bluegrass, and sedges increase and become dominant. Most areas that are well suited to livestock grazing support an open stand of ponderosa pine. Forage production of the understory varies and is dependent on the age and density of the pine stand. The best forage is produced in open stands of old growth.

This complex is suited to the limited production of ponderosa pine. The average site index is about 45, or low. About 2,000 cubic feet, or 6,200 board feet (International rule), of merchantable wood per acre are produced from an even-aged stand of 100-year-old trees. The main limitations are moderate depth to bedrock and the erosion hazard. The low water holding capacity of the soils could also influence seedling survival.

Ordinarily, the surface would be sufficiently broken up during harvest to assure site regeneration. Logging roads and skid trails should be carefully located to minimize erosion. To stabilize grades and cut and fill slopes and keep soil losses to a minimum, waterbar and reseed roads. Chisel or otherwise break up the roads to prepare an adequate seedbed, and broadcast the seed late in fall to assure adequate moisture to establish seedlings the next spring. Suitable seeding mixtures contain Manchar smooth brome, orchardgrass, and intermediate or pubescent wheatgrasses. Pine seedlings suitable for transplanting may also be planted in these areas, although cobblestones in the soil may interfere with the use of tree spades.

This complex is suited to limited use as homesites or for other urban developments. Limiting features include slope and depth to rock. Special sewage systems, foundation designs, and road locations may be needed.

This complex is in capability subclass VIe, nonirrigated.

46—Venable loam, 1 to 4 percent slopes. This is a deep, poorly drained soil on low terraces. It formed in alluvium. Elevation is 7,700 to 9,000 feet. The average annual precipitation is 14 to 23 inches, the average annual air temperature is 38 to 44 degrees F, and the frost-free season is 40 to 75 days.

Typically, the surface layer is very dark gray loam 23 inches thick. The next layer is mottled, very dark gray loam 21 inches thick. The substratum is mottled, light brownish gray loam to a depth of 60 inches or more. The soil is neutral.

Included with this soil in mapping, and making up about 10 percent of the map unit, are areas of Lamphier loam on the more sloping parts of the landscape. Also included are areas of Becks gravelly loam along stream channels that make up about 5 percent of the unit.

Permeability of this Venable soil is moderate, and the available water capacity is high. The effective rooting depth is somewhat limited by a seasonally high water table within 1 to 2.5 feet of the surface. Surface runoff is slow, and the hazard of erosion is slight. The soil is subject to occasional flooding of short duration.

Most of the acreage is used for irrigated hay and pasture (fig. 11). Mixtures of brome, orchardgrass, intermediate wheatgrass, and timothy are commonly grown.

Where this soil is irrigated, the proper use of water and maintenance of fertility are the main management concerns. Flooding from contour ditches is the most common method of irrigation. Border, corrugation, and sprinkler irrigation are also suitable methods. The land needs to be level and irrigation water managed to obtain uniform distribution of water and prevent losses of tail water. Land leveling is limited by wetness. Where outlets can be established, drainage systems can be used to reduce wetness in the root zone. Applications of manure and commercial fertilizer containing nitrogen and phosphorus help maintain soil fertility. With good management this soil is capable of producing 5 tons of grass hay per irrigated acre.

The potential native vegetation is mainly tufted hairgrass, redtop, and Nebraska sedge. As the range deteriorates, bluegrass, iris, Baltic rush, ovalhead sedge, willows, and shrubby cinquefoil increase. Renovating, use of a planned grazing system, and cross fencing help to prevent range deterioration and promote the production of the more desirable plants. In renovation, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are reed canarygrass, timothy, and Garrison creeping foxtail.

This soil is poorly suited to use as homesites. The major limiting features are a high ground water table and flooding.

This soil is in capability subclasses Vw, nonirrigated, and Vw, irrigated.

47—Venable cobbly clay loam, 3 to 10 percent slopes. This is a deep, poorly drained soil on foot slopes and in drainageways of high mountain valleys. It formed in alluvium and colluvium. Elevation is 9,400 to 10,400 feet. The average annual precipitation is 18 to 23 inches, the average annual air temperature is 38 to 42 degrees F, and the frost-free season is 40 to 60 days.

Typically, there is a 1 inch layer of peat on the surface. The surface layer is very dark gray cobbly clay loam 17 inches thick. The substratum is pinkish gray gravelly sandy clay loam in the upper 13 inches and light brown gravelly clay loam to a depth of 60 inches or more. The substratum is gleyed and mottled. The soil is neutral.

Included with this soil in mapping are areas of Lamphier loam in steeper parts of the landscape and Alvarado very cobbly sandy loam on small mounds. The Lamphier soil makes up about 10 percent of the map unit, and the Alvarado soil makes up 5 percent.

Permeability of this Venable soil is moderate, and the available water capacity is moderate. The effective rooting depth is limited by a water table at a depth of 1.5 to 3 feet. Surface runoff is medium, and the hazard of erosion is high to very high.

Most areas are used as rangeland.

The potential native vegetation is mainly tufted hairgrass, Nebraska sedge, and alpine timothy. As the range deteriorates, ovalhead sedge, Baltic rush, cinquefoil, and willows increase. Renovating, using a planned grazing system, and brush control help to prevent range deterioration and promote the production of the more desirable plants. Seeding is generally not advisable on this soil because of the limited growing season, wet soil condition, and the difficulty of preparing an adequate seedbed.

This soil is poorly suited to use as homesites. The main limitation is the high water table. Low strength and potential frost action are the main limitations for roads.

This soil is in capability subclass Vw, nonirrigated.

48—Wichup peat, 1 to 3 percent slopes. This is a deep, poorly drained soil on low terraces and in swales and drainageways. It formed in alluvium. Elevation is 7,700 to 8,400 feet. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 55 to 75 days.

Typically, the surface layer is covered by a layer of dark grayish brown peat 4 inches thick and very dark gray muck 5 inches thick. The surface layer is very dark gray sandy loam 13 inches thick. The subsoil extends to a depth of 37 inches. It is mottled, very dark gray loam 11 inches thick over mottled, gray loam 4 inches thick over mottled, very pale brown fine sandy loam 9 inches thick. The substratum is reddish brown sandy loam to a depth of 60 inches or more. The soil is moderately alkaline and calcareous in the peat layer, neutral to a depth of 24 inches, and mildly alkaline below that depth.

Included with this soil in mapping and making up about 20 percent of the unit, are areas of Venable loam on the more sloping terrain. Also included, and making up about 5 percent of the unit, are areas of Becks gravelly loam along stream channels.

Permeability of this Wichup soil is moderate, and the available water capacity is high. The effective rooting depth is somewhat limited by a seasonally high water table at 0.5 to 2.5 feet. Surface runoff is slow, and the hazard of erosion is slight. The soil is subject to frequent flooding of short duration.

Most of the acreage is used for irrigated hayland and pasture (fig. 12). Mixtures of brome, orchardgrass, intermediate wheatgrass, and timothy are commonly grown. Irrigation is limited to areas where the water table is sufficiently deep to prevent excessive wetness in the root zone.

Where this soil is irrigated, the proper use of water and maintenance of fertility are the main management concerns. Flooding from contour ditches is the most common method of irrigation. Borders and sprinklers are also suitable irrigation methods. Intensive management of irrigation water is necessary for the efficient use and uniform distribution of water. Light applications prevent excessive wetness in the root zone. In some places drainage systems can be used to lower the water table. Applications of nitrogen and phosphorus help maintain soil fertility. With good management this soil is capable of producing 4 tons of grass hay per irrigated acre.

The potential native vegetation is mainly tufted hairgrass, redtop, and sedges. As the range deteriorates, bluegrass, iris, willows, Baltic rush, ovalhead sedge, and cinquefoil increase. Renovating, the use of a planned grazing system, and cross fencing help to prevent range deterioration and promote the production of the more desirable plants. In renovating, seed should be drilled into a well prepared, firm, weed-free seedbed. Suitable grasses for seeding are Reed canarygrass, timothy, and Garrison's creeping foxtail.

This soil is poorly suited to use as homesites. Limiting features are wetness and flooding.

This soil is in capability subclasses Vw, nonirrigated, and Vw, irrigated.

49—Wix sandy loam, 3 to 25 percent slopes. This is a moderately deep, well drained soil on hilltops and mountainsides. It formed in residuum from granite. Elevation is 8,700 to 9,400 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is 40 to 44 degrees F, and the frost-free season is 40 to 60 days.

Typically, the surface is covered by a layer 1 inch thick of partially decomposed needles, twigs, and leaves. The surface layer is gray sandy loam 5 inches thick. The subsurface layer is pale brown sandy loam 3 inches thick. The subsoil extends to a depth of 22 inches. It is brown sandy clay loam in the upper 9 inches and pale brown sandy clay loam in the lower 5 inches. The substratum is light yellowish brown gravelly sandy loam 8 inches thick. Decomposed granite is at a depth of 30 inches. The soil is slightly acid to 5 inches and neutral below that depth.

Included with this soil in mapping are areas of Coutis sandy loam on foot slopes and along drainageways and

Figure 11.—Irrigated grass hay in windrow. The soil is Venable loam, 1 to 4 percent slopes.

Figure 12.—Wichup peat, 1 to 3 percent slopes, showing hummocky surface characteristic of very wet pastures.

Rock outcrop along ridgetops. The Coutis soil makes up about 10 percent of the map unit, and the Rock outcrop is 5 percent.

Permeability of this Wix soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the hazard of erosion is high to very high.

Most areas are used for woodland, wildlife habitat, limited grazing, and recreation.

The potential native vegetation is ponderosa pine and occasional Douglas-fir and pinyon trees. The understory is Gambel oak, mountainmahogany, snowberry, kinnikinnick, Arizona fescue, mountain muhly, and pine dropseed.

Most areas support an open stand of ponderosa pine and are well suited to livestock grazing. As the understory deteriorates, Gambel oak, snowberry, bluegrass, and sedges increase. Forage production is variable and depends on the age and density of the pine stand, but it is about 300 pounds per acre in normal years.

This soil is suited to the limited production of ponderosa pine. The average site index is about 45, or low. About 2,000 cubic feet, or 6,200 broad feet (International rule), can be produced per acre from a fully-stocked, managed stand of 100-year-old trees.

Ordinarily the surface would be sufficiently broken up during harvest to insure site regeneration, although the low available water capacity may affect seedling survival. Landings, skid trails, and logging roads should be located carefully. To stabilize grades and keep soil losses to a minimum, waterbar and reseed roads after harvest. Chisel or otherwise break up roads to prepare an adequate seedbed, and broadcast the seed late in November to assure adequate soil moisture the next spring. Suitable seeding mixtures include Machar smooth brome, orchardgrass, intermediate or pubescent wheatgrass, and yellow sweetclover.

The main limitations to homesite development are slope and depth to bedrock. Depth to rock limits the number of sites that can be used for conventional septic tank absorption fields—a concentration may cause sewage effluent to surface downslope. Community sewage systems are needed in areas of high population density. Although deep excavation may be difficult, bedrock over most of the area can be dug 1 to 3 feet with backhoe equipment.

This soil is in capability subclass VIe, nonirrigated.

50—Woodhall-Rogert extremely cobbly sandy loams, 5 to 20 percent slopes. This complex is on hills and ridges. Elevation is 7,500 to 10,000 feet. The average annual precipitation is 16 to 23 inches, the average annual air temperature is 38 to 44 degrees F, and the frost-free season is 40 to 70 days.

The Woodhall soil makes up about 50 percent of this complex, and the Rogert makes up about 40 percent. The Woodhall soil is in the more nearly level and concave areas, and the Rogert soil is in the steeper areas and on ridges.

Included with this complex in mapping are areas of Lamphier loam on foot slopes and in drainageways and Rock outcrop on ridges. The inclusions each make up about 5 percent of the complex.

The Woodhall soil is moderately deep and well drained. It formed in residuum and colluvium from granite. Typically, the surface layer is dark grayish brown extremely cobbly sandy loam 6 inches thick. The subsoil extends to a depth of 28 inches. It is dark grayish brown extremely cobbly sandy loam in the upper 4 inches and light brown very cobbly clay loam in the lower 18 inches. Granite bedrock is at a depth of 28 inches. The soil is slightly acid.

Permeability of this Woodhall soil is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of erosion is slight.

The Rogert soil is shallow and well drained. It formed in residuum from igneous rock, primarily granite. Typically, the surface layer is grayish brown extremely cobbly sandy loam 10 inches thick. The substratum is brown extremely gravelly sandy loam 5 inches thick. Granite bedrock is at a depth of 15 inches. The soil is slightly acid.

Permeability of this Rogert soil is moderately rapid, and the available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is rapid, and the hazard of erosion is slight.

Most of this complex is used as rangeland.

The potential native vegetation is mainly Arizona fescue, mountain muhly, pine dropseed, and mountainmahogany. As the range deteriorates, blue grama, fringed sagebrush, slimstem muhly, and rabbitbrush increase. The use of a planned grazing system, cross fencing, and livestock water developments helps to prevent range deterioration and promotes the production of the more desirable plants. Seeding on this site is limited to broadcasting. Suitable grasses for seeding are intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, and Arizona fescue.

The main limitation to use of the complex as homesites is depth to rock. Rogert soil is shallow to granite and especially difficult to excavate. The less sloping areas of Woodhall soils are more favorable sites, but moderate depth to rock and rock fragments make excavation somewhat difficult. Septic tank absorption fields will not function properly over most of the area. Depth to rock limits the amount of effluent that the Woodhall soil can adequately filter and precludes the use of Rogert soils for absorption fields.

This complex is in capability subclass VIIs, nonirrigated.

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 hay 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.

hay and pasture

The very short frost-free season limits cropping. Grass hay is the only commercial crop harvested in the survey area. Nearly all of the irrigated soils are used for pasture or hay. Where fields in permanent grass for hay or pasture are renovated or plowed, the soils are often seeded to oats or barley. This gives the sod time to decompose, and the soil surface can be smoothed before reseeding.

Fertilizers, especially nitrogen and phosphate, are needed for high-producing meadows and pasture. Nitrogen can be used every year or during years of extra moisture. Phosphate generally is applied during renovation periods or before seeding.

The most successful plantings for pasture or hay are made on well-prepared, firmly packed soil. If water is available, seeding in August and September helps deter weed growth and shortens the time for plant establishment. Where water for fall irrigation is not available, seeding can be done in the spring. Phosphate, especially needed for clover or alfalfa, should be applied during seedbed preparation or prior to seeding.

Nitrogen can be applied after the grass is up. It should also be applied annually to maintain plant vigor and composition throughout the life of the plant. If an old stand of pasture or hay has been plowed up, growing oats or barley for 1 or 2 years allows for control of undesirable grasses and weeds as well as producing a crop. The soil surface can be smoothed to facilitate the control of irrigation water. Good, clean stubble makes an almost ideal seedbed that generally requires no special treatment.

Smooth brome, meadow brome, Garrison creeping foxtail, meadow foxtail, reed canarygrass, intermediate wheatgrass, timothy, meadow fescue, tall fescue, and orchardgrass are adapted grasses to seed for pasture or hay. Alfalfa, cicer milk vetch, red clover, alsike clover, and Ladino clover are productive legumes that are adapted to the area. Drilling the seed with a grass or grain drill at a depth of about 1/2 inch produces a better stand.

Grass and grass-legume mixtures for pasture require proper use and management for good production. Stubble or leaf height generally is used to decide when a pasture is ready for use or when it is time to stop or rotate use. Pasture should have at least an 8-inch growth before grazing starts, and a 4-inch stubble should be left at all times to help maintain healthy, productive plants and reduce thinning and winterkill. A 4-inch stubble helps to minimize erosion and to spread irrigation water. Dragging, smoothing, renovation, and overseeding are used to maintain smooth pastures and meadows and good plant composition.

Irrigation water management entails irrigating without excessive erosion according to crop needs and the soil's ability to receive and store water. Pasture and hayland generally are irrigated by corrugations (small furrows) or by controlled flooding from gradient laterals (contour ditches) at intervals down the slope.

For nearly level, more uniform slopes, border irrigation is one of the more efficient methods of applying irrigation water. The water is flooded between small dikes across the field. This method requires a relatively large head of water, depending on the width and length of the borders and the water intake rate of the soil.

Any type of "on-off" irrigation is superior to the continuous irrigation practiced on some meadow soils. The soil then has a chance to aerate and warm up, and this encourages the growth of better grasses. With proper irrigation methods and resultant better plant composition, the pasture and meadows will respond to fertilizer and proper grazing use and will become consistently more productive.

Leveling or land smoothing, weed control, irrigation pipelines, checks, drops, turnouts, and diversions may be needed or desirable on any of the irrigated soils. Additional information on management of soils for hay and pasture and the estimated potential yields for hay are given in the detailed map unit description for each soil that is used for hay production.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*7*). 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.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

Frank Parrill, area range conservationist, Soil Conservation Service, assisted in preparing this section.

About 55 percent of the Custer County Area is rangeland, and the average ranch is about 2,000 acres (*9*). More than three-fourths of the farm income is derived from livestock, principally cattle. Cow-calf-yearling operations are dominant throughout the area.

The relationship between rangeland and hayland is significant in the agricultural economy of the Wet Mountain Valley. Grass hay is used to supplement range forage production in spring and is commonly pastured after cutting in fall. Several ranches ship cattle out of the valley to lower elevations during winter months to reduce feed costs.

Soils strongly influence the natural vegetation. Many of the soils in valley bottoms are poorly drained and highly organic. These soils support water-loving plants such as sedges and rushes, and production is high. The east side and north end of the Wet Mountain Valley are dominated by somewhat sandy calcareous soils. Needleandthread is the dominant native grass on these sites. Soils on the west side of the valley and high parks to the south along the Promontory Divide are commonly free of lime and very cobbly. Arizona fescue dominates these sites. Production on these soils is slightly higher than on the calcareous soils to the east and north.

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.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperature 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 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 in water resources

Proper grazing management is the major concern of rangeland conservation. Grazing is controlled so that the kinds and amounts of plants that make up the potential plant community are reestablished and maintained. To achieve this, 50 percent of the season's growth of selected key species should remain at the end of the growing season.

Deferred grazing or the application of a planned grazing system favors the improvement in condition of a range site. Deferment is the postponement of grazing during any part or all of the growing season of key forage plants. Deferment should be rotated among all pastures to benefit an entire range unit. A well planned and applied grazing system allows for more even use of all native forage plants. Used on a rotation basis, it allows key plants to put on growth prior to being grazed, in order to mature and to develop mature seed.

Fencing, properly locating watering areas, and distributing salt blocks are important in obtaining more uniform distribution of grazing. Furrowing, chiseling, or pitting are mechanical treatments designed to capture runoff water, improve water intake, prevent erosion, and speed recovery of vegetation. These practices are effective in areas of poor and fair range condition, primarily on the Mountain Loam and Loamy Park range sites.

Range seeding may be necessary to improve some badly depleted rangelands. Seedings can be made in conjunction with range pitting, or the seed can be planted into well prepared seedbeds. The best time for seeding in the survey area is mid-summer (end of June to the first of July). Brush control is beneficial where competitive shrubs have increased to exceed the amount the make up in the potential vegetation.

Sound range management based on soil survey information and rangeland inventories can result in increased productivity of the rangeland in the area.

woodland management and productivity

Woodland occupies about 23 percent of the Custer County Area. It is adjacent to the San Isabel National Forest on the west side of the Wet Mountain Valley, in the Wet Mountains along the east side of the valley, and in Grape Creek Canyon below the DeWeese Reservoir. Noncommercial stands of pinyon and one-seed juniper make up 3 percent of the woodland. They are on breaks

in the southern part of the county and on shallow, granite-derived soils near the Fremont County line.

Much of the rest of the woodland is considered to be of low commercial value. The form, shape, and growth rate of the trees are such that intensive management to produce wood crops is not practical. Long term investments in practices such as thinning are not financially sound because of the low productivity of the woodland and high interest rates. Any management of forest stands in this area should be self-sustaining. The best fiber is produced on Leadville, Larand, and Ula soils.

Logging in the early days of settlement had a significant influence on the composition and age structure of stands in the Custer County Area. Timber was harvested long before the establishment of the San Isabel National Forest in 1907. The first sawmill arrived in the early 1870's; the first large portable sawmill in 1890. From 1872 through the early 1880's, development of the Hardscrabble Mining District increased the demand for wood products. About 1900 the building of the railroad from Texas Creek to Westcliffe brought a demand for ties. Demand for these products resulted in woodland with an imbalance of age classes. There was an excess of large overmature sawtimber and sapling-size material, neither of which is valuable for props or ties. Only four sawmills are currently operating in the Area.

Many forest insects and plant diseases are in the survey area. Spruce budworn, dwarfmistletoes, and mountain pine beetle are among the most common. The western spruce budworm is a defoliator of Engelmann Spruce, subalpine and white firs, and Douglas-fir. Dwarfmistletoes are serious parasites on lodgepole pine and ponderosa pine in the Custer County Area. The dwarfmistletoe does not kill the tree outright, but over many years may so deform and weaken the tree that it succumbs to some other forest pest. Perhaps the most devastating of the forest insects in the county is the mountain pine beetle. Infesting stands of overmature and overcrowded trees, this insect can kill large acreages of lodgepole or ponderosa pine in a single season. Intensive forest management can significantly reduce populations of the beetle from the current epidemic state.

The native forest cover can be divided into several forest-cover types. The forest-cover types in the Custer County Area are classified as pinyon-juniper, ponderosa pine, Douglas-fir, aspen, and spruce-fir.

The pinyon-juniper type covers 3 percent of the survey area. It is at elevations of 8,400 to 9,100 feet on steep sandstone breaks in the southern end of the survey area and at 7,400 and 8,600 feet on granite hills in the northern end of the survey area near the Fremont County line. Pinyon generally predominates on the moister sites, juniper on the drier. This forest type is utilized for firewood, fence posts, and Christmas trees. It is found in the Rogert-Woodhall-Boyle general soil map unit.

The ponderosa-pine type covers 11 percent of the survey area and is the most extensive forest-cover type. It occurs between 8,500 and 10,000 feet in elevation. Because most stands were heavily logged in the early days of settlement for sawtimber, props, and ties, they now have an excess of pole-size or overmature, large sawtimber. The principal management need is protection from fire, insects, and disease. Stands of ponderosa pine are capable of producing sawtimber, mine props, railroad ties, and fence posts. The older, larger trees should be harvested to provide maximum protection from the mountain pine beetle. The better, younger stands may need commercial thinning to produce sufficient corral poles and fence posts. This forest cover type is in the Redfeather-Wix and Leadville-Troutville-Ula general soil map units.

The Douglas-fir type covers 6 percent of the survey area. This type is normally associated with large amounts of white fir and ponderosa pine. It is generally on steep north-facing slopes above an elevation of about 8,500 feet. Douglas-fir is the most valuable tree in the survey area. Good quality construction lumber is the dominant product. Since most Douglas-fir sites in the survey area are of low quality, they often receive incidental or opportunistic management. Sawtimber may be harvested, but it is unlikely that a subsequent crop could be harvested within 150 years. Better management opportunities exist where there is fire protection and limited Christmas tree production. This forest cover type is in the Leadville-Troutville and Granile-Peeler-Lake Creek general soil map units.

The aspen forest-cover type covers 2 percent of the survey area. Generally it occurs on foot slopes and in drainways at elevations of 8,000 to 10,000 feet. It is dominated by nearly pure stands of aspen. This type is used mainly for seasonal grazing and wildlife habitat. It is in the Leadville-Troutville and Granile-Peeler-Lake Creek general soil map units (fig. 13).

The spruce-fir type covers less than 1 percent of the survey area and is the smallest forest-cover type in the survey area. It is dominated by Engelmann spruce and subalpine fir with some aspen and lodgepole pine. It occupies mountain slopes at elevations of 9,000 to 11,000 feet in the eastern part of the survey area. Engelmann spruce is cut mostly for sawtimber. This type is in the Granile-Peeler-Lake Creek general soil map unit.

Professional help in sale, layout, appraisal, and forest land planning is available through the local office of the Colorado State Forest Service.

Site index is given in each map unit description of a soil that produces woodland.

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. Important trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected

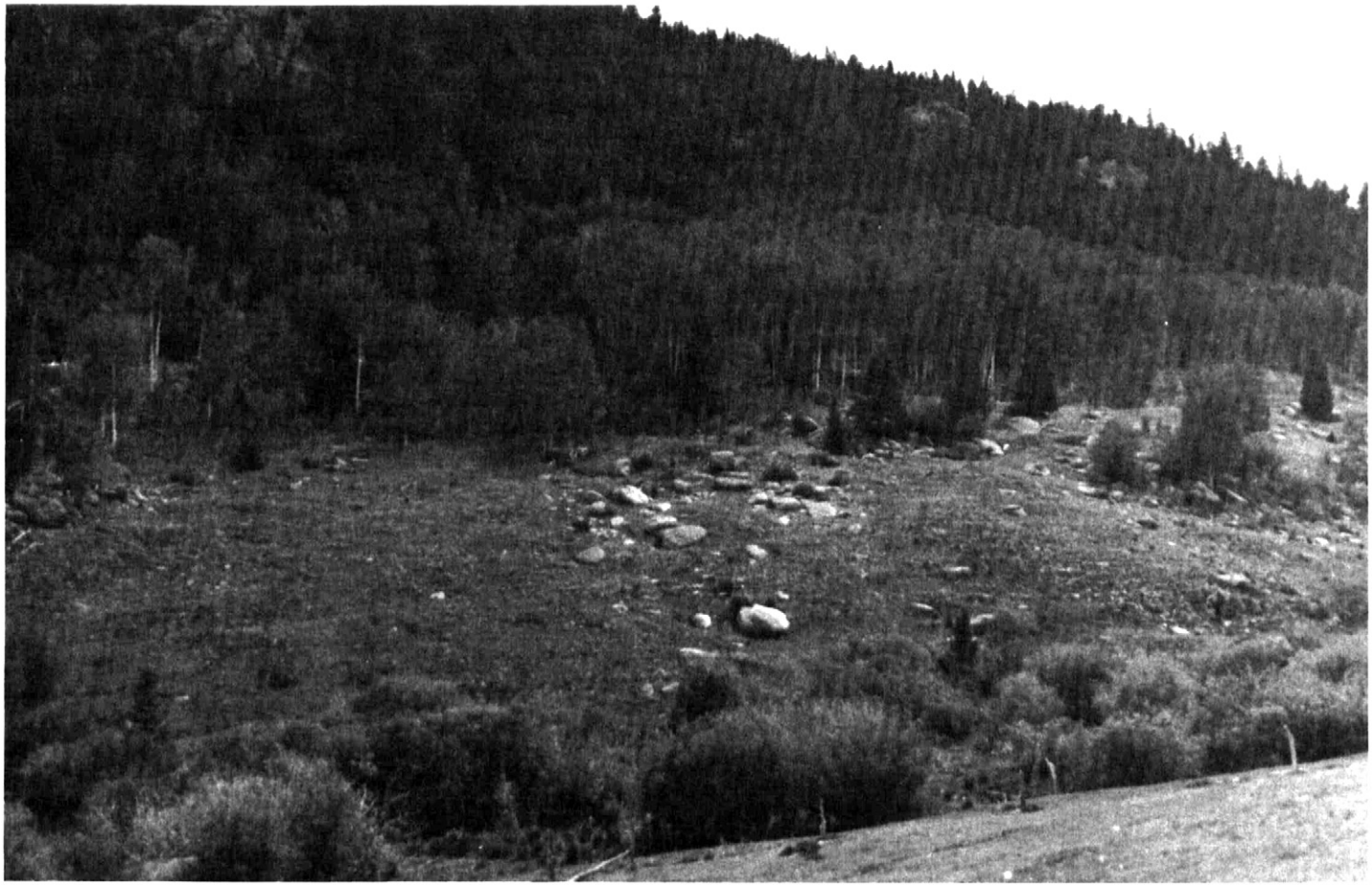


Figure 13.—Aspen woodland on Northwater very stony loam, 20 to 45 percent slopes, on far foot slope. Douglas-fir on steep mountainside on Lake Creek-Rock outcrop complex, 35 to 65 percent slopes.

on the basis of growth rate, quality, value, and marketability.

windbreaks and environmental plantings

Windbeaks are established to protect livestock, buildings, and yards from winds and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low-and high-growing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well-prepared site and maintained in good condition can insure a high degree of plant survival.

A cool, short growing season, limited moisture, and areas with high water tables make the establishment of windbreaks difficult in the Custer County Area. The selection of adapted species, site selection and preparation, timely cultivation, and supplemental water in the early stages of growth can be combined to make windbreak plantings successful.

The short growing season limits the selection of plants that will do well in the Wet Mountain Valley. Plants that are well suited to the upland sites of the Norriston-Gelkie-Libeg and Feltonia-Coutis-Silvercliff general soil map units are Rocky Mountain juniper, lilac, mountain ash, ponderosa pine, skunkbush, sumac, and rose. Soils of the Venable-Alvarado map unit are on lowlands and have a high water table over much of the area. Engelmann spruce, Colorado blue spruce, and golden willow are suited to these wetter soils.

Planting problems may occur on the generally rocky

soils of the Norriston-Gelkie-Libeg map unit. Hand planting is generally the rule, although trees may be machine planted on the Gelkie soils. Supplemental water applied on dry sites through the early years of establishing a windbreak help seedling survival. Livestock must be excluded to preclude trampling or browsing of the planted seedlings.

The windbreak must be located carefully. For information on specific soils, refer to the map unit description. Additional information on planning windbreaks and screens and care of trees can be obtained from local offices of the Soil Conservation Service, the Colorado State Forest Service, or from nurserymen.

recreation

Outdoor recreation in the survey area includes hunting, fishing, hiking, camping, and skiing. Tourism is particularly important in summer, when many people come from the plains areas of Colorado and adjoining states to enjoy the cool climate and mountain scenery.

The DeWeese Reservoir, with its public camp and picnic ground, attracts many campers, picnickers, and fishermen. Trout fishing opportunities abound along the Grape, South Hardscrabble, Texas, and Bigelow Creeks.

Deer and elk are mainly hunted in high mountain parks and forested areas adjacent to the San Isabel National Forest. Antelope tend to stay in grassland areas adjacent to the irrigated valley.

Several campgrounds are adjacent to the survey area within the San Isabel National Forest. The campground at Lake DeWeese is the main camp and picnic area within the survey area.

The soils of the survey area are rated in table 6 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 6, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 6 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

wildlife habitat

Furbearers such as beaver and muskrat attracted trappers to the Wet Mountain Valley. The mule deer, elk, and antelope which can still be seen in the valley were important sources of food for early inhabitants, both Indians and settlers.

Over the years the beaver ponds and their associated vegetation disappeared. The land typically was converted from wetland habitat to irrigated hayland. The wetlands supported waterfowl and furnished winter cover for deer and elk and other wildlife totally or partially dependent on this kind of habitat. Wildlife, especially deer, still utilize some of the vegetation of the haylands. Waterfowl use areas adjacent to wetland or water for nesting cover.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 7, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, smooth brome, yellow clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are sunflower, prairie junegrass, needleandthread, Arizona fescue, wheatgrasses, and gramas.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, Engelmann spruce, white fir, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, reed canarygrass, saltgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include blue grouse, woodpeckers, squirrels, fox, raccoon, deer, elk, and black bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, jackrabbit, mule deer, meadowlark, and lark bunting.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are

given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, 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.

building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for dwellings with basements and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil

after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 11 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a

depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 12 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 13 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.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields (fig. 14), 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

Figure 14.—Bags of bentonite, used to seal sewage lagoon, on Feltonia sandy loam, 2 to 6 percent slopes, where substratum permeability is moderately rapid to very rapid.

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.

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.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 13, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 14 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 14 gives the frequency of flooding and the time of year when flooding is most likely.

Frequency and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 14 are the depth to the seasonal high water table and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 14.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). 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 15, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

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 Cryoborolls (*Cryo*, meaning cold summer, plus *boroll*, the suborder of the Mollisols that have a cool temperature regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aquic* identifies the subgroup that is wetter than typical of the great group. An example is Aquic Cryoborolls.

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 loamy-skeletal, mixed, Aquic Cryoborolls.

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 (*6*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*8*). 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."

Alvarado series

The Alvarado series consists of deep, somewhat poorly drained soils on fans and low terraces. These soils formed in alluvium and outwash. Slope is 2 to 5 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Alvarado very cobbly sandy loam, 2 to 5 percent slopes, 2,640 feet south and 1,140 feet west of the northeast corner of sec. 8, T. 22 S., R. 73 W.

A11—0 to 7 inches; brown (7.5YR 5/2) very cobbly sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable,

nonsticky and nonplastic; 20 percent gravel, 15 percent cobbles, 5 percent stones; slightly acid; clear smooth boundary.

A12—7 to 12 inches; dark brown (10YR 4/3) very cobbly sandy loam, dark brown (10YR 3/3) moist; weak very fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; 20 percent gravel, 15 percent cobbles, 5 percent stones; slightly acid; clear smooth boundary.

B2t—12 to 31 inches; brown (7.5YR 5/4) very cobbly sandy clay loam, reddish brown (5YR 4/4) moist; common medium distinct yellowish red (5YR 5/8) and common fine prominent black (N 21) mottles; moderate medium subangular blocky structure; very hard, friable, slightly sticky and plastic; common thin clay films on faces of peds; 25 percent gravel, 15 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.

B3t—31 to 41 inches; brown (7.5YR 5/4) very cobbly sandy clay loam, reddish brown (5YR 4/3) moist; common medium black (N 2/) mottles; weak fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few thin clay films on peds; 25 percent gravel, 15 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.

C—41 to 60 inches; light brown (7.5YR 6/4) very cobbly sandy loam, reddish brown (5YR 4/3) moist; common medium distinct yellowish red (5YR 5/6) and common fine prominent black (N 2/) mottles; massive; very hard, friable, slightly sticky and slightly plastic; common large calcareous spots on bottoms of cobbles; 20 percent gravel, 15 percent cobbles, 5 percent stones; mildly alkaline.

In most years, a seasonal water table is at a depth of 2 to 4 feet between March 1 and June 30 and is below 4 feet or absent the remainder of the year. Rock fragments in the profile range from 35 to 75 percent. Depth to any calcareous material is 30 inches or more.

The A horizon is reddish gray, dark gray, or brown. The B2t horizon is reddish brown, reddish gray, brown, light brown, or yellowish brown. Clay content of the B2t horizon is 20 to 30 percent.

Becks series

The Becks series consists of deep, somewhat poorly drained soils on low terraces and fans. These soils formed in alluvium. Slope is 1 to 5 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Becks gravelly loam, 1 to 5 percent slopes, 825 feet west of the northeast corner of sec. 35, T. 22 S., R. 73 W.

A11—0 to 11 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 20 percent gravel, 5 percent cobbles; calcareous; mildly alkaline; clear smooth boundary.

A112—11 to 15 inches; pale brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; strong medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 20 percent gravel, 10 percent cobbles; gravel and cobbles are lime coated on the bottom; calcareous; mildly alkaline; gradual boundary.

B2—15 to 19 inches; pinkish gray (7.5YR 6/2) very gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate very fine subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few thin clay films on faces of peds; 30 percent gravel, 15 percent cobbles; gravel and cobbles are lime coated on the bottom; calcareous; mildly alkaline; clear smooth boundary.

C1g—19 to 37 inches; pinkish gray (7.5YR 6/2) extremely gravelly loamy sand, dark brown (7.5YR 4/2) moist; few fine distinct black (10YR 2/1) and common medium prominent strong brown (10YR 5/8) mottles; single grained; loose, nonsticky and nonplastic; 50 percent gravel, 15 percent cobbles; calcareous; mildly alkaline; gradual wavy boundary.

C2—37 to 60 inches; light brown (7.5YR 6/4) extremely gravelly sand, dark brown (7.5YR 4/4) moist; many large prominent (10YR 2/1) mottles on gravel; single grained; loose, nonsticky and nonplastic; 50 percent gravel, 20 percent cobbles; calcareous; mildly alkaline.

These soils are calcareous throughout. The 10- to 40-inch control section is 35 to 75 percent rock fragments. Rock fragments are rounded and usually less than 6 inches in diameter. Hue is 2.5YR to 7.5YR throughout the profile. Between depths of 10 and 40 inches the profile averages less than 18 percent clay.

The A horizon is brown, light brown, grayish brown, or light yellowish brown. The B2 horizon is pinkish gray, brown, light brownish gray, or grayish brown.

Boyle series

The Boyle series consists of shallow, well drained soils on hills, ridges, and mountainsides. These soils formed in residuum from igneous rock, mainly granite. Slope is 4 to 55 percent. The average annual precipitation is 12 to 15 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Boyle very gravelly sandy loam, warm, 4 to 25 percent slopes, 2,400 feet west and 2,200 feet south of the northeast corner of sec. 3, T. 21 S., R. 71 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; moderate very fine granular structure; slightly

hard, very friable, slightly sticky and nonplastic; 35 percent gravel, 15 percent cobbles; neutral; clear wavy boundary.
B2t—8 to 14 inches; brown (7.5YR 5/2) extremely gravelly sandy clay loam, brown (7.5YR 4/4) moist; moderate very fine subangular blocky structure; very hard, very friable, sticky and slightly plastic; 65 percent gravel, 20 percent cobbles; neutral; abrupt irregular boundary.
Cr—14 to 22 inches; soft, weathered granite bedrock becoming more resistant with depth.
R—22 inches; hard granite bedrock.

The depth to soft, weathered bedrock is 10 to 20 inches, and thickness of the mollic epipedon is 7 to 12 inches. Rock fragments range from 35 to 80 percent by volume and are mainly gravel or cobbles. The soil is slightly acid or neutral. Secondary calcium carbonate is deposited along fractures in the bedrock in some pedons. Some pedons have a thin C horizon. Hue of the profile is 10YR or 7.5YR.

The A1 horizon is grayish brown, dark grayish brown, or brown. It is very gravelly sandy loam or very cobbly sandy loam. The B2t horizon is very gravelly sandy clay loam, extremely gravelly sandy clay loam, or very cobbly sandy clay loam.

Buena Vista series

The Buena Vista series consists of moderately deep, well drained soils on low hills. These soils formed in residuum from trachyte. Slope is 3 to 20 percent. The average annual precipitation is 14 to 16 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Buena Vista sandy loam, 3 to 20 percent slopes, 2,400 feet east and 500 feet south of the northwest corner of sec. 16, T. 22 S., R. 72 W.

A11—0 to 10 inches; brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; clear wavy boundary.
A12—10 to 15 inches; dark grayish brown (10YR 4/2) extremely channery sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and slightly plastic; 80 percent channery rock fragments; neutral; clear wavy boundary.
B2t—15 to 19 inches; brown (10YR 5/3) extremely channery sandy loam, dark brown (10YR 4/3) moist; weak very fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 80 percent channery rock fragments; neutral; clear wavy boundary.
B3ca—19 to 26 inches; light yellowish brown (10YR 6/4) extremely flaggy sandy loam, yellowish brown (10YR 5/4) moist; weak fine granular structure; hard, very friable, slightly sticky and slightly plastic; 40 percent channery and 40 percent flaggy rock fragments; calcareous on rock faces; mildly alkaline; clear wavy boundary.
Cca—26 to 30; light yellowish brown (10YR 6/4) extremely channery sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 90 percent channery rock fragments; calcareous; moderately alkaline; gradual wavy boundary.
R—30 inches; fractured trachyte.

Depth to bedrock is 20 to 40 inches. Depth to continuous subhorizons of visible secondary calcium carbonate is 10 to 40 inches. Hue is 2.5Y to 7.5YR.

The A horizon is brown or dark brown. The B2t horizon is brown, light yellowish brown, or yellowish brown. It averages less than 18 percent clay. The B2t horizon is neutral, mildly alkaline, or moderately alkaline.

Buffork series

The Buffork series consists of moderately deep, well drained soil on uplands and side slopes along drainageways. These soils formed in residuum from conglomeratic tuff or granite. Slope is 5 to 12 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Buffork sandy loam, warm, 5 to 12 percent slopes, 900 feet west and 600 feet north of the southeast corner of sec. 9, T. 23 S., R. 71 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; clear smooth boundary.
B1—4 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.
B2t—8 to 19 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common thin clay films on ped surfaces; neutral; gradual wavy boundary.
B3—19 to 24 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky and plastic; neutral; gradual wavy boundary.
C1—24 to 30 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, slightly sticky and plastic; lime concretions; mildly alkaline; gradual wavy boundary.

C2r—30 to 60 inches; soft, weathered conglomeratic tuff or granite.

Depth to bedrock is 20 to 40 inches. Rock fragments range from 0 to 15 percent in the B and C horizons.

The A1 horizon is grayish brown, dark grayish brown, or very dark grayish brown. The B2t horizon is brown, pale brown, grayish brown, or dark grayish brown. The C horizon is neutral or mildly alkaline.

Buffork Variant

The Buffork Variant consists of moderately deep, well drained soils on side slopes along drainageways. These soils formed in residuum from conglomeratic tuff. Slope is 20 to 40 percent. The average annual precipitation is 16 to 18 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Buffork Variant cobbly sandy loam, 20 to 40 percent slopes, 1,320 feet north and 1,700 feet west of the southeast corner of sec. 18, T. 24 S., R. 70 W.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) cobbly sandy loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; 15 percent cobbles, 10 percent gravel; neutral; abrupt smooth boundary.

B21t—2 to 5 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; 10 percent gravel; neutral; abrupt smooth boundary.

B22t—5 to 8 inches; dark grayish brown (10YR 4/2) sandy clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; clear wavy boundary.

B3t—8 to 14 inches; brown (10YR 5/3) gravelly sandy clay loam, dark brown (10YR 4/3) moist; weak fine granular structure; very hard, very friable, slightly sticky and nonplastic; 25 percent gravel; neutral; clear smooth boundary.

C1—14 to 21 inches; light gray (2.5Y 7/2) very gravelly loamy coarse sand, light brownish gray (2.5Y 6/2) moist; massive; soft, very friable, nonsticky and nonplastic; 45 percent gravel; neutral; clear irregular boundary.

C2r—21 to 60 inches; soft conglomeratic tuff.

The depth to bedrock is 20 to 40 inches.

The A horizon is dark gray, very dark gray, dark brown, or very dark brown. The B2t horizon is dark grayish brown, dark brown, brown, or very dark grayish brown. Rock fragments range from 5 to 25 percent of the horizon. The C horizon is light gray or light brownish gray. Rock fragments range from 35 to 55 percent.

The Buffork Variant in Custer County has a cobbly A horizon and a very gravelly C horizon. The Buffork soils have less than 15 percent rock fragments throughout the profile.

Coutis series

The Coutis series consists of deep, well drained soils in drainageways and on foot slopes. These soils formed in somewhat sandy colluvial and alluvial materials. Slope is 2 to 15 percent. The average annual precipitation is 14 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Coutis sandy loam, 5 to 15 percent slopes, 1,000 feet east and 1,500 feet south of the northwest corner of sec. 26, T. 24 S., R. 72 W.

A1—0 to 11 inches; dark brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) moist; moderate very fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel; slightly acid; gradual smooth boundary.

Ac—11 to 48 inches; dark brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) moist; weak coarse subangular blocky structure; hard, very friable, nonsticky and nonplastic; 10 percent gravel; neutral; clear wavy boundary.

C—48 to 60 inches; brown (7.5YR 5/4) gravelly loam, dark brown (7.5YR 4/4) moist; massive; hard, very friable, nonsticky and nonplastic; 15 percent gravel; neutral.

The mollic epipedon ranges from 16 to 48 inches in thickness. Between depths of 10 and 40 inches the texture averages sandy loam or fine sandy loam. The C horizon is gravelly loam or gravelly sandy loam.

Feltonia series

The Feltonia series consists of deep, well drained soils on terraces and fans. These soils formed in alluvium. Slope is 2 to 15 percent. The average annual precipitation is 14 to 17 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Feltonia sandy loam, 2 to 6 percent slopes, 45 feet north and 75 feet east of the southwest corner of sec. 35, T 22 S., R. 72 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; slightly hard, very friable, nonsticky and slightly plastic; mildly alkaline; clear smooth boundary.

B2—8 to 19 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; 15 percent gravel; mildly alkaline; abrupt wavy boundary.

C1ca—19 to 32 inches; light brownish gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; 30 percent gravel; calcareous; moderately alkaline; gradual irregular boundary.
IIC2ca—32 to 60 inches; white (N 8/) very gravelly sandy loam, very pale brown (10YR 7/3) moist; massive; hard, very friable, slightly sticky and slightly plastic; 30 percent gravel, 10 percent cobbles; calcareous; moderately alkaline.

Very gravelly soil material is typically at a depth of 20 to 40 inches. The 10- to 40-inch control section averages less than 35 percent rock fragments and is dominantly gravelly sandy loam. This part of the profile averages 10 to 18 percent clay. The mollic epipedon is 16 to 28 inches thick and includes the B2 horizon. The hue of the profile is commonly 10YR but ranges to 2.5Y.

The A horizon is grayish brown or dark grayish brown.

Gelkie series

The Gelkie series consists of deep, well drained soils on fans and terraces. These soils formed in alluvium. Slope is 1 to 10 percent. The average annual precipitation is 15 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Gelkie sandy loam, 1 to 10 percent slopes, about 500 feet west and 1,200 feet north of the southeast corner of sec. 25, T. 24 S., R. 71 W.

A11—0 to 6 inches; dark brown (10YR 4/2) sandy loam, dark brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; neutral; clear smooth boundary.
A12—6 to 13 inches; dark brown (10YR 4/2) sandy loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; neutral; clear smooth boundary.
B1—13 to 15 inches; brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 3/2) moist; weak very fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 5 percent gravel; neutral; abrupt wavy boundary.
B2t—15 to 28 inches; brown (7.5YR 5/4) cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; 15 percent gravel, 15 percent cobbles; neutral, abrupt irregular boundary.
B3tca—28 to 40 inches; brown (7.5YR 5/4) cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 15 percent gravel; 15 percent cobbles; calcareous in spots; moderately alkaline; clear irregular boundary.
C1ca—40 to 45 inches; pink (7.5YR 7/4) very gravelly sandy loam, light brown (7.5YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 25 percent gravel, 15 percent cobbles; calcareous; moderately alkaline; clear irregular boundary.
C2—45 to 60 inches; brown (7.5YR 5/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 25 percent gravel, 15 percent cobbles; moderately alkaline.

Rock fragments range from 5 to 35 percent above a depth of 40 inches and from 10 to 50 percent below that depth. Depth to calcareous material ranges from 20 to 30 inches. Hue of the profile is 2.5Y, 10YR, or 7.5YR.

The A horizon is brown, dark brown, gray, grayish brown, dark gray, or dark grayish brown. The B2t horizon is brown, strong brown, reddish yellow, light brown, grayish brown, yellowish brown, or pale brown. It is cobbly sandy clay loam, gravelly sandy clay loam, or sandy clay loam.

Granile series

The Granile series consists of deep, well drained soils on mountainsides. These soils formed in colluvium from granite. Slope is 25 to 50 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Granile cobbly sandy loam, from an area of Granile-Peeler complex, 25 to 50 percent slopes, 2,380 feet south and 1,700 feet east of the northwest corner of sec. 21, T. 22 S., R. 70 W.

O1—3 to 2 inches; partially decomposed needles, leaves, and twigs.
O2—2 inches to 0; decomposed forest litter.
A1—0 to 2 inches; brown (7.5YR 4/2) very cobbly sandy loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; 20 percent cobbles, 2 percent stones; neutral; clear wavy boundary.
A2—2 to 16 inches; very pale brown (10YR 7/3) very cobbly sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent gravel, 40 percent cobbles, 2 percent stones; neutral; clear wavy boundary.
B&A—16 to 19 inches; mixed brown(7.5YR 5/4) and very pale brown (10YR 7/3) very cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; 15 percent gravel, 40 percent cobbles, 2 percent stones; neutral; clear wavy boundary.
B2t—19 to 41 inches; brown (7.5YR 5/4) very cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; 10 percent gravel, 45

percent cobbles, 2 percent stones; neutral; gradual wavy boundary.
B3—41 to 51 inches; yellowish brown (10YR 5/4) very cobbly sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; 10 percent gravel, 45 percent cobbles, 2 percent stones; neutral; gradual wavy boundary.
C—51 to 60 inches; brown (10YR 5/3) very cobbly sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent gravel, 40 percent cobbles, 2 percent stones; neutral.

Depth to bedrock is more than 60 inches. The profile has hue of 2.5Y through 7.5YR.

The A2 horizon is pale brown or very pale brown. The B2t horizon is brown, yellowish brown, or olive brown.

Hoodle series

The Hoodle series consists of deep, well drained soils on terraces and fans. These soils formed in alluvium. Slope is 1 to 5 percent. The average annual precipitation is 16 to 18 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Hoodle cobbly sandy loam, 1 to 5 percent slopes, 1,600 feet south and 2,610 feet west of the northeast corner of sec. 10, T. 24 S., R. 72 W.

A1—0 to 3 inches; grayish brown (10YR 5/2) cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent gravel, 15 percent cobbles; mildly alkaline; clear smooth boundary.
B21t—3 to 12 inches; dark brown (10YR 4/3) very cobbly sandy clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, friable, sticky and plastic; few thin clay films on ped faces; 30 percent gravel, 20 percent cobbles; mildly alkaline; abrupt wavy boundary.
B22tca—12 to 17 inches; brown (7.5YR 5/4) very cobbly clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; few thin clay films on ped faces; 30 percent gravel, 20 percent cobbles; calcareous; mildly alkaline; abrupt wavy boundary.
B3ca—17 to 23 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, very friable, nonsticky and nonplastic; 30 percent gravel, 10 percent cobbles; calcareous; moderately alkaline; gradual wavy boundary.
C1ca—23 to 45 inches; white (N 8/) very gravelly loam, pinkish gray (7.5YR 7/2) moist; massive; hard, friable, slightly sticky and slightly plastic; 30 percent gravel, 10 percent cobbles; calcareous; moderately alkaline; gradual wavy boundary.
C2ca—45 to 60 inches; pinkish gray (7.5YR 7/2) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; 30 percent gravel, 5 percent cobbles; calcareous; moderately alkaline; gradual irregular boundary.

The hue of the profile is 7.5YR or 10YR.

The A1 horizon is grayish brown or dark grayish brown. The B2t horizon is brown or dark brown. It is very gravelly or very cobbly sandy clay loam or very gravelly or very cobbly clay loam. It is 35 to 50 percent rock fragments. The Cca horizon is white or pinkish gray. It is very gravelly sandy loam or very cobbly sandy loam.

Lake Creek series

The Lake Creek series consists of moderately deep, well drained soils on mountainsides. These soils formed in residuum and colluvium from granite. Slope is 35 to 65 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Lake Creek very bouldery sandy loam, from an area of Lake Creek-Rock outcrop complex, 35 to 65 percent slopes, 900 feet south and 2,300 feet west of the northeast corner of sec. 21, T. 22 S., R. 70 W.

O1—1 inch to 0; partially decomposed needles and twigs.
A1—0 to 2 inches; dark brown (10YR 3/3) very bouldery sandy loam, black (10YR 2/1) moist; moderate very fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 30 percent boulders, 20 percent stones; neutral; clear smooth boundary.
A2—2 to 15 inches; pale brown (10YR 6/3) very stony sandy loam, brown (10YR 4/3) moist; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 50 percent stones; neutral; gradual wavy boundary.
B&A—15 to 23 inches; mixed yellowish brown (10YR 5/4) and pale brown (10YR 6/3) very stony sandy loam (composite texture), brown (10YR 4/3) moist; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 15 percent gravel, 20 percent cobbles, 25 percent stones; neutral; gradual irregular boundary.
B2t—23 to 32 inches; yellowish brown (10YR 5/4) very stony sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few thin clay films on ped faces; 10 percent gravel, 20 percent cobbles, 25 percent stones; neutral; abrupt irregular boundary.
R—32 inches; hard granite.

Depth to bedrock is 20 to 40 inches. The hue of the profile is 2.5Y or 10YR.

The A2 horizon is light gray, pale brown, or light brownish gray. The B2t horizon is brown, yellowish brown, grayish brown, or light olive brown. The fine earth fraction is clay loam or sandy clay loam and ranges in clay content from 20 to 35 percent. The B2t horizon is 35 to 70 percent rock fragments.

Lamphier series

The Lamphier series consists of deep, well drained soils on foot slopes and fans and in upland drainageways. These soils formed in mixed alluvium. Slope is 4 to 20 percent. The average annual precipitation is 17 to 23 inches, and the average annual air temperature is 38 to 44 degrees F.

Typical pedon of Lamphier loam, 4 to 20 percent slopes, 1,380 feet south and 2,200 feet east of the northwest corner of sec. 21, T. 22 S., R. 70 W.

A1—0 to 14 inches; dark reddish gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and plastic; 10 percent gravel; neutral; clear wavy boundary.

AC—14 to 48 inches; dark reddish gray (5YR 4/2) clay loam, dark reddish brown (5YR 3/2) moist; massive; soft, very friable, sticky and plastic; 10 percent gravel; neutral; clear wavy boundary.

C—48 to 60 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 10 percent gravel; neutral.

The mollic epipedon is 16 to 40 inches or more thick. Rock fragments range from 0 to 15 percent throughout most of the profile. The hue of the profile is 2.5YR, 5YR, or 7.5YR.

The A horizon is reddish gray, dark reddish gray, reddish brown, brown, or dark brown. The AC horizon is weak red, reddish brown, reddish gray, dark reddish gray, brown, or dark brown. It is typically loam or light clay loam, but it ranges in clay content from 20 to 35 percent. The C horizon is weak red, reddish brown, reddish gray, dark reddish gray, brown, or dark brown.

Larand Variant

The Larand Variant consists of deep, well drained soils on mountaintops. These soils formed in colluvium from granite. Slope is 4 to 25 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Larand Variant very stony sandy loam, 4 to 25 percent slopes, about 600 feet east of the southwest corner of sec. 33, T. 22 S., R. 70 W.

O2—1 inch to 0; partially decomposed needles, leaves, and twigs.

A2—0 to 16 inches; pale brown (10YR 7/3) very stony sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 20 percent stones, 20 percent cobbles; medium acid; clear irregular boundary.

A&B—16 to 19 inches; mixed light yellowish brown (10YR 6/4) and brown (7.5Y 5/2) very stony sandy loam (composite texture), dark brown (10YR 4/3) and reddish brown (7.5YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 40 percent stones; about 30 percent of this horizon consists of nodules of sandy clay loam; medium acid; clear irregular boundary.

B2t—19 to 24 inches; brown (7.5YR 5/2) extremely stony sandy clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; very hard, friable, sticky and plastic; 15 percent gravel, 20 percent cobbles, 40 percent stones; medium acid; clear irregular boundary.

B3—24 to 31 inches; brown (7.5YR 5/2) extremely stony sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 30 percent gravel, 10 percent cobbles, 40 percent stones; medium acid; clear irregular boundary.

C—31 to 60 inches; pinkish gray (7.5YR 6/2) extremely stony loamy sand, dark brown (7.5YR 4/4) moist; single grained; loose; nonsticky and nonplastic; 30 percent gravel, 10 percent cobbles, 40 percent stones; medium acid.

Depth to the top of the B2t horizon is less than 24 inches. Rock fragments range from 35 to 75 percent throughout most of the profile.

Where there is an A1 horizon, it is gray or brown. The A2 horizon is brown, light brown, pinkish gray, or pink. The B2t horizon is gray, brown, reddish brown, or reddish yellow. It is very stony or extremely stony sandy clay loam.

The Larand Variant in Custer County is very stony or extremely stony throughout the profile. The Larand series has rock fragments mainly 1/4 inch to 10 inches in diameter.

Leadville series

The Leadville series consists of deep, well drained soils on fans and mountainsides. These soils formed in glacial outwash and till. Slope is 8 to 45 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Leadville very cobbly sandy loam, warm, 8 to 20 percent slopes, along Hermit Lake Road, about 1,500 feet north and 2,380 feet west of the southeast corner of sec. 19, T. 22 S., R. 73 W.

O1—1 inch to 0; decomposed and partially decomposed needles and twigs.

A1—0 to 1 inch; reddish gray (5YR 5/2) very cobbly sandy loam, black (5YR 2/1) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel, 40 percent cobbles, 10 percent stones; slightly acid; abrupt smooth boundary.

A2—1 to 12 inches; pinkish gray (5YR 6/2) very cobbly sandy loam, reddish gray (5YR 5/2) moist; weak very fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 30 percent cobbles, 10 percent stones; slightly acid; clear smooth boundary.

B&A—12 to 22 inches; mixed reddish brown (2.5YR 5/4) and pinkish gray (5YR 6/2) very cobbly sandy loam (composite texture), reddish brown (5/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; 10 percent gravel, 40 percent cobbles; neutral; gradual smooth boundary.

B21t—22 to 30 inches; reddish brown (2.5YR 5/4) extremely cobbly sandy clay loam, reddish brown (2.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few thin clay films on ped faces; 20 percent gravel, 35 percent cobbles, 10 percent stones; neutral; gradual smooth boundary.

B22t—30 to 40 inches; light reddish brown (2.5YR 6/4) extremely cobbly sandy clay loam, reddish brown (2.5YR 4/4) moist; weak medium subangular blocky structure parting to moderate fine subangular blocky; very hard, friable, slightly sticky and slightly plastic; few thin clay films on ped faces; 40 percent gravel, 20 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.

B3—40 to 60 inches; light pinkish gray (2.5YR 6/4) extremely gravelly sandy loam, red (2.5YR 4/6) moist; weak fine blocky structure; hard, very friable, slightly sticky and slightly plastic; few thin clay films on ped faces; 45 percent gravel, 15 percent cobbles, 5 percent stones; neutral.

Depth to bedrock is more than 60 inches. The profile is 35 to 80 percent rock fragments.

The A1 horizon has hue of 10YR to 5YR and is reddish gray, brown, or grayish brown. The A2 horizon has hue of 10YR to 5YR and is pinkish gray or light brownish gray. The B2t horizon has hue of 5YR to 10R and is reddish brown or weak red. The fine earth fraction is typically clay loam or sandy clay loam. Rock fragments range from 35 to 75 percent in the B2t horizon. The C horizon, where there is one, has hue of 5YR to 10R and is reddish brown or weak red.

Libeg series

The Libeg series consists of deep, well drained soils on fans and terraces. These soils formed primarily in glacial outwash. Slope is 5 to 20 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Libeg extremely cobbly sandy loam, 5 to 20 percent slopes, 800 feet north and 2,400 feet east of the southwest corner sec. 4, T. 46 N., R. 12 E.

A1—0 to 10 inches; brown (7.5YR 5/2) extremely cobbly sandy loam, dark brown (7.5YR 3/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; 25 percent gravel, 40 percent cobbles, 10 percent stones; neutral; clear wavy boundary.

B1—10 to 17 inches; brown (7.5YR 5/2) extremely cobbly sandy loam, dark brown (7.5YR 4/2) moist; weak very fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 20 percent gravel, 40 percent cobbles, 10 percent stones; neutral; gradual wavy boundary.

B2t—17 to 35 inches; brown (7.5YR 5/4) very cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 15 percent gravel, 30 percent cobbles, 5 percent stones; neutral; gradual wavy boundary.

B3—35 to 60 inches; brown (7.5YR 5/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 30 percent gravel, 10 percent cobbles, 2 percent stones; few lime spots on undersides of rock fragments below 48 inches; neutral.

Thickness of the A and B horizons combined ranges from 30 to 50 inches. Thickness of the dark surface layer ranges from 7 to 15 inches.

The A horizon is brown, grayish brown, or dark grayish brown. The B horizon is brown, dark brown, or reddish brown. Texture is extremely cobbly sandy clay loam or very cobbly sandy clay loam, and the clay content ranges from 20 to 35 percent. Rock fragments make up 35 to 90 percent of the B2t horizon.

Martinsdale series

The Martinsdale series consists of deep, well drained soils on fans and foot slopes. The soils formed in alluvium and colluvium from granite. Slope is 3 to 12 percent. The average annual precipitation is 13 to 15 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Martinsdale gravelly sandy loam, 3 to 12 percent slopes, 1,400 feet south of the northwest corner of sec. 2, T. 21 S., R. 73 W.

A1—0 to 7 inches; dark brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; 15 percent gravel; mildly alkaline; clear smooth boundary.

B21t—7 to 10 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 10 percent gravel; mildly alkaline; clear smooth boundary.
B22t—10 to 17 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 10 percent gravel; mildly alkaline; abrupt wavy boundary.
B3ca—17 to 20 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 10 percent gravel; calcareous; moderately alkaline; clear wavy boundary.
C1ca—20 to 36 inches; light gray (10YR 7/2) sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; 10 percent gravel; calcareous; strongly alkaline; gradual irregular boundary.
C2ca—36 to 60 inches; pale brown (10YR 6/3) gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 15 percent gravel; calcareous; strongly alkaline.

The mollic epipedon is 7 to 16 inches thick. Depth to lime is less than 30 inches. Rock fragments in the profile range from 0 to 15 percent but commonly increase below 40 inches.

The A horizon is grayish brown, brown, dark brown, or dark yellowish brown. The B horizon is brown, yellowish brown, dark yellowish brown, or dark brown. Clay content is 25 to 30 percent. The C horizon is white, light gray, pale brown, very pale brown, brown, or light yellowish brown. It is typically sandy loam, gravelly sandy loam, or very gravelly sandy loam.

Norriston series

The Norriston series consists of deep, somewhat excessively drained soils on terraces and fans. These soils formed primarily in glacial outwash. Slope is 2 to 40 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Norriston extremely cobbly sandy loam, 6 to 15 percent slopes, 180 feet south and 1,300 feet east of the northwest corner sec. 17, T. 22 S., R. 73 W.

A1—0 to 6 inches; brown (7.5YR 5/2) extremely cobbly sandy loam, very dark brown (7.5YR 2/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; 40 percent gravel, 30 percent cobbles; neutral; clear smooth boundary.
B1—6 to 11 inches; brown (7.5YR 5/4) extremely cobbly sandy loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 40 percent gravel, 30 percent cobbles; neutral; clear smooth boundary.
B2t—11 to 18 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; 50 percent gravel, 30 percent cobbles, neutral; gradual smooth boundary.
B3—18 to 23 inches; light brown (7.5YR 5/4) extremely gravelly loamy sand, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure parting to single grained; slightly hard, very friable, nonsticky and nonplastic; 50 percent gravel, 30 percent cobbles, neutral; clear wavy boundary.
C1—23 to 34 inches; light brown (7.5YR 6/4) extremely cobbly loamy sand, strong brown (7.5YR 4/6) moist; single grained; loose, nonsticky and nonplastic; 50 percent gravel, 30 percent cobbles; neutral; gradual wavy boundary.
C2—34 to 60 inches; light brown (7.5YR 6/4) extremely cobbly sand; strong brown (7.5YR 4/6) moist; single grained; loose, nonsticky and nonplastic; 50 percent gravel, 30 percent cobbles; neutral.

Depth to bedrock is more than 40 inches. The profile is 35 to 85 percent rock fragments. It is 10YR or 7.5YR in hue. The A horizon is grayish brown, dark grayish brown, brown, or dark brown, extremely cobbly sandy loam or very cobbly sandy loam. The B2t horizon is light brown, brown, yellowish brown, or light yellowish brown.

Northwater series

The Northwater series consists of deep, well drained soils on mountainsides. These soils formed in colluvium from granite. Slope is 20 to 45 percent. The average annual precipitation is 20 to 25 inches, and the average air temperature is 38 to 42 degrees F.

Typical pedon of Northwater very stony loam, 20 to 45 percent slopes, 2,600 feet north and 2,600 feet east of the southwest corner of sec, 34, T. 22 S., R. 70 W.

A11—0 to 7 inches; dark grayish brown (10YR 4/2) very stony loam, very dark grayish brown (10YR 3/2) moist; strong very fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 20 percent cobbles, 30 percent stones; neutral; clear wavy boundary.
A12—7 to 25 inches; dark brown (10YR 4/3) extremely stony loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 30 percent cobbles, 30 percent stones; neutral; gradual irregular boundary.
A&B—25 to 35 inches; mixed dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) extremely stony loam (composite texture), dark brown (10YR

3/3) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 30 percent cobbles, 30 percent stones; neutral; gradual irregular boundary.

B21t—35 to 44 inches; dark yellowish brown (10YR 4/4) extremely stony sandy clay loam, dark yellowish brown (10YR 3/4) moist; moderate fine subangular blocky structure; very hard, friable, very sticky and plastic; few thin clay films on ped faces; 10 percent gravel, 30 percent cobbles, 30 percent stones; neutral; clear wavy boundary.

B22t—44 to 50 inches; yellowish brown (10YR 5/4) very stony sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; very hard, friable, sticky and plastic; few fine black manganese concretions; 15 percent gravel, 20 percent cobbles, 20 percent stones; neutral; gradual irregular boundary.

2C—50 to 60 inches; yellowish brown (10YR 5/4) very cobbly sandy loam, dark brown (10YR 4/3) moist; massive; hard, very friable, sticky and plastic; 15 percent gravel, 30 percent cobbles, 15 percent stones; neutral.

Depth to bedrock is more than 40 inches. The dark colored surface layer is 22 to 35 inches thick. The profile is slightly acid or neutral. Depth to the top of the developed subsoil is more than 24 inches. The profile has hue of 7.5YR, 10YR, or 2.5Y.

The A horizon is very dark brown, very dark grayish brown, or dark grayish brown. The B2t horizon is yellowish brown, brown, or dark yellowish brown. It is very stony clay loam, extremely stony clay loam, very stony sandy clay loam, or extremely stony sandy clay loam. The B2t horizon is 35 to 70 percent rock fragments.

Novary series

The Novary series consists of deep, poorly drained soils on low terraces. These soils formed in alluvium. Slope is 0 to 2 percent. The average annual precipitation is 14 to 17 inches, and the average air temperature is 40 to 44 degrees F.

Typical pedon of Novary loam, 0 to 2 percent slopes, 60 feet north and 1,625 feet west of the southeast corner sec. 18, T. 22 S., R. 72 W.

A11—0 to 4 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; calcareous; moderately alkaline; clear smooth boundary.

A12—4 to 9 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; strong fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 5 percent gravel; calcareous; moderately alkaline; clear smooth boundary.

B1—9 to 19 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; 5 percent gravel; calcareous; moderately alkaline; gradual smooth boundary.

B2g—19 to 31 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; few fine distinct very dark gray (N 3/) mottles, weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 5 percent gravel; calcareous; moderately alkaline; clear smooth boundary.

C1g—31 to 40 inches; dark gray (10YR 4/0) silty clay loam, very dark gray (10YR 3/0) moist; many fine distinct dark yellowish brown (10YR 4/4) mottles; massive; very hard, friable, slightly sticky and slightly plastic; 10 percent gravel, calcareous; moderately alkaline; clear smooth boundary.

C2g—40 to 60 inches; greenish gray (5BG 5/1) silt loam, dark greenish gray (5BG 4/1) moist; massive; hard, friable, nonsticky and nonplastic; 10 percent gravel; calcareous; moderately alkaline.

The soil is calcareous in the A1 horizon and in places is calcareous below the A1 horizon. Mottles occur within 20 inches of the surface. A seasonally high water table occurs within a depth of 2 feet. Hue of the profile is 7.5YR of 10YR. Gleyed parts of the profile have a hue of 5 BG.

The A horizon is grayish brown or dark grayish brown. Few fine and distinct reddish brown mottles are in the lower part of the A horizon in some pedons. The C horizon is dark gray or greenish gray. Mottles are common in the upper part. The C horizon is loam, silt loam, clay loam, or silty clay loam. It has discontinuous strata of gravel in some pedons.

Patent series

The Patent series consists of deep, well drained soils on uplands. These soils formed in eolian material derived mainly from granite. Slope is 3 to 10 percent. The average annual precipitation is 13 to 15 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Patent loam, 3 to 10 percent slopes, 1,500 feet north and 1,000 feet west of the southwest corner of sec. 6, T. 21 S., R. 72 W.

A1—0 to 2 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak very fine granular structure; slightly hard, very friable, nonsticky and nonplastic; neutral; abrupt smooth boundary.

AC—2 to 7 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 4/3) moist; weak coarse prismatic structure; hard, friable, slightly sticky and slightly plastic; neutral; abrupt wavy boundary.

C1ca—7 to 54 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; massive; hard, friable,

slightly sticky and slightly plastic; calcareous; moderately alkaline; clear irregular boundary.
C2ca—54 to 60 inches; white (10YR 8/2) loam, very pale brown (10YR 7/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; calcareous; moderately alkaline.

Depth to bedrock is more than 60 inches. Hue of the profile is 10YR or 7.5YR.

The A horizon is pale brown or brown. It is neutral or mildly alkaline. The C horizon is loam or clay loam.

Peeler series

The Peeler series consists of deep, well drained soils on mountain foot slopes. These soils formed in colluvium from granite. Slope is 10 to 30 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Peeler sandy loam, 10 to 30 percent slopes, 1,300 feet east and 900 feet south of the northwest corner of sec. 3, T. 23 S., R. 70 W.

O2—1 inch to 0; decomposed forest litter of needles, twigs, and leaves.
A2—0 to 14 inches; pinkish gray (7.5YR 7/2) sandy loam, brown (7.5YR 5/4) moist; weak very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; gradual wavy boundary.
A&B—14 to 22 inches; mixed pinkish gray (7.5YR 7/2) and light brown (7.5YR 6/4) sandy clay loam (composite texture), brown (7.5YR 5/4) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; 10 percent gravel; neutral; clear wavy boundary.
B21t—22 to 28 inches; light brown (7.5YR 6/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; very hard, friable, sticky and plastic; continuous thin clay films on ped faces; 20 percent gravel; neutral; gradual wavy boundary.
B22t—28 to 44 inches; brown (7.5YR 5/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) moist, weak medium subangular blocky structure; very hard, friable, sticky and plastic; few thin clay films on ped faces, 15 percent gravel, 15 percent cobbles; neutral; gradual wavy boundary.
Cr—44 to 60 inches; soft, weathered granite.

Depth to weathered granite is 40 to 60 inches. The 10- to 40-inch section averages 10 to 35 percent rock fragments. It is slightly acid or neutral. A thin brown or dark brown A1 horizon is in some profiles. The profile has hue of 7.5YR or 10YR.

The A2 horizon is pinkish gray, pinkish white, pink, light brown, or brown. The B2t horizon is brown, strong brown, light brown, or reddish yellow. It is gravelly sandy clay loam or sandy clay loam.

Piltz series

The Piltz series consists of moderately deep, well drained soils on hilltops and side slopes. These soils formed in residuum from igneous rock, primarily granite. Slope is 5 to 20 percent. The average annual precipitation is 18 to 23 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Piltz loam, 5 to 20 percent slopes, 1,150 feet north and 1,675 feet west of the southeast corner of sec. 21, T. 22 S., R. 71 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; gradual smooth boundary.
A3—8 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; gradual wavy boundary.
B21t—14 to 20 inches; pale brown (10YR 6/3) gravelly clay loam, brown (10YR 4/3) moist; moderate very fine subangular blocky structure; very hard, friable, very sticky and very plastic; 30 percent gravel, 5 percent cobbles; neutral; clear wavy boundary.
B22t—20 to 36 inches; pale brown (10YR 6/3) gravelly clay, brown (10YR 4/3) moist; moderate fine subangular blocky structure; very hard, firm, very sticky and very plastic; 30 percent gravel; neutral; clear irregular boundary.
Cr—36 to 60 inches; soft granite.

Depth to soft bedrock is 20 to 40 inches. Rock fragments in the control section range from 15 to 35 percent. The profile is neutral or mildly alkaline. The profile has hue of 2.5Y, 10YR, or 7.5YR.

The A1 horizon is grayish brown or dark grayish brown. The B2t horizon is pale brown, brown, or dark brown. Clay content is 35 to 50 percent. Reaction is neutral or mildly alkaline.

Redfeather series

The Redfeather series consists of shallow, well drained soils on hilltops and side slopes. These soils formed in residuum from granite. Slope is 5 to 35 percent. The average annual precipitation is 16 to 21 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Redfeather stony loam, from an area of Redfeather-Rock outcrop complex, 5 to 35 percent slopes, 950 feet north and 1,800 feet east of the southwest corner of sec. 8, T. 21 S., R. 73 W.

O1—1 inch to 0; partially decomposed needles and twigs.

A1—0 to 3 inches; grayish brown (10YR 5/2) stony sandy loam, very dark gray (10YR 3/1) moist; weak very fine granular structure; soft, loose, nonsticky and nonplastic; 5 percent stones; slightly acid; clear smooth boundary.
A2—3 to 7 inches; light brownish gray (10YR 6/2) very gravelly sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 55 percent gravel; neutral; gradual wavy bounday.
B2t—7 to 14 inches; brown (7.5YR 5/4) extremely gravelly heavy sandy loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 75 percent gravel; neutral; clear irregular boundary.
R—14 inches; hard granite.

Depth to the bedrock is 10 to 20 inches. The control section is 35 to 75 percent rock fragments.

The A2 horizon is light gray, light brownish gray, pinkish gray, or gray. The B2t horizon is light reddish brown, reddish yellow, brown, light brown, strong brown, or pale brown. It is extremely gravelly heavy sandy loam or extremely gravelly sandy clay loam.

Rogert series

The Rogert series consists of shallow, well drained soils on mountainsides, hills, and ridges. These soils formed in residuum from igneous rock, primarily granite. Slope is 5 to 45 percent. The average annual precipitation is 16 to 23 inches, and the average annual air temperature is 38 to 44 degrees F.

Typical pedon of Rogert extremely cobbly sandy loam, from an area of Rogert-Woodhall extremely cobbly sandy loams, 20 to 45 percent slopes, 2,000 feet north and 1,280 feet east of the southwest corner of sec. 19, T. 22 S., R. 71 W.

A1—0 to 10 inches; grayish brown (10YR 5/2) extremely cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; 15 percent gravel, 50 percent cobbles, 15 percent stones; slightly acid; clear wavy boundary.
C—10 to 15 inches; brown (10YR 5/3) extremely gravelly sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; 70 percent gravel, 5 percent cobbles, 5 percent stones; slightly acid; clear irregular boundary.
R—15 inches; fractured granite bedrock.

Depth to bedrock is 10 to 20 inches. The control section averages 35 to 80 percent rock fragments. It is slightly acid or neutral. Hue of the profile is 2.5Y, 10YR, or 7.5YR.

The A horizon is grayish brown, dark grayish brown, brown, or dark brown. It is very cobbly sandy loam or extremely cobbly sandy loam. The C horizon is brown, dark brown, or grayish brown.

Silvercliff series

The Silvercliff series consists of deep, well drained soils on alluvial fans and terrace edges. These soils formed in alluvium and colluvium. Slope is 1 to 50 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Silvercliff cobbly sandy loam, 15 to 35 percent slopes; 2,000 feet south and 2,400 feet east of northwest corner of sec. 2, T. 23 S., R. 72 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable; 20 percent gravel, 15 percent cobbles; mildly alkaline; clear smooth boundary.
B2—8 to 14 inches; brown (7.5YR 5/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 25 percent gravel, 15 percent cobbles; mildly alkaline; abrupt wavy boundary.
C1ca—14 to 34 inches; white (N8/) stratified very gravelly sandy and cobbly loam, sand, and very gravelly sandy loam grading to light brown (7.5YR 6/4) and brown (7.5YR 5/4) with depth, pinkish gray (7.5YR 6/2) moist; massive to single grained; slightly hard, very friable, nonsticky and slightly plastic; 40 percent gravel, 15 percent cobbles; disseminated lime with many fine lime concretions and pendants on lower surface of rock fragments; calcareous; moderately alkaline; clear irregular boundary.
IIC2—34 to 43 inches; light reddish brown (5YR 6/4) loamy sand, reddish brown (5YR 5/4) moist; massive; loose, soft; 5 percent gravel; calcareous; mildly alkaline; clear irregular boundary.
IIC3ca—43 to 60 inches; white (N 8/) gravelly loam, pinkish gray (5YR 7/2) moist; massive; slightly hard, friable, slightly sticky and plastic; 10 percent gravel, 10 percent cobbles; secondary calcium carbonate well disseminated throughout horizon and many fine lime concretions; calcareous, moderately alkaline.

The A horizon is brown, grayish brown, or dark grayish brown. It is very cobbly sandy loam, cobbly sandy loam, or gravelly sandy loam. The B horizon is yellowish brown, brown, or light brown. It is very gravelly sandy loam or gravelly loam. The B2 horizon is mildly alkaline or moderately alkaline. The C horizon is reddish brown, light brown, pink, or white. It is very gravelly sandy loam, very gravelly sand, or very gravelly loamy sand. Strata of cobbly loam and loamy sand occur in many places.

Skutum series

The Skutum series consists of deep, well drained soils on foot slopes. These soils formed in colluvium from granite. Slope is 5 to 20 percent. The average annual precipitation is 18 to 23 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Skutum fine sandy loam, 5 to 20 percent slopes, 250 feet west of the northeast corner of sec. 23, T. 22 S., R. 71 W.

A11—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, very friable, nonsticky and slightly plastic; neutral; clear smooth boundary.

A12—8 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and slightly plastic; neutral; abrupt wavy boundary.

B1t—16 to 19 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few thin clay films on ped faces; neutral; abrupt wavy boundary.

B2t—19 to 34 inches; brown (7.5YR 5/4) gravelly clay, dark brown (7.5YR 4/4) moist; strong fine subangular blocky structure; very hard, very firm, very sticky and plastic; 20 percent gravel, 10 percent cobbles; neutral; gradual wavy boundary.

B3t—34 to 48 inches; brown (10YR 5/3) very gravelly clay, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; 25 percent gravel, 15 percent cobbles; neutral; gradual wavy boundary.

IIC—48 to 60 inches; grayish brown (10YR 5/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive parting to single grained; loose, nonsticky and nonplastic; 20 percent gravel, 10 percent cobbles; neutral.

The A horizon is 16 to 30 inches thick. It is brown, grayish brown, or dark grayish brown. The B2t horizon is brown or reddish brown. Gravel and clay increase with depth in the Bt horizon.

Splitro series

The Splitro series consists of shallow, well drained soils on uplands, mountainsides, and ridges. These soils formed in residuum from sandstone. Slope is 5 to 35 percent. The average annual precipitation is 17 to 23 inches, and the average annual air temperature is 38 to 44 degrees F.

Typical pedon of Splitro sandy loam, from an area of Tripit, warm-Splitro sandy loams, 5 to 20 percent slopes, 2,100 feet south and 700 feet east of the northwest corner of sec. 28, T. 24 S., R. 72 W.

A1—0 to 8 inches; brown (7.5YR 4/2) sandy loam; very dark brown (7.5YR 2/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; neutral; clear smooth boundary.

B2—8 to 13 inches; reddish brown (5YR 4/4) gravelly sandy loam; dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; 20 percent gravel; neutral; abrupt wavy boundary.

R—13 inches; hard sandstone.

Depth to bedrock is 10 to 20 inches. The A horizon is brown, dark brown, grayish brown, or dark grayish brown.

The B2 horizon is reddish brown, brown, or dark brown. Texture is gravelly sandy loam, channery sandy loam, or sandy loam.

Stumpp Variant

The Stumpp Variant consists of deep, somewhat poorly drained soils on low terraces. These soils formed in fine textured alluvial sediments. Slope is 1 to 4 percent. The average annual precipitation is 14 to 17 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Stumpp Variant loam, 1 to 4 percent slopes, 2,300 feet east and 1,500 feet north of the southwest corner of sec. 23, T. 23 S., R. 72 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; strongly alkaline; abrupt smooth boundary.

B2t—5 to 12 inches; dark brown (10YR 4/3) clay, very dark brown (10YR 2/2) moist; strong medium prismatic structure; extremely hard, very firm, sticky and plastic; very strongly alkaline; abrupt wavy boundary.

B3ca—12 to 19 inches; very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; weak medium subangular blocky structure; very hard, friable, very sticky and plastic; calcareous; strongly alkaline; gradual wavy boundary.

C1ca—19 to 40 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; many large prominent light gray (10YR 7/1) and strong brown (7.5YR 5/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; calcareous; strongly alkaline; clear wavy boundary.

C2ca—40 to 60 inches; light yellowish brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) moist; common medium prominent yellowish red (5YR 5/8) mottles; massive; hard, very friable, slightly sticky and slightly plastic; moderately alkaline.

Depth to uniformly calcareous material is 0 to 12 inches. Depth to continuous subhorizons of visible

secondary salt accumulation is 6 to 30 inches. Rock fragments range from 0 to 15 percent throughout the profile. A permanent water table is at a depth of more than 60 inches, but may rise to 40 inches seasonally.

The A1 horizon is grayish brown, brown, or gray. It ranges from mildly alkaline to strongly alkaline. The B2t horizon is dark brown or dark grayish brown. It ranges from strongly alkaline to very strongly alkaline. It is typically heavy clay loam or clay and averages 35 to 60 percent clay.

The Stumpp Variant in Custer County has a sandy loam C horizon. The Stumpp series has a very gravelly loamy sand C horizon.

Terric Borosaprists

Terric Borosaprists are deep, very poorly drained soils on low stream terraces. Slope is 0 to 3 percent. The average annual precipitation is 14 to 23 inches, and the average annual air temperature is 38 to 44 degrees F.

Reference profile of Terric Borosaprists, nearly level, 350 feet west and 100 feet north of the southeast corner of sec. 7, T. 21 S., R. 73 W.

Oa1—0 to 10 inches; black (10YR 2/1) moist, very dark brown (10YR 2/2) rubbed, sapric material; medium very fine granular structure; nonsticky; abundant fine and medium roots; mildly alkaline; gradual smooth boundary.

Oa2—10 to 20 inches; black (10YR 2/1) moist, very dark brown (10YR 2/2) rubbed, sapric material; weak fine granular structure; nonsticky; common fine and medium roots; neutral; gradual smooth boundary.

C1—20 to 40 inches; black (10YR 2/1) moist, very dark brown (10YR 2/2) rubbed, mucky silty clay loam; massive; slightly sticky; few fine roots; mildly alkaline; gradual smooth boundary.

C2—40 to 60 inches; black (10YR 2/1) moist, very dark brown (10YR 2/2) rubbed, silty clay; massive; sticky; few fine roots; mildly alkaline.

Depth to bedrock is more than 40 inches. The profile is slightly acid, neutral, or mildly alkaline.

The O horizon is 16 to 30 inches thick. The C1 horizon is mucky silty clay loam, silty clay, silt loam, or loam.

Tripit series

The Tripit series consists of moderately deep, well drained soils on uplands. These soils formed in residuum from siltstone. Slope is 5 to 20 percent. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Tripit sandy loam, from an area of Tripit, warm-Splitro sandy loams, 5 to 20 percent slopes, 2,100 feet south and 700 feet east of the northwest corner of sec. 28, T. 24 S., R. 72 W.

A1—0 to 8 inches; dark reddish gray (5YR 4/2) sandy loam, dark reddish brown (5YR 2.5/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; 5 percent gravel; neutral; gradual smooth boundary.

A3—8 to 18 inches; reddish brown (5YR 4/3) sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; 10 percent gravel; neutral; clear wavy boundary.

B2t—18 to 28 inches; red (2.5YR 4/6) gravelly light clay loam, dark red (2.5YR 3/6) moist; moderate medium angular blocky structure parting to strong fine angular blocky; very hard, very friable, slightly sticky and slightly plastic; few thin clay films on ped faces; 30 percent siltstone gravel; neutral; gradual irregular boundary.

Cr—28 to 50 inches; soft red siltstone, with some CaCO3 on rock faces.

Depth to bedrock is 20 to 40 inches.

The A horizon is reddish brown, reddish gray, dark reddish gray, brown, or dark brown. It is 0 to 15 percent rock fragments. This horizon is sandy loam or loam. The B2t horizon is light reddish brown, reddish brown, red, or light red. It is 15 to 30 percent rock fragments.

Troutdale series

The Troutdale series consists of moderately deep, well drained soils on uplands. These soils formed in residuum from micaceous schist. Slope is 5 to 15 percent. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Troutdale sandy loam, from an area of Troutdale-Rogert complex, 5 to 15 percent slopes, 500 feet north and 2,400 feet west of the southeast corner of sec. 24, T. 21 S., R. 71 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; slightly acid; clear smooth boundary.

B1—8 to 14 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; slightly acid; clear wavy boundary.

B2t—14 to 20 inches; brown (7.5YR 5/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; 20 percent gravel; neutral; gradual wavy boundary.

B3—20 to 30 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

C1—30 to 35 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; massive; hard, very friable, nonsticky and nonplastic; neutral; abrupt irregular boundary.
C2r—35 to 60 inches; weathered soft micaceous schist, becoming more resistant with depth.

Depth to bedrock is 20 to 40 inches. The upper 1 to 3 feet of bedrock is soft. The profile is 0 to 35 percent rock fragments. It is slightly acid or neutral. Some pedons have a few segregations of lime in the C horizon. Hue is 10YR or 7.5YR.

The A1 horizon is grayish brown or dark grayish brown. The B2t horizon is brown, pale brown, light brown, brown, or light yellowish brown. It is sandy clay loam, clay loam, gravelly sandy clay loam, or gravelly clay loam. The C horizon is loam, sandy loam, or gravelly sandy loam.

Troutville series

The Troutville series consists of deep, somewhat excessively drained soils on stream terraces and mountainsides. These soils formed in glacial outwash and till. Slope is 4 to 60 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Troutville extremely stony sandy loam, 25 to 60 percent slopes, about 0.2 mile east of the Forest Service boundary along South Colony Lakes Road, sec. 6, T. 24 S., R. 72 W.

O1—1 inch to 0; partially decomposed needles, twigs, and leaves.
A2—0 to 15 inches; pinkish gray (7.5YR 7/2) extremely stony sandy loam, brown (7.5YR 5/2) moist; weak very fine granular structure; soft very friable, nonsticky and nonplastic; 30 percent gravel, 20 percent cobbles, 15 percent stones; slightly acid; gradual wavy boundary.
A&B—15 to 29 inches; mixed pinkish gray (7.5YR 7/2) and pink (7.5YR 7/4) extremely stony loamy sand with a few lamellae, brown (7.5YR 5/2) moist; weak fine subangular blocky structure; slightly hard very friable, nonsticky and nonplastic; 35 percent gravel, 20 percent cobbles, 20 percent stones; slightly acid; diffuse wavy boundary.
B21t—29 to 53 inches; variable colored mainly pink (7.5YR 7/4) extremely stony loamy sand that has disontinuous sandy loam lamellae and large granules, brown (7.5YR 4/4) moist; soft, very friable, slightly sticky and nonplastic; 40 percent gravel, 15 percent cobbles, 20 percent stones; slightly acid; gradual wavy boundary.
B22t—53 to 60 inches; variable colored mainly pink (7.5YR 7/4) extremely cobbly sandy loam in which discontinuous pockets of sandy clay loam comprise 30 percent of the fines; brown (7.5YR 4/4) moist; moderate fine subangular blocks of sandy clay loam; hard, very friable, slightly sticky and slightly plastic; 30 percent gravel, 20 percent cobbles, 15 percent stones; neutral.

Depth to bedrock is more than 40 inches. Rock fragments range from 50 to 80 percent in a major part of the profile. The profile is neutral to slightly acid throughout.

Some profiles have a dark colored A1 horizon as much as 4 inches thick between the O1 and A2 horizons. The A2 horizon is pinkish gray or pink. The B2t horizon is variable in color, but it is mainly pink or light brown.

Ula series

The Ula series consists of moderately deep, well drained soils on mountainsides, benches, and foot slopes. These soils formed in residuum from congolmeratic sandstone. Slope is 5 to 60 percent. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 38 to 42 degrees F.

Typical pedon of Ula cobbly sandy loam, 5 to 20 percent slopes, 700 feet west and 450 feet south of the northeast corner of sec. 32, T. 22 S., R. 73 W.

O1—1 inch to 0; partially decomposed oak leaves and pine needles.
A1—0 to 5 inches; reddish gray (5YR 5/2) cobbly sandy loam, dark reddish brown (5YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 10 percent cobbles; common medium and coarse roots; neutral; clear wavy boundary.
A2—5 to 12 inches; light reddish brown (5YR 6/4) cobbly sandy loam, reddish brown (5YR 5/4) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, nonsticky and nonplastic; 10 percent gravel, 10 percent cobbles, 5 percent stones; common medium and coarse roots; neutral; gradual wavy boundary.
B1—12 to 17 inches; light reddish brown (5YR 6/4) cobbly sandy loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and nonplastic; 10 percent gravel, 10 percent cobbles, 5 percent stones; common medium and coarse roots; few thin clay films in fine tubular or interstitial pores; neutral; gradual wavy boundary.
B2t—17 to 33 inches; reddish brown (5YR 5/4) cobbly sandy clay loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky and plastic; 10 percent gravel, 10 percent cobbles, 5 percent stones; common medium and coarse roots; many clay films on ped faces; slightly acid; gradual wavy boundary.

B3—33 to 37 inches; yellowish red (5YR 5/6) cobbly sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; 10 percent gravel, 10 percent cobbles, 5 percent stones; few coarse roots; few clay films on ped faces; slightly acid; gradual wavy boundary.
Cr—37 to 45 inches; soft weathered conglomeratic sandstone.

Depth to soft bedrock is 20 to 40 inches. These soils are noncalcareous throughout. Rock fragments range from 15 to 35 percent of the soil, are mainly angular, and range from 1 to 10 inches in diameter.

The A1 horizon is reddish gray, reddish brown, or brown. The A2 horizon is light brown or light reddish brown. The B2t horizon is red, weak red, or reddish brown. It is typically cobbly or gravelly sandy clay loam.

Venable series

The Venable series consists of deep, poorly drained soils on low terraces and foot slopes and in drainageways in high mountain valleys. These soils formed in alluvium. Slope is 1 to 10 percent. The average annual precipitation is 14 to 23 inches, and the average annual air temperature is 38 to 44 degrees F.

Typical pedon of Venable loam, 1 to 4 percent slopes, 2,050 feet north and 600 feet west of the southeast corner of sec. 7, T. 24 S., R. 72 W.

A11—0 to 5 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; neutral; clear smooth boundary.
A12g—5 to 23 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; common fine prominent red (2.5YR 5/8) mottles; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic, neutral; gradual wavy boundary.
ACg—23 to 44 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; common prominent dark yellowish brown (10YR 4/8) mottles; weak coarse prismatic and subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.
Cg—44 to 60 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; common coarse distinct yellowish brown (10YR 5/8) mottles; massive; very hard, friable, slightly sticky and slightly plastic; neutral.

Sand and gravel is commonly encountered at a depth of more than 40 inches. Rock fragments range from 0 to 15 percent above a depth of 40 inches. They are dominantly less than 3 inches in diameter. The profile is slightly acid, neutral, or mildly alkaline.

The A horizon is brown, dark brown, dark gray, very dark gray, dark grayish brown, or very dark grayish brown. It is loam or cobbly clay loam.

Wichup series

The Wichup series consists of deep, poorly drained soils on low terraces and in swales and drainageways. These soils formed in alluvium. Slope is 1 to 3 percent. The water table is within 40 inches of the surface most of the year, and in spring it is at the surface. The average annual precipitation is 14 to 18 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Wichup peat, 1 to 3 percent slopes, 1,600 feet south and 1,300 feet west of the northeast corner of sec. 11, T. 46 N., R. 12 E.

O1—9 to 5 inches; dark grayish brown (10YR 4/2) peat, very dark grayish brown (10YR 3/2) moist; calcareous; moderately alkaline; clear wavy boundary.
O2—5 inches to 0; very dark gray (N 3/) muck, black (N 2/) moist; neutral; clear smooth boundary.
A1—0 to 13 inches; very dark gray (N 3/) sandy loam, black (N 2/) moist; weak fine granular structure; slightly hard, friable, nonsticky and nonplastic; neutral; clear wavy boundary.
B21g—13 to 24 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; common medium distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.
B22g—24 to 28 inches; gray (N 5/) loam, dark gray (N 4/) moist; massive; hard, firm, slightly sticky and slightly plastic; mildly alkaline; gradual wavy boundary.
B23g—28 to 37 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; common fine distinct yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear wavy boundary.
C—37 to 60 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; mildly alkaline.

The organic surface material is 4 to 10 inches thick. The profile is noncalcareous with the exception of the O1 horizon, which is calcareous in places. The profile is 0 to 15 percent rock fragments, but horizons that are 15 to 35 percent gravel and cobbles are in some pedons.

The A horizon is black, very dark gray, dark olive gray, olive gray, dark gray, very dark grayish brown, or dark grayish brown. The B2 horizon is black, very dark gray, dark gray, gray, very dark grayish brown, dark grayish brown, dark olive gray, or olive gray.

Wix series

The Wix series consists of moderately deep, well drained soils on hilltops and mountainsides. These soils formed in residuum from granite. Slope is 3 to 25 percent. The average annual precipitation is 18 to 20 inches, and the average annual air temperature is 40 to 44 degrees F.

Typical pedon of Wix sandy loam, 3 to 25 percent slopes, 1,250 feet south and 250 feet east of the northwest corner of sec. 15, T. 23 S., R. 71 W.

O1—1 inch to 0; partially decomposed needles, leaves, and twigs.
A1—0 to 5 inches; gray (10YR 5/1) sandy loam, very dark gray (10YR 3/1) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; slightly acid; abrupt smooth boundary.
A2—5 to 8 inches; pale brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.
B2t—8 to 17 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm, very sticky and plastic; common thin clay films on faces of peds; neutral; clear wavy boundary.
B3—17 to 22 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; very hard, firm, sticky and plastic; few thin clay films on faces of peds; neutral; clear wavy boundary.
C1—22 to 30 inches; light yellowish brown (2.5Y 6/4) gravelly sandy loam, light olive brown (2.5Y 5/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; 20 percent fine gravel; neutral; gradual wavy boundary.
C2r—30 to 60 inches; soft granite bedrock becoming more resistant with depth.

Depth to bedrock is 20 to 40 inches. The profile is 0 to 20 percent rock fragments, mainly fine gravel. The profile is slightly acid or neutral.

The A1 horizon is gray or grayish brown. The B2t horizon is dark grayish brown, brown, or dark brown. The C horizon is light yellowish brown or brown.

Woodhall series

The Woodhall series consists of moderately deep, well drained soils on hills, ridges, and mountainsides. These soils formed in residuum and colluvium from granite. Slope is 5 to 45 percent. The average annual precipitation is 15 to 23 inches, and the average annual air temperature is 38 to 44 degrees F.

Typical pedon of Woodhall extremely cobbly sandy loam, from an area of Rogert-Woodhall extremely cobbly sandy loams, 20 to 45 percent slopes, 2,550 feet west and 2,400 feet north of the southeast corner of sec. 19, T. 22 S., R. 71 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) extremely cobbly sandy loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; 15 percent gravel, 50 percent cobbles, 15 percent stones; slightly acid; clear wavy boundary.
B1—6 to 10 inches; dark grayish brown (10YR 4/2) extremely cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; 15 percent gravel, 50 percent cobbles; slightly acid; clear wavy boundary.
B2t—10 to 28 inches; light brown (7.5YR 5/4) very cobbly clay loam, brown (7.5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; extremely hard, friable, sticky and plastic; 10 percent gravel, 40 percent cobbles; slightly acid; clear irregular boundary.
R—28 inches; fractured igneous bedrock.

Depth to bedrock is 20 to 40 inches. The profile is 35 to 75 percent rock fragments. Hue of the profile is 2.5Y, 10YR, or 7.5YR.

The A horizon is dark grayish brown, brown, or dark brown. The B2t horizon is light yellowish brown, yellowish brown, or brown. It is loam or clay loam and ranges from 20 to 35 percent clay content.

formation of the soils

This section discusses the factors of soil formation and relates them to the formation of soils in the Custer County Area.

Soil is formed by the interaction of five factors of soil formation. These factors are: (1) the physical and mineralogical composition of the parent materials; (2) the climate under which the parent material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time these forces have acted on the parent material. Each of these factors of soil formation are important but, in different locations and under different conditions some are more effective than others. In areas where one factor varies widely, many different soils are formed. The five main factors of soil formation are discussed in the following paragraphs.

parent materials

The soils of the Custer County Area formed from a variety of parent materials. The differences in physical, chemical, and mineralogical properties inherent in each parent material have resulted in the formation of different soils. Texture, color, consistence, and other soil properties are many times determined by the parent material from which the soil forms.

The following paragraphs discuss the major parent materials of the Custer County Area.

Unconsolidated glacial outwash and till. Glacial outwash is well stratified rock debris that has been deposited by glacial meltwaters. Glacial till is rock debris that is deposited directly by ice with no apparent bedding or stratification.

Glacial outwash in the Custer County Area is on gently sloping to moderately sloping fans and terraces along the western boundary. Alvarado, Libeg, and Norriston soils formed in these well stratified outwash fans and terraces. These soils are medium to coarse textured and extremely gravelly or very cobbly.

Glacial till is on moderately sloping to extremely steep mountainsides along the western boundary of the Area. The medium to coarse textured, very cobbly or very stony Leadville and Troutville soils formed in glacial till.

Permian red beds. This parent material consists of red sandstone, siltstone, and conglomerate of Permian age. Relatively small amounts of this parent material are along the extreme western boundary of the Area. It is on moderately sloping to moderately steep mountainsides and foot slopes. The medium to coarse textured, gravelly or cobbly red Ula, Splitro, and Tripit soils formed in residuum of red beds in the Custer County Area.

Mixed alluvial sediments. This parent material is on level to gently sloping bottom lands and stream terraces along Grape Creek and Texas Creek and their tributaries. This is highly stratified alluvium ranging from sandy loam to clay. A fluctuating water table in many areas of this parent material results in mottling and gleying of the soil. The Becks, Novary, Stumpp Variant, Venable, and Wichup soils formed under these conditions. The Coutis and Lamphier soils formed in mixed alluvial sediments but without influence from a water table.

Calcareous alluvial sediments. This parent material is on moderately sloping to moderately steep fans and terraces that slope westward from the Wet Mountains. The soils are well stratified sand and gravel. Feltonia, Hoodle, and Silvercliff soils formed in this calcareous alluvium.

Igneous rocks. This parent material includes granite, gneiss, schist, and all volcanic rocks found in the area. These igneous rocks are on moderately steep to very steep uplands, hills, and mountains on the east side of the Area. Soils that formed in residuum and colluvium of igneous rocks are Buena Vista, Buffork, Granile, Lake Creek, Piltz, Peeler, Redfeather, Rogert, Skutum, Troutdale, Wix, and Woodhall soils.

climate

Through its influence on the vegetation, the rate of biological activity, and the physical and chemical weathering of parent material, climate has been important in the formation of soils in the Custer County Area. Soil temperature and moisture are the main factors. Such factors as wind velocity and humidity also have a significant influence.

The Custer County Area has a subhumid continental climate, but there are also a number of microclimates as a result of differences in elevation and aspect. The average annual precipitation is about 15 inches at Westcliffe, and increases to about 25 inches in the mountains. Summers are cool in the valley and considerably cooler in the mountains. Winters are cold. At Westcliffe the average annual air temperature is 38 to 42 degrees F and the frost-free season is 45 to 80 days.

The limited amount of precipitation and cool temperature contribute to the accumulation of organic matter in the soil. They also increase the physical movement of substances in suspension or solution and control the rate of chemical processes in the soil.

The fans and terraces in the eastern part of the county receive less precipitation than those in the western part. Because the amount of precipitation controls calcium carbonate leaching, calcium carbonate is much shallower in soils in the east than in the west.

Because of the infrequent high temperatures, relatively low rainfall, and cool nights, the chemical and biological processes of soil formation proceed slowly in the survey area.

plant and animal life

Plant and animal life affects the thickness, structure, and organic-matter content of a soil. The kinds of plant cover and animal life at any location are controlled, in turn, by soil temperature, soil moisture, and the physical and chemical character of the soil.

The native vegetation of the Custer County Area is either grass or forest. Grasses have been important in the formation of soils on fans and terraces in all parts of the Area. Usually soils that are in grassland have a surface layer with a high organic matter content, which is indicated by a dark color. This organic matter is supplied mainly by decomposing roots. Roots also increase permeability of the soil to air and water.

Coniferous forests, which are on mountainsides in the eastern and western parts of the Area, have been important in soil formation. Soils that formed under coniferous forests usually have a surface layer low in organic matter because they do not have fine roots near the surface.

The number and kinds of living organisms are significant in the formation of soils. Micro-organisms decompose organic matter and change it into humus. Earthworms mix organic matter with the mineral soil and improve its fertility. Beaver have played an important role in soil formation in the Custer County Area by building dams. Dams slow the rate of streamflow and cause the waters to spread, lose velocity, and deposit sediment—eventually the ponds fill in with sediment. Some of the irrigated hayland formed this way.

relief

Relief is often the most important factor in determining the kind of soils that form in a particular landscape. Relief affects soils through its influence on drainage, runoff, erosion, and aspect. Internal drainage and moisture content differ in areas of different relief. If plant cover and the amount of rainfall are about the same in two areas, runoff will be more rapid where slopes are steep than it is where they are nearly level.

Depressional areas tend to concentrate runoff waters. Soils in these positions receive more water than is normal and have a thicker, darker surface layer.

Unless good vegetative cover is maintained on steep slopes, soil material may erode faster than it forms. Soils that have steep slopes generally have a thinner surface layer and less development in the subsoil than soils that are nearly level.

Aspect also affects soil formation. North-facing slopes are generally cooler than south-facing slopes, and moisture is more effective on them.

time

The formation of soil requires time; the length of time depending, to a large extent, on the kind of parent materials. In soils that formed in residuum, the weathering of rock and the formation of soil horizons generally occur simultaneously. In transported, unconsolidated materials, such as glacial outwash or alluvium, soil formation can begin as soon as the materials are stabilized.

Frequently the relative length of time that a soil has been developing can best be evaluated by specific soil characteristics. Soil characteristics commonly used to determine the comparitive maturity of soils are thickness, color of the surface layer, degree of structure in the subsoil, evidence of clay movement, depth to calcium carbonate accumulation, and thickness of the solum.

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glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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

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

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

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

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

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

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

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

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax 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. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse 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 slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil 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.

Conglomeratic. Having the properties of gravel and rounded stones that have been cemented together into rock by hardened clay, lime, iron oxide, or silica.

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.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

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

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—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 they are wet 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 alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

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

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

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

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.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue 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.
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.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

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.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

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

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 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, 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.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site 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.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

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.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

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.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

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

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.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-74 at Westcliffe, Colorado]

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days[1]	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January	39.6	6.4	23.0	58	-30	10	0.50	0.20	0.73	2	8.0
February	41.9	8.5	25.2	61	-28	19	.60	.17	.94	2	10.2
March	47.1	15.6	31.4	67	-18	34	1.17	.53	1.69	3	16.8
April	56.1	24.0	40.1	72	-4	101	1.38	.51	2.06	4	13.2
May	66.6	32.0	49.3	81	13	288	1.65	.53	2.53	4	6.1
June	77.1	39.4	58.3	89	25	549	.93	.25	1.46	3	.0
July	81.6	44.2	62.9	91	34	710	2.38	1.22	3.32	6	.0
August	78.8	43.3	61.1	88	31	654	2.52	1.25	3.55	6	.0
September	73.0	34.9	53.9	85	17	417	1.14	.42	1.72	3	2.6
October	62.9	25.4	44.2	77	2	169	1.29	.42	1.98	3	10.4
November	49.1	14.6	31.9	69	-17	55	.82	.22	1.29	2	11.6
December	41.0	6.7	23.9	61	-26	10	.73	.32	1.05	2	12.6
Year	59.6	24.6	42.1	91	-33	3,016	15.11	11.56	18.40	40	91.5

[1]A growing degree day is an 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

[Recorded in the period 1951-74 at Westcliffe, Colorado]

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	June 6	June 16	June 22
2 years in 10 later than--	May 31	June 11	June 18
5 years in 10 later than--	May 20	June 2	June 12
First freezing temperature in fall:			
1 year in 10 earlier than--	September 10	August 26	August 5
2 years in 10 earlier than--	September 15	August 31	August 15
5 years in 10 earlier than--	September 26	September 11	September 1

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-74 at Westcliffe, Colorado]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	105	79	53
8 years in 10	113	86	62
5 years in 10	128	100	81
2 years in 10	143	115	99
1 year in 10	150	122	109

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

Map symbol	Soil name	Acres	Percent
1	Alvarado very cobbly sandy loam, 2 to 5 percent slopes	8,000	2.8
2	Becks gravelly loam, 1 to 5 percent slopes	4,720	1.6
3	Boyle very gravelly sandy loam, warm, 4 to 25 percent slopes	5,880	2.0
4	Boyle-Rock outcrop complex, warm, 25 to 55 percent slopes	7,440	2.6
5	Buena Vista sandy loam, 3 to 20 percent slopes	1,040	0.4
6	Buffork sandy loam, warm, 5 to 12 percent slopes	2,200	0.8
7	Buffork Variant cobbly sandy loam, 20 to 40 percent slopes	2,120	0.7
8	Coutis sandy loam, 2 to 5 percent slopes	7,640	2.6
9	Coutis sandy loam, 5 to 15 percent slopes	12,200	4.2
10	Feltonia sandy loam, 2 to 6 percent slopes	19,000	6.6
11	Feltonia-Coutis sandy loams, 6 to 15 percent slopes	16,240	5.6
12	Gelkie sandy loam, 1 to 10 percent slopes	12,360	4.3
13	Granile-Peeler complex, 25 to 50 percent slopes	13,760	4.8
14	Hoodle cobbly sandy loam, 1 to 5 percent slopes	3,080	1.1
15	Lake Creek-Rock outcrop complex, 35 to 65 percent slopes	4,840	1.7
16	Lamphier loam, 4 to 20 percent slopes	9,440	3.3
17	Larand Variant very stony sandy loam, 4 to 25 percent slopes	1,200	0.4
18	Leadville very cobbly sandy loam, warm, 8 to 20 percent slopes	4,840	1.7
19	Libeg extremely cobbly sandy loam, 5 to 20 percent slopes	8,520	3.0
20	Martinsdale gravelly sandy loam, 3 to 12 percent slopes	4,640	1.6
21	Norriston very cobbly sandy loam, 2 to 6 percent slopes	12,680	4.4
22	Norriston extremely cobbly sandy loam, 6 to 15 percent slopes	3,600	1.2
23	Norriston extremely cobbly sandy loam, 15 to 40 percent slopes	1,640	0.6
24	Northwater very stony loam, 20 to 45 percent slopes	2,880	1.0
25	Novary loam, 0 to 2 percent slopes	4,560	1.6
26	Patent loam, 3 to 10 percent slopes	1,080	0.4
27	Peeler sandy loam, 10 to 30 percent slopes	1,760	0.6
28	Piltz loam, 5 to 20 percent slopes	4,080	1.4
29	Redfeather-Rock outcrop complex, 5 to 35 percent slopes	19,320	6.8
30	Rogert-Rock outcrop complex, 20 to 45 percent slopes	6,440	2.2
31	Rogert-Woodhall extremely cobbly sandy loams, 20 to 45 percent slopes	19,760	6.8
32	Silvercliff gravelly sandy loam, 1 to 4 percent slopes	2,320	0.8
33	Silvercliff cobbly sandy loam, 15 to 35 percent slopes	5,360	1.9
34	Silvercliff very cobbly sandy loam, 30 to 50 percent slopes	1,240	0.4
35	Skutum fine sandy loam, 5 to 20 percent slopes	3,040	1.1
36	Splitro-Rock outcrop complex, 25 to 55 percent slopes	520	0.2
37	Stumpp Variant loam, 1 to 4 percent slopes	920	0.3
38	Terric Borosaprists, nearly level	280	0.1
39	Tripit, warm-Splitro sandy loams, 5 to 20 percent slopes	1,120	0.4
40	Troutdale-Rogert complex, 5 to 15 percent slopes	12,440	4.3
41	Troutville extremely cobbly sandy loam, 4 to 15 percent slopes	1,720	0.6
42	Troutville extremely stony sandy loam, 25 to 60 percent slopes	2,600	0.9
43	Ula cobbly sandy loam, 5 to 20 percent slopes	2,400	0.8
44	Ula-Leadville complex, 25 to 60 percent slopes	1,240	0.4
45	Ula-Splitro complex, 5 to 20 percent slopes	680	0.2
46	Venable loam, 1 to 4 percent slopes	6,200	2.1
47	Venable cobbly clay loam, 3 to 10 percent slopes	720	0.2
48	Wichup peat, 1 to 3 percent slopes	2,400	0.8
49	Wix sandy loam, 3 to 25 percent slopes	4,880	1.7
50	Woodhall-Rogert extremely cobbly sandy loams, 5 to 20 percent slopes	11,400	3.9
	Water	280	0.1
	Total	288,720	100.0

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
1 Alvarado	Mountain Outwash	Favorable Normal Unfavorable	1,200 1,000 800	Arizona fescue Needleandthread Mountain muhly Baltic rush Bluegrass Western wheatgrass Sedge Low rabbitbrush	25 15 10 10 10 10 5 5
2 Becks	Mountain Outwash	Favorable Normal Unfavorable	1,400 1,200 1,000	Arizona fescue Sedge Western wheatgrass Bluegrass Needleandthread Baltic rush Mountain muhly Shrubby cinquefoil	20 15 10 10 10 10 10 5
5 Buena Vista	Mountain Loam	Favorable Normal Unfavorable	1,000 700 500	Needleandthread Western wheatgrass Arizona fescue Mountain muhly Blue grama Fringed sagebrush Prairie junegrass Low rabbitbrush	30 20 10 10 5 5 5 5
6 Buffork	Loamy Park	Favorable Normal Unfavorable	1,800 1,500 1,200	Arizona fescue Mountain muhly Parry danthonia Western wheatgrass Prairie junegrass	30 20 15 10 5
7 Buffork Variant	Shallow Loam	Favorable Normal Unfavorable	900 700 500	Arizona fescue Mountain muhly Pine dropseed Mountainmahogany Mountain snowberry Antelope bitterbrush Bottlebrush squirreltail	30 20 10 10 5 5 5
8 Coutis	Loamy Park	Favorable Normal Unfavorable	2,000 1,800 1,600	Western wheatgrass Needleandthread Arizona fescue	25 20 15
9 Coutis	Loamy Park	Favorable Normal Unfavorable	2,000 1,800 1,600	Western wheatgrass Needleandthread Arizona fescue	25 20 15
10 Feltonia	Mountain Loam	Favorable Normal Unfavorable	1,200 800 600	Needleandthread Western wheatgrass Mountain muhly	30 15 15
11*: Feltonia	Mountain Loam	Favorable Normal Unfavorable	1,200 800 600	Needleandthread Western wheatgrass Mountain muhly	30 15 15
Coutis	Loamy Park	Favorable Normal Unfavorable	2,000 1,800 1,600	Western wheatgrass Needleandthread Arizona fescue	25 20 15

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
12 Gelkie	Loamy Park	Favorable Normal Unfavorable	2,000 1,800 1,600	Arizona fescue Mountain muhly Parry oatgrass Slender wheatgrass Columbia needlegrass Bottlebrush squirreltail Fringed sagebrush	30 15 10 5 5 5 5
14 Hoodle	Mountain Loam	Favorable Normal Unfavorable	1,000 750 400	Needleandthread Western wheatgrass Arizona fescue Indian ricegrass Prairie junegrass Bottlebrush squirreltail	40 20 10 10 10 5
16 Lamphier	Loamy Park	Favorable Normal Unfavorable	2,200 2,000 1,800	Arizona fescue Mountain muhly Wheatgrass Parry oatgrass Nodding bromegrass Columbia needlegrass Bluegrass	30 20 15 10 5 5 5
19 Libeg	Mountain Outwash	Favorable Normal Unfavorable	1,200 1,000 800	Mountain muhly Arizona fescue Needleandthread Western wheatgrass Bluegrass Sedge Prairie junegrass	15 15 15 10 10 5 5
20 Martinsdale	Mountain Loam	Favorable Normal Unfavorable	1,000 750 400	Needleandthread Western wheatgrass Prairie junegrass	40 20 15
21, 22, 23 Norriston	Mountain Outwash	Favorable Normal Unfavorable	1,000 800 600	Needleandthread Arizona fescue Mountain muhly Prairie junegrass Muttongrass Bottlebrush squirreltail Fringed sagebrush Western wheatgrass Slender wheatgrass	20 15 10 5 5 5 5 5 5
24 Northwater	Aspen Grassland	Favorable Normal Unfavorable	3,000 2,500 2,000	Thurber fescue Parry oatgrass Nodding brome	30 10 10
25 Novary	Mountain Meadow	Favorable Normal Unfavorable	4,000 3,000 2,000	Tufted hairgrass Redtop Reedgrass Sedge Alpine timothy Baltic rush	40 20 10 5 5 5
26 Patent	Mountain Loam	Favorable Normal Unfavorable	1,100 800 500	Western wheatgrass Needleandthread Mountain muhly Prairie junegrass Blue grama	20 20 10 5 5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
28----------	Loamy Park----------	Favorable	1,800	Arizona fescue----------	25
Piltz		Normal	1,500	Mountain muhly----------	15
		Unfavorable	1,200	Western wheatgrass----------	15
				Parry oatgrass----------	10
				Columbia needlegrass----------	5
				Prairie junegrass----------	5
				Slender wheatgrass----------	5
30*:					
Rogert----------	Shallow Loam----------	Favorable	900	Arizona fescue----------	30
		Normal	700	Mountain muhly----------	20
		Unfavorable	500	Pine dropseed----------	10
				True mountainmahogany----------	10
				Bottlebrush squirreltail------	5
Rock outcrop.					
31*:					
Rogert----------	Shallow Loam----------	Favorable	900	Arizona fescue----------	30
		Normal	700	Mountain muhly----------	20
		Unfavorable	500	Pine dropseed----------	10
				True mountainmahogany----------	10
				Bottlebrush squirreltail------	5
Woodhall----------	Shallow Loam----------	Favorable	1,000	Arizona fescue----------	30
		Normal	800	Mountain muhly----------	20
		Unfavorable	600	Pine dropseed----------	10
				True mountainmahogany----------	10
				Bluegrass----------	5
32, 33----------	Mountain Loam----------	Favorable	1,200	Needleandthread----------	30
Silvercliff		Normal	800	Western wheatgrass----------	15
		Unfavorable	600	Mountain muhly----------	10
				Arizona fescue----------	10
				Prairie junegrass----------	10
				Fringed sagebrush----------	5
				Bluegrass----------	5
35----------	Loamy Park----------	Favorable	2,000	Arizona fescue----------	30
Skutum		Normal	1,500	Mountain muhly----------	20
		Unfavorable	1,000	Western wheatgrass----------	15
				Parry oatgrass----------	15
				Bluegrass----------	5
36*:					
Splitro----------	Shallow Loam----------	Favorable	900	Arizona fescue----------	30
		Normal	700	Mountain muhly----------	20
		Unfavorable	500	Pine dropseed----------	10
				True mountainmahogany----------	10
				Antelope bitterbrush----------	5
Rock outcrop.					
37----------	Salt Flat----------	Favorable	900	Alkali sacaton----------	25
Stumpp Variant		Normal	700	Western wheatgrass----------	10
		Unfavorable	500	Inland saltgrass----------	10
				Fourwing saltbush----------	10
				Greasewood----------	5
				Alkali bluegrass----------	5
				Bottlebrush squirreltail------	5
				Baltic rush----------	5
				Sedge----------	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
38---------- Terric Borosaprists	Mountain Meadow----------	Favorable Normal Unfavorable	4,000 3,000 2,000	Sedge---------- Tufted hairgrass---------- Redtop---------- Willow---------- Baltic rush---------- Cowparsnip---------- Reedgrass----------	40 20 15 8 5 5 5
39*:					
Tripit----------	Loamy Park----------	Favorable Normal Unfavorable	2,000 1,800 800	Arizona fescue---------- Mountain muhly---------- Western wheatgrass---------- Parry oatgrass----------	30 20 15 15
Splitro----------	Shallow Loam----------	Favorable Normal Unfavorable	900 700 500	Arizona fescue---------- Mountain muhly---------- Pine dropseed---------- True mountainmahogany---------- Antelope bitterbrush----------	30 20 10 10 5
40*:					
Troutdale----------	Mountain Loam----------	Favorable Normal Unfavorable	1,100 800 500	Needleandthread---------- Western wheatgrass---------- Arizona fescue---------- Mountain muhly---------- Indian ricegrass---------- Prairie junegrass---------- Fringed sagebrush---------- Blue grama----------	20 20 10 10 5 5 5 5
Rogert----------	Mountain Loam----------	Favorable Normal Unfavorable	900 700 500	Arizona fescue---------- Mountain muhly---------- Pine dropseed---------- True mountainmahogany---------- Bottlebrush squirreltail----------	30 20 10 10 5
46---------- Venable	Mountain Meadow----------	Favorable Normal Unfavorable	4,000 3,000 2,000	Tufted hairgrass---------- Sedge---------- Redtop---------- Wheatgrass---------- Willow---------- Rush---------- Bluegrass---------- Reedgrass----------	20 15 15 10 5 5 5 5
47---------- Venable	High Mountain Meadow----------	Favorable Normal Unfavorable	2,500 1,500 1,200	Sedge---------- Tufted hairgrass---------- Alpine timothy---------- Parry clover---------- Willow---------- Showy cinquefoil---------- Redtop---------- Reedgrass----------	25 20 20 10 10 5 5 5
48---------- Wichup	Mountain Meadow----------	Favorable Normal Unfavorable	4,000 3,000 2,000	Sedge---------- Tufted hairgrass---------- Redtop---------- Willow---------- Reedgrass---------- Cowparsnip---------- Baltic rush----------	40 20 15 8 5 5 5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
50*:					
Woodhall	Shallow Loam	Favorable	1,000	Arizona fescue	30
		Normal	800	Mountain muhly	20
		Unfavorable	600	Pine dropseed	10
				True mountainmahogany	10
				Bluegrass	5
Rogert	Shallow Loam	Favorable	900	Arizona fescue	30
		Normal	700	Mountain muhly	20
		Unfavorable	500	Pine dropseed	10
				True mountainmahogany	10
				Bottlebrush squirreltail	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RECREATIONAL DEVELOPMENT

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

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Alvarado	Severe: large stones.	Severe: large stones.	Severe: large stones, small stones.	Moderate: large stones.
2 Becks	Slight	Slight	Severe: small stones.	Slight.
3 Boyle	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
4*: Boyle	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.
Rock outcrop.				
5 Buena Vista	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
6 Buffork	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
7 Buffork Variant	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
8 Coutis	Slight	Slight	Moderate: slope.	Slight.
9 Coutis	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
10 Feltonia	Slight	Slight	Moderate: slope.	Slight.
11*: Feltonia	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Coutis	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
12 Gelkie	Slight	Slight	Moderate: slope, small stones.	Slight.
13*: Granile	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Severe: slope.
Peeler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
14---------- Hoodle	Moderate: large stones, small stones.	Moderate: large stones, small stones.	Severe: large stones, small stones.	Moderate: large stones.
15*: Lake Creek----------	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: large stones, slope.
Rock outcrop.				
16---------- Lamphier	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
17---------- Larand Variant	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope, small stones.	Severe: large stones.
18---------- Leadville	Severe: large stones.	Severe: large stones.	Severe: slope, small stones.	Moderate: large stones.
19---------- Libeg	Severe: large stones, small stones.	Severe: large stones, small stones.	Severe: large stones, slope, small stones.	Severe: large stones.
20---------- Martinsdale	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight.
21---------- Norriston	Severe: large stones.	Severe: large stones.	Severe: large stones, small stones.	Moderate: large stones.
22---------- Norriston	Severe: large stones.	Severe: large stones.	Severe: large stones, slope, small stones.	Moderate: large stones.
23---------- Norriston	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Severe: slope.
24---------- Northwater	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: slope.
25---------- Novary	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
26---------- Patent	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
27---------- Peeler	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
28---------- Piltz	Moderate: percs slowly, slope.	Moderate: percs slowly, slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
29*:				
Redfeather	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Rock outcrop.				
30*:				
Rogert	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: large stones, slope, small stones.	Severe: slope, small stones.
Rock outcrop.				
31*:				
Rogert	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: large stones, slope, small stones.	Severe: slope, small stones.
Woodhall	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.
32--- Silvercliff	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
33--- Silvercliff	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
34--- Silvercliff	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Severe: slope.
35--- Skutum	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
36*:				
Splitro	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop.				
37--- Stumpp Variant	Severe: floods, excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
38. Terric Borosaprists				
39*:				
Tripit	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Splitro	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
40*:				
Troutdale	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
40*:				
Rogert	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones.	Slight.
41				
Troutville	Severe: small stones.	Severe: small stones.	Severe: large stones, slope, small stones.	Severe: large stones.
42				
Troutville	Severe: small stones, slope.	Severe: small stones, slope.	Severe: large stones, slope, small stones.	Severe: large stones, slope.
43				
Ula	Moderate: small stones, slope.	Moderate: small stones, slope.	Severe: large stones, slope, small stones.	Moderate: large stones.
44*:				
Ula	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.
Leadville	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, small stones.	Severe: slope.
45*:				
Ula	Moderate: small stones.	Moderate: small stones.	Severe: large stones, slope, small stones.	Moderate: large stones.
Splitro	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
46				
Venable	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
47				
Venable	Moderate: large stones, wetness.	Moderate: wetness, large stones.	Severe: large stones, slope.	Moderate: large stones, wetness.
48				
Wichup	Severe: floods, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, floods.	Severe: wetness, excess humus.
49				
Wix	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
50*:				
Woodhall	Slight	Slight	Severe: slope, large stones.	Slight.
Rogert	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, small stones.	Severe: small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1---------- Alvarado	Poor	Poor	Good	---	Fair	Fair	Fair	---	Fair	Fair.
2---------- Becks	Poor	Poor	Good	---	Good	Fair	Fair	---	Fair	Good.
3---------- Boyle	Very poor.	Very poor	Poor	---	Fair	Very poor.	Very poor.	---	Very poor.	Poor.
4*: Boyle---------- Rock outcrop.	Very poor.	Very poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	---
5---------- Buena Vista	Poor	Fair	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
6---------- Buffork	Poor	Poor	Good	---	Good	Very poor.	Very poor.	---	Very poor.	Good.
7---------- Buffork Variant	Very poor.	Very poor	Good	---	Good	Very poor.	Very poor.	---	Very poor.	Good.
8, 9---------- Coutis	Poor	Poor	Good	---	Good	Very poor.	Very poor.	---	Very poor.	Good.
10---------- Feltonia	Fair	Fair	Good	---	Good	Poor	Very poor.	---	Very poor.	Good.
11*: Feltonia---------- Coutis----------	Fair Poor	Fair Poor	Good Good	--- ---	Good Good	Poor Very poor.	Very poor. Very poor.	--- ---	Very poor. Very poor.	Good. Good.
12---------- Gelkie	Poor	Fair	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
13*: Granile---------- Peeler----------	Very poor. Very poor.	Very poor Very poor	Good Good	Fair Good	Fair Fair	Very poor. Very poor.	Very poor. Very poor.	Fair Good	Very poor. Very poor.	--- ---
14---------- Hoodle	Very poor.	Very poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
15*: Lake Creek--------- Rock outcrop.	Very poor.	Very poor	Very poor.	Fair	---	Very poor.	Very poor.	Poor	Very poor.	---
16---------- Lamphier	Poor	Poor	Good	---	Fair	Poor	Very poor.	---	Very poor.	Fair.
17---------- Larand Variant	Very poor.	Very poor	Very poor.	Poor	Fair	Very poor.	Very poor.	Poor	Very poor.	---

See footnote at end of table.

TABLE 7.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Woodland wildlife	Wetland wildlife	Rangeland wildlife
18---------- Leadville	Poor	Poor	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	---
19---------- Libeg	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	---	Very poor.	Good.
20---------- Martinsdale	Fair	Good	Good	---	Good	---	---	---	---	Good.
21, 22, 23---------- Norriston	Very poor.	Very poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
24---------- Northwater	Very poor.	Very poor	Good	---	Good	Very poor.	Very poor.	---	Very poor.	Good.
25---------- Novary	Very poor.	Poor	Good	---	Good	Good	Good	---	Good	Good.
26---------- Patent	Fair	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
27---------- Peeler	Poor	Poor	Good	Good	Fair	Very poor.	Very poor.	Good	Very poor.	---
28---------- Piltz	Poor	Poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
29*: Redfeather----------	Very poor.	Very poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	---
Rock outcrop.										
30*: Rogert----------	Very poor.	Very poor	Poor	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
Rock outcrop.										
31*: Rogert----------	Very poor.	Very poor	Poor	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
Woodhall----------	Very poor.	Very poor	Fair	Poor	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
32---------- Silvercliff	Poor	Fair	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
33---------- Silvercliff	Very poor.	Very poor	Fair	---	Poor	Very poor.	Very poor.	---	Very poor.	Poor.
34---------- Silvercliff	Very poor.	Very poor	Fair	Fair	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
35---------- Skutum	Very poor.	Very poor	Good	Good	Good	Very poor.	Very poor.	Good	Very poor.	Good.
36*: Splitro----------	Very poor.	Very poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
Rock outcrop.										
37---------- Stumpp Variant	Poor	Poor	Fair	---	Fair	Poor	Very poor.	---	Very poor.	Fair.

See footnote at end of table.

TABLE 7.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Woodland wildlife	Wetland wildlife	Rangeland wildlife
38---------- Terric Borosaprists	Very poor.	Poor	Poor	Poor	Poor	Good	Good	---	Good	Fair.
39*:										
Tripit----------	Poor	Poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
Splitro----------	Very poor.	Very poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
40*:										
Troutdale----------	Fair	Good	Good	Fair	Good	Very poor.	Very poor.	---	Very poor.	Good.
Rogert----------	Very poor.	Very poor	Poor	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
41---------- Troutville	Very poor.	Very poor	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	---
42---------- Troutville	Very poor.	Very poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	---
43---------- Ula	Poor	Fair	Good	Good	Fair	Very poor.	Very poor.	Good	Very poor.	---
44*:										
Ula----------	Very poor.	Very poor	Good	Good	Fair	Very poor.	Very poor.	Fair	Very poor.	---
Leadville----------	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	---
45*:										
Ula----------	Poor	Fair	Good	Good	Fair	Very poor.	Very poor.	Good	Very poor.	---
Splitro----------	Very poor.	Very poor	Fair	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
46---------- Venable	Poor	Fair	Good	---	Good	Good	Good	---	Good	Good.
47---------- Venable	Very poor.	Poor	Good	---	Good	Good	Poor	---	Fair	Good.
48---------- Wichup	Very poor.	Very poor	Fair	---	Fair	Good	Good	---	Good	Fair.
49---------- Wix	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	---
50*:										
Woodhall----------	Very poor.	Very poor	Fair	Poor	Fair	Very poor.	Very poor.	---	Very poor.	Fair.
Rogert----------	Very poor.	Very poor	Poor	---	Fair	Very poor.	Very poor.	---	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

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

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Local roads and streets
1 Alvarado	Severe: wetness.	Moderate: wetness, large stones.	Severe: wetness.	Moderate: wetness, frost action, large stones.
2 Becks	Severe: cutbanks cave.	Slight	Moderate: wetness.	Moderate: frost action.
3 Boyle	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Moderate: depth to rock, slope, frost action.
4*: Boyle	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.
Rock outcrop.				
5 Buena Vista	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Moderate: depth to rock, slope, frost action.
6 Buffork	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Moderate: slope, frost action, shrink-swell.
7 Buffork Variant	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.
8 Coutis	Slight	Slight	Slight	Moderate: frost action.
9 Coutis	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope, frost action.
10 Feltonia	Severe: cutbanks cave.	Slight	Slight	Moderate: frost action.
11*: Feltonia	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Moderate: slope, frost action.
Coutis	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope, frost action.
12 Gelkie	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.
13*: Granile	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Local roads and streets
13*:				
Peeler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14 Hoodle	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: frost action, large stones.
15*:				
Lake Creek	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.
Rock outcrop.				
16 Lamphier	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Moderate: low strength, slope, frost action.
17 Larand Variant	Severe: cutbanks cave, large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
18 Leadville	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
19 Libeg	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
20 Martinsdale	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.
21 Norriston	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.
22 Norriston	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Moderate: slope, large stones.
23 Norriston	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.
24 Northwater	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
25 Novary	Severe: cutbanks cave, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, frost action.
26 Patent	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
27 Peeler	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
28 Piltz	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Moderate: low strength, slope, shrink-swell.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Local roads and streets
29*:				
Redfeather	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock outcrop.				
30*:				
Rogert	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock outcrop.				
31*:				
Rogert	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Woodhall	Severe: depth to rock, large stones, slope.	Severe: slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones.
32---------- Silvercliff	Severe: cutbanks cave.	Slight----------	Slight----------	Slight.
33, 34---------- Silvercliff	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.
35---------- Skutum	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Moderate: slope, frost action, shrink-swell.
36*:				
Splitro	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rock outcrop.				
37---------- Stumpp Variant	Moderate: wetness, floods.	Severe: floods.	Severe: floods.	Severe: floods.
38. Terric Borosaprists				
39*:				
Tripit	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Moderate: slope, frost action, shrink-swell.
Splitro	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
40*:				
Troutdale	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Moderate: slope, frost action.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Local roads and streets
40*:				
Rogert	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
41 Troutville	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.
42 Troutville	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
43 Ula	Moderate: depth to rock, large stones, slope.	Moderate: slope, large stones.	Moderate: depth to rock, slope, large stones.	Moderate: slope, frost action, large stones.
44*:				
Ula	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Leadville	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
45*:				
Ula	Moderate: depth to rock, large stones.	Moderate: large stones.	Moderate: depth to rock, large stones.	Moderate: frost action, large stones.
Splitro	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
46 Venable	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, frost action.
47 Venable	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Severe: frost action.
48 Wichup	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, frost action.
49 Wix	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: low strength.
50*:				
Woodhall	Severe: depth to rock, large stones.	Severe: large stones.	Severe: depth to rock, large stones.	Severe: large stones.
Rogert	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

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

Soil name and map symbol	Septic tank absorption fields	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1 Alvarado	Severe: wetness.	Severe: seepage, wetness, large stones.	Severe: seepage, wetness.	Poor: small stones.
2 Becks	Severe: wetness, poor filter.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
3 Boyle	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
4*: Boyle	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
Rock outcrop.				
5 Buena Vista	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
6 Buffork	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
7 Buffork Variant	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, seepage, small stones.
8 Coutis	Slight	Severe: seepage.	Severe: seepage.	Good.
9 Coutis	Moderate: slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
10 Feltonia	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Fair: small stones, thin layer.
11*: Feltonia	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope, thin layer.
Coutis	Moderate: slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
12 Gelkie	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Poor: small stones.
13*: Granile	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: large stones, slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13*:				
Peeler	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: small stones, slope.
14--- Hoodle	Moderate: percs slowly, large stones.	Severe: seepage, large stones.	Slight	Poor: small stones.
15*:				
Lake Creek	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, large stones, slope.
Rock outcrop.				
16--- Lamphier	Moderate: percs slowly, slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
17--- Larand Variant	Severe: poor filter, large stones.	Severe: seepage, large stones.	Severe: seepage.	Poor: seepage, large stones.
18--- Leadville	Severe: large stones.	Severe: seepage, large stones.	Moderate: slope.	Poor: small stones.
19--- Libeg	Severe: large stones.	Severe: large stones.	Moderate: slope.	Poor: small stones.
20--- Martinsdale	Severe: percs slowly.	Moderate: too clayey.	Slight	Fair: too clayey.
21, 22--- Norriston	Severe: poor filter.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
23--- Norriston	Severe: poor filter, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
24--- Northwater	Severe: percs slowly, poor filter, slope.	Severe: seepage, slope, large stones.	Severe: slope.	Poor: large stones, slope.
25--- Novary	Severe: wetness, poor filter.	Severe: seepage, wetness, floods.	Severe: wetness.	Poor: wetness.
26--- Patent	Severe: percs slowly.	Slight	Slight	Good.
27--- Peeler	Severe: slope.	Severe: depth to rock, slope.	Severe: seepage, slope.	Poor: small stones, slope.
28--- Piltz	Severe: depth to rock, percs slowly.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, small stones.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
29*:				
Redfeather	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
30*:				
Rogert	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, seepage, small stones.
Rock outcrop.				
31*:				
Rogert	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, seepage, small stones.
Woodhall	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
32 Silvercliff	Severe: poor filter.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
33 Silvercliff	Severe: poor filter, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: too sandy, small stones, slope.
34 Silvercliff	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: small stones, slope.
35 Skutum	Severe: percs slowly.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, small stones.
36*:				
Splitro	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Rock outcrop.				
37 Stumpp Variant	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods.	Fair: small stones.
38. Terric Borosaprists				
39*:				
Tripit	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Splitro	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
40*:				
Troutdale	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Rogert	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, seepage, small stones.
41 Troutville	Severe: poor filter, large stones.	Severe: seepage, large stones.	Severe: seepage.	Poor: large stones.
42 Troutville	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: large stones, slope.
43 Ula	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
44*:				
Ula	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
Leadville	Severe: slope, large stones.	Severe: seepage, slope, large stones.	Severe: slope.	Poor: small stones, slope.
45*:				
Ula	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
Splitro	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
46 Venable	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
47 Venable	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, small stones.
48 Wichup	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Poor: small stones, wetness.
49 Wix	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
50*:				
Woodhall	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
50*: Rogert----------	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, seepage, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

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

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1 Alvarado	Fair: large stones, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
2 Becks	Fair: wetness.	Probable	Probable	Poor: small stones, area reclaim.
3 Boyle	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
4*: Boyle	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones, slope.
Rock outcrop.				
5 Buena Vista	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
6 Buffork	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, slope.
7 Buffork Variant	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: small stones, slope.
8 Coutis	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
9 Coutis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
10 Feltonia	Good	Probable	Probable	Poor: small stones, area reclaim.
11*: Feltonia	Good	Probable	Probable	Poor: small stones, area reclaim.
Coutis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
12 Gelkie	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
13*: Granile	Poor: large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
13*: Peeler	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
14 Hoodle	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
15*: Lake Creek	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, slope.
Rock outcrop.				
16 Lamphier	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
17 Larand Variant	Poor: large stones.	Improbable: large stones.	Improbable: large stones.	Poor: large stones, area reclaim.
18 Leadville	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones.
19 Libeg	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, area reclaim.
20 Martinsdale	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
21, 22 Norriston	Fair: large stones.	Probable	Probable	Poor: small stones, area reclaim.
23 Norriston	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
24 Northwater	Poor: large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
25 Novary	Poor: wetness.	Probable	Probable	Poor: wetness.
26 Patent	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
27 Peeler	Fair: area reclaim, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
28 Piltz	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
29*: Redfeather	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
30*: Rogert	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
31*: Rogert	Poor: area reclaim, slope.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones, slope.
Woodhall	Poor: area reclaim, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, slope.
32--- Silvercliff	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
33--- Silvercliff	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
34--- Silvercliff	Poor: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
35--- Skutum	Fair: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
36*: Splitro	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
37--- Stumpp Variant	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, excess salt.
38. Terric Borosaprists				
39*: Tripit	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Splitro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
40*:				
Troutdale	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rogert	Poor: area reclaim.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones.
41 Troutville	Poor: large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim.
42 Troutville	Poor: large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones, area reclaim, slope.
43 Ula	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
44*:				
Ula	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Leadville	Poor: large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones, slope.
45*:				
Ula	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Splitro	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
46, 47 Venable	Fair: wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
48 Wichup	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, small stones, area reclaim.
49 Wix	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
50*:				
Woodhall	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: large stones.
Rogert	Poor: area reclaim.	Improbable: thin layer.	Improbable: thin layer.	Poor: area reclaim, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1---------- Alvarado	Moderate: seepage, slope.	Severe: large stones.	Large stones, slope.	Large stones, wetness, droughty.	Large stones, wetness.	Large stones, droughty.
2---------- Becks	Severe: seepage.	Severe: seepage.	Large stones, slope, cutbanks cave.	Wetness, droughty.	Large stones, wetness, too sandy.	Large stones, droughty.
3---------- Boyle	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Slope, droughty, depth to rock.
4*: Boyle----------	Severe: depth to rock, slope.	Severe: large stones, thin layer.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
5---------- Buena Vista	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, droughty, soil blowing.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
6---------- Buffork	Severe: slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
7---------- Buffork Variant	Severe: seepage, slope.	Severe: seepage.	Deep to water	Depth to rock, slope.	Slope, depth to rock, too sandy.	Slope, depth to rock.
8---------- Coutis	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
9---------- Coutis	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.
10---------- Feltonia	Severe: seepage.	Severe: piping.	Deep to water	Slope----------	Favorable------	Favorable.
11*: Feltonia----------	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Slope----------	Slope.
Coutis----------	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.
12---------- Gelkie	Moderate: seepage, slope.	Moderate: thin layer, large stones.	Deep to water	Soil blowing, slope.	Large stones, soil blowing.	Large stones.
13*: Granile----------	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
Peeler----------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Soil blowing, slope.	Slope, large stones, soil blowing.	Large stones, slope.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
14---------- Hoodle	Moderate: seepage, slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Large stones---	Large stones, droughty.
15*: Lake Creek-------	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
16---------- Lamphier	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope----------	Slope.
17---------- Larand Variant	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
18---------- Leadville	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty.	Slope, large stones.	Large stones, slope, droughty.
19---------- Libeg	Severe: slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
20---------- Martinsdale	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, excess salt.	Erodes easily	Erodes easily.
21---------- Norriston	Severe: seepage.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Large stones, too sandy.	Large stones, droughty.
22, 23---------- Norriston	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
24---------- Northwater	Severe: slope.	Severe: large stones.	Deep to water	Large stones, slope.	Slope, large stones.	Large stones, slope.
25---------- Novary	Moderate: seepage.	Severe: piping, wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
26---------- Patent	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Favorable-------	Favorable.
27---------- Peeler	Severe: slope.	Moderate: thin layer.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.
28---------- Piltz	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, percs slowly.	Slope, depth to rock, percs slowly.
29*: Redfeather-------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
Rock outcrop.						
30*: Rogert----------	Severe: depth to rock, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
30*: Rock outcrop.						
31*: Rogert	Severe: depth to rock, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Woodhall	Severe: slope.	Severe: piping, large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
32--- Silvercliff	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Large stones, too sandy.	Large stones, droughty.
33--- Silvercliff	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
34--- Silvercliff	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
35--- Skutum	Severe: slope.	Moderate: seepage.	Deep to water	Soil blowing, percs slowly, slope.	Slope, soil blowing, percs slowly.	Slope, percs slowly.
36*: Splitro	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
Rock outcrop.						
37--- Stumpp Variant	Moderate: seepage.	Severe: piping.	Deep to water	Droughty, percs slowly.	Erodes easily	Excess salt, erodes easily, droughty.
38. Terric Borosaprists						
39*: Tripit	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Splitro	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
40*: Troutdale	Severe: seepage, slope.	Severe: seepage.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Rogert	Severe: depth to rock, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
41, 42--- Troutville	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
43--- Ula	Severe: slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
44*:						
Ula	Severe: slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Leadville	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty.	Slope, large stones.	Large stones, slope, droughty.
45*:						
Ula	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, large stones.	Deep to water	Large stones, depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
Splitro	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
46--- Venable	Moderate: seepage.	Severe: piping, wetness.	Floods, frost action.	Wetness, floods.	Wetness	Wetness.
47--- Venable	Moderate: seepage, slope.	Severe: wetness.	Frost action, slope.	Wetness, slope.	Large stones, wetness.	Large stones.
48--- Wichup	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Wetness, floods.	Wetness	Wetness.
49--- Wix	Severe: seepage, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
50*:						
Woodhall	Moderate: seepage, depth to rock, slope.	Severe: piping, large stones.	Deep to water	Large stones, depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
Rogert	Severe: depth to rock, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more 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	
1---------- Alvarado	0-12	Very cobbly sandy loam.	SM	A-2, A-1	35-45	60-80	55-75	40-65	20-35	15-25	NP-5
	12-41	Very cobbly sandy clay loam.	SM-SC	A-2, A-4	30-40	65-85	50-60	45-55	20-40	20-30	5-10
	41-60	Very cobbly sandy loam, very gravelly sandy loam.	SM	A-2, A-1	20-40	75-95	50-60	40-50	20-35	15-25	NP-5
2---------- Becks	0-15	Gravelly loam----	ML	A-4	5-10	70-80	65-75	60-70	50-60	25-35	NP-10
	15-19	Very gravelly sandy clay loam.	SC, GC	A-2	5-20	50-60	40-50	30-40	20-35	25-35	10-15
	19-37	Very gravelly loamy sand.	GP-GM	A-1	5-20	25-40	15-30	10-20	5-10	---	NP
	37-60	Very gravelly sand.	GP	A-1	10-30	20-40	10-25	5-15	0-5	---	NP
3---------- Boyle	0-8	Very gravelly sandy loam.	GM, GM-GC	A-2, A-1	10-25	40-55	35-50	25-40	10-20	15-30	NP-10
	8-14	Gravelly sandy clay loam, very gravelly sandy clay loam.	SM-SC	A-2, A-1	10-30	70-90	20-60	15-35	15-25	15-25	5-10
	14	Weathered bedrock	---	---	---	---	---	---	---	---	---
4*:											
Boyle----------	0-3	Very cobbly sandy loam.	SM, GM	A-1, A-2	25-50	60-80	60-80	40-60	15-25	---	NP
	3-12	Very cobbly sandy clay loam, very cobbly sandy loam.	SM-SC, GM-GC	A-2	20-50	55-75	55-75	35-60	15-30	15-25	5-10
	12	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
5---------- Buena Vista	0-10	Sandy loam-------	SM	A-2	0-5	75-100	75-100	50-65	20-30	---	NP
	10-30	Very channery sandy loam, very flaggy sandy loam.	GM, SM	A-1	20-50	45-65	45-65	25-45	15-25	---	NP
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
6---------- Buffork	0-4	Sandy loam-------	SM, ML	A-4	0	90-100	80-100	70-85	40-55	15-25	NP-5
	4-8	Fine sandy loam, sandy loam.	SM-SC, CL-ML	A-4	0	90-100	75-100	70-85	45-55	15-25	5-10
	8-30	Sandy clay loam	CL, SC	A-6	0	90-100	75-100	70-90	35-55	30-40	10-15
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
7---------- Buffork Variant	0-2	Cobbly sandy loam	SM	A-2, A-1	15-30	75-85	70-80	40-55	20-30	15-25	NP-5
	2-14	Sandy clay loam, gravelly sandy clay loam.	SC, GC	A-2, A-6	0-5	65-95	60-95	45-65	20-50	30-40	10-20
	14-21	Very gravelly loamy coarse sand.	GP-GM, SP-SM, GM, SM	A-1	0-5	40-60	30-50	15-25	5-15	---	NP
	21	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--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	
8, 9---------- Coutis	0-11	Sandy loam-------	SM	A-4	0	100	90-100	70-85	40-50	---	NP
	11-48	Fine sandy loam, sandy loam.	SM	A-4	0	100	90-100	70-85	40-50	---	NP
	48-60	Gravelly loam, gravelly sandy loam.	GM-GC, SM-SC	A-2, A-4	0-5	50-75	50-75	40-60	30-45	20-30	5-10
10---------- Feltonia	0-8	Sandy loam-------	SM	A-4, A-2	0	90-100	90-100	60-85	30-50	15-25	NP-5
	8-32	Loam, gravelly sandy loam.	ML, CL-ML, SM, SM-SC	A-4, A-2	0	70-100	60-100	50-85	30-60	15-25	NP-10
	32-60	Very gravelly loam, very gravelly sandy loam.	GM	A-1, A-2	0-15	50-60	30-50	20-40	10-30	15-20	NP-5
11*: Feltonia--------	0-8	Sandy loam-------	SM	A-4, A-2	0	90-100	90-100	60-85	30-50	15-25	NP-5
	8-32	Loam, gravelly sandy loam.	ML, CL-ML, SM, SM-SC	A-4, A-2	0	70-100	60-100	50-85	30-60	15-25	NP-10
	32-60	Very gravelly loam, very gravelly sandy loam.	GM	A-1, A-2	0	50-60	30-50	20-40	10-30	15-20	NP-5
Coutis----------	0-11	Sandy loam-------	SM	A-4	0	100	90-100	70-85	40-50	---	NP
	11-48	Fine sandy loam, sandy loam.	SM	A-4	0	100	90-100	70-85	40-50	---	NP
	48-60	Gravelly loam, gravelly sandy loam.	GM-GC, SM-SC	A-2, A-4	0-5	50-75	50-75	40-60	30-45	20-30	5-10
12---------- Gelkie	0-13	Sandy loam-------	SM	A-2, A-4	0-15	75-95	75-90	50-65	25-40	15-25	NP-5
	13-15	Sandy clay loam	SC	A-2, A-6	0-10	75-85	75-80	60-70	25-45	25-35	10-15
	15-40	Gravelly sandy clay loam, cobbly sandy clay loam, sandy clay loam.	GC, SC	A-2	0-25	50-85	50-80	30-60	15-35	25-35	10-15
	40-60	Very gravelly sandy loam, gravelly sandy loam, sandy loam.	SM, GM, SM-SC, GM-GC	A-1, A-2	0-35	40-85	40-80	25-50	10-30	15-25	NP-10
13*: Granile---------	0-16	Very cobbly sandy loam.	GM, SM	A-1, A-2, A-4	35-50	55-80	50-75	30-65	15-40	---	NP
	16-51	Very cobbly clay loam, very cobbly sandy clay loam.	GC, SC	A-6, A-2	25-75	50-75	40-70	35-65	30-50	25-40	10-20
	51-60	Very cobbly sandy loam.	GM, SM	A-1, A-2	40-75	30-75	25-70	20-40	10-30	---	NP
Peeler----------	0-14	Sandy loam-------	SM	A-2, A-4	0	80-95	75-90	50-65	25-40	20-25	NP-5
	14-44	Gravelly sandy clay loam, gravelly clay loam, cobbly sandy clay loam.	SC	A-2, A-6	0-30	65-90	60-75	30-45	20-40	30-35	10-15
	44-60	Gravelly coarse sandy loam, cobbly sandy loam.	SM	A-1	0-30	65-80	50-75	20-30	15-25	15-20	NP-5

See footnote at end of table.

TABLE 12.--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	
14---------- Hoodle	0-3	Cobbly sandy loam	GM, SM	A-2, A-1, A-4	20-30	60-85	60-80	35-65	20-40	15-20	NP-5
	3-17	Very cobbly clay loam, very cobbly sandy clay loam, very gravelly clay loam.	GC, SC, CL	A-6, A-2	20-40	50-75	50-75	35-70	30-65	25-35	10-15
	17-45	Very gravelly loam, very cobbly loam.	GM-GC	A-2, A-4	10-35	40-65	40-65	30-60	25-50	20-30	5-10
	45-60	Very gravelly sandy loam, very cobbly sandy loam.	GM	A-1, A-2	5-40	30-60	30-60	15-45	15-30	---	NP
15*:											
Lake Creek------	0-2	Very bouldery sandy loam.	SM	A-2	55-75	75-100	75-100	50-65	20-30	15-25	NP-5
	2-23	Very stony sandy loam, very bouldery sandy loam.	SM	A-2	55-75	75-100	75-100	50-65	20-30	15-25	NP-5
	23-32	Very stony sandy clay loam, very bouldery sandy clay loam, very stony clay loam.	SM-SC, CL	A-2, A-4	60-80	75-100	75-100	45-80	20-55	20-30	5-10
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
16---------- Lamphier	0-14	Loam----------	ML	A-4	0-10	80-100	75-100	70-95	50-75	25-35	NP-5
	14-60	Loam, clay loam, sandy clay loam.	CL-ML, CL	A-4, A-6	0-10	80-100	75-100	70-100	55-80	25-40	5-15
17---------- Larand Variant	0-19	Very stony sandy loam.	SM-SC, GM-GC	A-2, A-4	35-60	70-80	65-70	50-70	20-50	20-25	5-10
	19-31	Extremely stony sandy loam, extremely stony sandy clay loam.	GM-GC, GC	A-2	60-70	35-45	30-40	25-35	10-30	25-35	5-15
	31-60	Extremely stony loamy sand.	SM, GM, SP-SM, GP-GM	A-1	60-70	55-65	50-60	25-45	5-20	10-15	NP-5
18---------- Leadville	0-22	Very cobbly sandy loam.	ML, GM	A-4	20-40	70-100	70-95	55-80	40-60	20-35	NP-10
	22-40	Very stony clay loam, very cobbly clay loam, very cobbly sandy clay loam.	GC, SC	A-2, A-6	35-70	30-80	25-70	25-50	20-45	30-40	10-20
	40-60	Very gravelly sandy loam.	GM	A-1	15-20	25-50	25-50	15-35	10-20	---	NP

See footnote at end of table.

TABLE 12.--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	
19---------- Libeg	0-10	Very cobbly sandy loam.	SM, GM	A-1, A-2, A-4	40-65	55-90	45-80	30-60	15-40	15-25	NP-5
	10-17	Very channery loam, very channery clay loam, very cobbly sandy loam.	GM-GC, GC, SM-SC, SC	A-2, A-4, A-6	30-65	35-80	30-70	20-55	15-50	20-35	5-15
	17-35	Very channery sandy clay loam, very channery clay loam, very cobbly sandy clay loam.	GM-GC, GC, SM-SC, SC	A-2, A-4, A-6	30-65	40-80	30-70	20-55	15-50	25-35	5-15
	35-60	Extremely stony sandy loam, very cobbly sandy loam, very gravelly sandy loam.	GM-GC, GM	A-1, A-2	15-65	30-60	20-50	15-40	10-30	20-30	NP-10
20---------- Martinsdale	0-7	Gravelly sandy loam.	SM-SC, SC, SM	A-2, A-4	0-5	65-85	55-75	30-55	20-40	25-35	5-10
	7-20	Sandy clay loam, clay loam, loam.	CL	A-4, A-6	0-5	85-100	80-100	60-80	50-70	30-40	10-15
	20-60	Gravelly loam, gravelly sandy clay loam, gravelly sandy loam.	SM, GM	A-4, A-2	0-10	70-90	60-80	40-60	30-50	25-35	NP-10
21, 22, 23------- Norriston	0-6	Very cobbly sandy loam.	GM, SM	A-1	35-50	55-75	50-70	25-50	15-25	---	NP
	6-18	Very cobbly sandy loam, very gravelly sandy loam.	GM-GC, SM-SC	A-2	20-50	40-60	35-55	20-40	10-20	15-20	5-10
	18-60	Very cobbly loamy sand, very cobbly sand, very gravelly loamy sand.	SP, SP-SM	A-1	35-50	55-75	50-70	25-45	0-10	---	NP
24---------- Northwater	0-35	Very stony loam	ML	A-4	25-70	75-95	75-90	65-90	50-70	25-35	NP-5
	35-50	Very cobbly clay loam, very stony clay loam, extremely stony sandy clay loam.	GC, SC	A-2, A-6	30-70	40-80	40-80	35-75	25-50	25-35	10-15
	50-60	Very cobbly sandy loam.	GM, SM	A-2, A-1	30-60	50-80	50-80	35-55	20-35	---	NP
25---------- Novary	0-4	Loam----------	ML, CL-ML	A-4	0	95-100	90-100	85-95	55-75	20-30	NP-10
	4-60	Stratified loam to silty clay.	CL-ML, CL	A-4, A-6	0	95-100	85-100	70-95	50-95	25-35	5-15
26---------- Patent	0-7	Loam----------	CL	A-6	0-5	95-100	95-100	85-100	65-95	25-40	10-20
	7-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	65-95	25-45	10-25
27---------- Peeler	0-14	Sandy loam-------	SM-SC, CL-ML	A-2, A-4	0-5	75-100	75-95	40-70	20-55	15-25	5-10
	14-22	Sandy clay loam	SC, CL	A-2, A-6	0-5	75-100	75-95	55-75	25-60	20-30	10-15
	22-44	Gravelly sandy clay loam.	GC, SC	A-2, A-6	0-5	50-75	50-75	35-60	20-40	20-30	10-15
	44	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--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	
28---------- Piltz	0-14	Loam----------	CL-ML	A-4	0-10	75-100	75-95	60-85	50-75	25-30	5-10
	14-36	Gravelly clay loam, gravelly clay.	GC, SC, CL	A-2, A-6, A-7	0-10	50-75	50-75	35-70	30-65	35-50	20-30
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
29*:											
Redfeather------	0-3	Stony sandy loam	SM	A-2	5-10	75-95	75-90	45-65	25-35	---	NP
	3-7	Very gravelly sandy loam, gravelly sandy loam.	SM, GM	A-1, A-2	0-10	40-80	30-75	20-50	10-30	---	NP
	7-14	Very gravelly sandy clay loam, very gravelly sandy loam.	GC, GM-GC	A-2	5-15	25-55	20-50	15-45	10-30	20-40	5-20
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
30*:											
Rogert----------	0-5	Very cobbly sandy loam.	GP-GM, GM	A-1, A-2	10-45	15-70	15-70	10-50	5-30	20-30	NP-5
	5-18	Very gravelly sandy loam, very cobbly sandy loam.	GM, GP-GM	A-1	10-50	20-50	20-50	15-35	5-20	---	NP
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
31*:											
Rogert----------	0-10	Very cobbly sandy loam.	GP-GM, GM	A-1, A-2	10-45	15-70	15-70	10-50	5-30	20-30	NP-5
	10-15	Very gravelly sandy loam, very cobbly sandy loam.	GM, GP-GM	A-1	10-50	20-50	20-50	15-35	5-20	---	NP
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Woodhall--------	0-10	Very cobbly sandy loam.	SM	A-2, A-4, A-1	15-75	80-90	75-90	40-70	20-50	15-20	NP-5
	10-28	Very stony loam, very stony clay loam, very cobbly clay loam.	ML, GM, SM	A-4	40-60	50-90	50-85	45-80	35-55	30-40	5-10
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
32---------- Silvercliff	0-8	Gravelly sandy loam.	SM	A-1, A-2	0-5	65-80	60-75	40-65	20-35	---	NP
	8-21	Very gravelly sandy loam, gravelly loam.	GM, GM-GC, SM-SC, SM	A-1, A-2, A-4	5-15	35-70	30-70	25-45	15-40	15-25	NP-10
	21-60	Stratified very gravelly sand to cobbly loam.	GM, SM	A-1, A-2	5-20	40-75	40-65	25-50	10-30	---	NP

See footnote at end of table.

TABLE 12.--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	
33---------- Silvercliff	0-8	Cobbly sandy loam	SM	A-1, A-2	5-20	65-90	60-80	40-65	20-35	---	NP
	8-14	Very gravelly sandy loam, gravelly loam.	GM, GM-GC, SM-SC, SM	A-1, A-2, A-4	5-15	35-70	30-70	25-45	15-40	15-25	NP-10
	14-60	Stratified very gravelly sand to cobbly loam.	GM, SM	A-1, A-2	5-20	40-75	40-65	25-50	10-30	---	NP
34---------- Silvercliff	0-8	Very cobbly sandy loam.	SM	A-1, A-2	15-40	65-90	60-80	40-65	20-35	---	NP
	8-50	Very cobbly sandy loam, very gravelly sandy loam.	GM, GM-GC, SM-SC, SM	A-1, A-2	10-30	35-65	30-60	25-45	15-25	15-25	NP-10
	50-60	Very gravelly loamy sand.	GP-GM, SP-SM, GM, SM	A-1	5-15	40-60	35-60	25-50	5-15	---	NP
35---------- Skutum	0-16	Fine sandy loam	SM, ML	A-2, A-4	0	75-100	70-100	60-95	30-55	15-25	NP-5
	16-48	Gravelly clay loam, gravelly clay, gravelly sandy clay loam.	GC	A-6, A-7	0-15	55-75	50-70	45-65	35-50	30-45	10-20
	48-60	Gravelly sandy loam.	GM-GC, SM-SC	A-2	5-20	60-75	55-75	35-50	20-35	20-30	5-10
36*: Splitro---------	0-8	Sandy loam-------	SM	A-4	0-5	90-100	90-100	60-80	35-50	---	NP
	8-13	Gravelly sandy loam, sandy loam.	SM	A-2	0-10	60-90	60-90	55-65	25-35	---	NP
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
37---------- Stumpp Variant	0-5	Loam----------	ML, CL-ML	A-4	0	85-100	80-100	70-95	50-75	20-35	5-10
	5-19	Clay, clay loam	CH, CL	A-7	0	85-100	80-100	70-100	60-95	40-65	25-45
	19-60	Loam, sandy loam	SM, ML, SM-SC, CL-ML	A-2, A-4	0-5	80-100	75-100	55-90	30-70	15-30	NP-10
38. Terric Borosaprists											
39*: Tripit----------	0-18	Sandy loam-------	SM	A-2, A-4	0	75-90	75-90	45-65	25-40	---	NP
	18-28	Gravelly clay loam, clay loam.	GC, CL	A-2, A-6	0-5	55-75	50-75	35-70	30-60	30-40	15-20
	28	Weathered bedrock	---	---	---	---	---	---	---	---	---
Splitro---------	0-8	Sandy loam-------	SM	A-4	0-5	90-100	90-100	60-80	35-50	---	NP
	8-13	Gravelly sandy loam, sandy loam.	SM	A-2	0-10	60-90	60-90	55-65	25-35	---	NP
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--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	
40*:											
Troutdale	0-14	Sandy loam	SM	A-2	0-5	75-100	75-100	50-75	20-35	---	NP
	14-30	Sandy clay loam, gravelly sandy clay loam, loam.	SM-SC, CL-ML, GM-GC	A-2, A-4	0-5	60-100	55-95	35-80	25-60	15-25	5-10
	30-35	Coarse sandy loam, sandy loam, gravelly sandy loam.	SM, GM	A-2, A-1	0-5	60-95	55-90	30-65	15-35	---	NP
	35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rogert	0-8	Gravelly sandy loam.	GM	A-4, A-2	5-10	60-75	55-70	35-50	30-40	25-35	NP-5
	8-15	Very gravelly sandy loam, very cobbly sandy loam.	GM, GP-GM	A-1	10-50	20-50	20-50	15-35	5-20	---	NP
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
41 Troutville	0-15	Very cobbly sandy loam.	SM, GM	A-1, A-2	20-60	45-70	40-65	30-60	15-35	---	NP
	15-60	Stratified extremely stony loamy sand to sandy clay loam.	GM, SM	A-1, A-2	60-75	35-65	35-60	25-50	20-35	---	NP
42 Troutville	0-15	Extremely stony sandy loam.	SM, GM	A-1, A-2	20-60	45-70	40-65	30-60	15-35	---	NP
	15-60	Stratified extremely stony loamy sand to sandy clay loam.	GM, SM	A-1, A-2	60-75	35-65	35-60	25-50	20-35	---	NP
43 Ula	0-5	Cobbly sandy loam	SM	A-2, A-1	10-30	65-85	60-80	40-65	20-35	20-30	NP-5
	5-17	Cobbly sandy loam, sandy loam, gravelly sandy loam.	SM, GM	A-2, A-1	0-30	60-95	50-90	40-60	20-35	15-25	NP-5
	17-37	Cobbly sandy clay loam, gravelly sandy clay loam.	SM-SC, SC	A-2, A-4, A-6	0-30	70-95	60-90	45-75	30-40	25-35	5-15
	37	Weathered bedrock	---	---	---	---	---	---	---	---	---
44*:											
Ula	0-5	Cobbly sandy loam	SM	A-2, A-1	10-30	65-85	60-80	40-65	20-35	20-30	NP-5
	5-17	Cobbly sandy loam, sandy loam, gravelly sandy loam.	SM, GM	A-2, A-1	0-30	60-95	50-90	40-60	20-35	15-25	NP-5
	17-37	Cobbly sandy clay loam, gravelly sandy clay loam.	SM-SC, SC	A-2, A-4, A-6	0-30	70-95	60-90	45-75	30-40	25-35	5-15
	37	Weathered bedrock	---	---	---	---	---	---	---	---	---
Leadville	0-22	Very cobbly sandy loam.	ML, GM	A-4	20-40	70-100	70-95	55-80	40-60	20-35	NP-10
	22-40	Very stony clay loam, very cobbly clay loam, very gravelly sandy clay loam.	GC, SC	A-2, A-6	35-70	30-80	25-70	25-50	20-45	30-40	10-20
	40-60	Very gravelly sandy loam.	GM	A-1	5-10	25-50	25-50	15-35	10-20	---	NP

See footnote at end of table.

TABLE 12.--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	
45*:											
Ula	0-5	Cobbly sandy loam	SM	A-2, A-1	10-30	65-85	60-80	40-65	20-35	20-30	NP-5
	5-17	Cobbly sandy loam, sandy loam, gravelly sandy loam.	SM, GM	A-2, A-1	0-30	60-95	50-90	40-60	20-35	15-25	NP-5
	17-37	Cobbly sandy clay loam, gravelly sandy clay loam.	SM-SC, SC	A-2, A-4, A-6	0-30	70-95	60-90	45-75	30-40	25-35	5-15
	37	Weathered bedrock	---	---	---	---	---	---	---	---	---
Splitro	0-4	Sandy loam	SM	A-4	0-5	90-100	90-100	60-80	35-50	---	NP
	4-16	Channery sandy loam, sandy loam.	SM	A-2	0-10	60-90	60-90	55-65	25-35	---	NP
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
46	0-23	Loam	ML, SM	A-4	0-5	90-100	75-100	75-90	45-70	20-30	NP-5
Venable	23-60	Loam	CL, CL-ML	A-4, A-6	0-5	85-100	75-100	75-90	50-75	20-30	5-15
47	0-17	Cobbly clay loam	CL	A-6	15-30	80-90	75-90	70-90	55-70	25-40	10-20
Venable	17-30	Gravelly sandy clay loam, gravelly loam.	SC	A-6, A-2	0-10	75-85	70-80	55-70	30-50	30-40	15-20
	30-60	Gravelly sandy clay loam, gravelly clay loam.	SC	A-6, A-7	0-10	75-85	70-80	60-70	35-50	30-45	15-25
48	9-0	Peat	PT	A-8	0	---	---	---	---	---	---
Wichup	0-13	Loam, sandy loam	CL-ML, CL, SM-SC, SC	A-4, A-2	0	90-100	90-100	70-95	30-70	20-30	5-15
	13-60	Sandy loam, gravelly sandy loam.	SM, GM	A-2, A-4	0-5	60-90	50-85	50-70	30-40	15-20	NP-5
49	0-8	Sandy loam	SM, SM-SC	A-2, A-4, A-1	0-5	85-100	75-100	45-70	20-40	15-25	NP-10
Wix	8-22	Sandy clay loam, clay loam.	CL	A-6	0-5	85-100	75-100	70-100	50-80	25-40	15-25
	22-30	Gravelly sandy loam.	SM, SM-SC	A-2, A-1	0-5	65-80	50-75	35-50	15-30	15-25	NP-10
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
50*:											
Woodhall	0-10	Very cobbly sandy loam.	SM	A-2, A-4, A-1	15-65	80-90	75-90	40-70	20-50	15-20	NP-5
	10-28	Very stony loam, very stony clay loam, very cobbly clay loam.	ML, GM, SM	A-4	40-60	50-90	50-85	45-80	35-55	30-40	5-10
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rogert	0-10	Very cobbly sandy loam.	GP-GM, GM	A-1, A-2	10-45	15-70	15-70	10-50	5-30	20-30	NP-5
	10-15	Very gravelly sandy loam, very cobbly sandy loam.	GM, GP-GM	A-1	10-50	20-50	20-50	15-35	5-20	---	NP
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
1----------	0-12	10-20	2.0-6.0	0.07-0.09	6.6-7.3	<2	Low----------	0.15	5	4-6
Alvarado	12-41	20-30	0.6-2.0	0.08-0.10	6.6-7.3	<2	Low----------	0.24		
	41-60	10-20	2.0-6.0	0.07-0.09	6.6-8.4	<2	Low----------	0.15		
2----------	0-15	15-25	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.15	2	2-4
Becks	15-19	20-30	0.6-2.0	0.07-0.09	7.4-8.4	<2	Low----------	0.15		
	19-37	3-7	>20	0.03-0.05	7.4-8.4	<2	Low----------	0.10		
	37-60	1-3	>20	0.03-0.05	7.4-8.4	<2	Low----------	0.10		
3----------	0-8	10-20	2.0-6.0	0.05-0.08	6.1-7.3	<2	Low----------	0.15	1	2-4
Boyle	8-14	20-30	0.6-2.0	0.06-0.08	6.1-7.3	<2	Low----------	0.10		
	14	---	---	---	---	---	----------	----		
4*:										
Boyle----------	0-3	10-15	2.0-6.0	0.07-0.09	6.1-7.3	<2	Low----------	0.10	1	2-4
	3-12	18-25	0.6-2.0	0.07-0.09	6.1-7.3	<2	Low----------	0.10		
	12	---	---	---	---	---	----------	----		
Rock outcrop.										
5----------	0-10	10-18	2.0-6.0	0.11-0.13	6.6-7.3	<2	Low----------	0.17	2	3-4
Buena Vista	10-30	10-18	2.0-6.0	0.03-0.05	6.6-8.4	<2	Low----------	0.15		
	30	---	---	---	---	---	----------	----		
6----------	0-4	10-15	0.6-6.0	0.13-0.15	6.1-7.3	<2	Low----------	0.17	3	2-4
Buffork	4-8	10-15	0.6-2.0	0.13-0.15	6.1-7.8	<2	Low----------	0.17		
	8-30	20-35	0.6-2.0	0.14-0.16	6.6-7.8	<2	Moderate-----	0.15		
	30	---	---	---	---	---	----------	----		
7----------	0-2	10-20	2.0-6.0	0.11-0.13	6.6-7.3	<2	Low----------	0.20	3	2-4
Buffork Variant	2-14	20-30	0.6-2.0	0.14-0.16	6.6-7.3	<2	Moderate-----	0.24		
	14-21	3-6	6.0-20	0.05-0.07	6.6-7.3	<2	Low----------	0.15		
	21	---	---	---	---	---	----------	----		
8, 9----------	0-11	12-18	2.0-6.0	0.13-0.15	6.1-7.8	<2	Low----------	0.20	5	2-4
Coutis	11-48	12-18	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low----------	0.20		
	48-60	15-25	2.0-6.0	0.12-0.14	6.7-7.8	<2	Low----------	0.28		
10----------	0-8	10-18	0.6-2.0	0.13-0.19	7.4-7.8	<2	Low----------	0.24	5	3-5
Feltonia	8-32	10-18	0.6-2.0	0.13-0.19	7.4-8.4	<2	Low----------	0.24		
	32-60	10-18	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low----------	0.17		
11*:										
Feltonia--------	0-8	10-18	0.6-2.0	0.13-0.19	7.4-7.8	<2	Low----------	0.24	5	3-5
	8-32	10-18	0.6-2.0	0.13-0.19	7.4-8.4	<2	Low----------	0.24		
	32-60	10-18	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low----------	0.17		
Coutis----------	0-11	12-18	2.0-6.0	0.13-0.15	6.1-7.8	<2	Low----------	0.20	5	2-4
	11-48	12-18	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low----------	0.20		
	48-60	15-25	2.0-6.0	0.12-0.14	6.7-7.8	<2	Low----------	0.28		
12----------	0-13	5-15	2.0-6.0	0.10-0.13	6.6-7.8	<2	Low----------	0.15	5	2-3
Gelkie	13-15	20-35	0.6-2.0	0.14-0.16	6.6-7.8	<2	Moderate-----	0.24		
	15-40	20-35	0.6-2.0	0.10-0.13	6.6-8.4	<2	Moderate-----	0.24		
	40-60	5-20	2.0-6.0	0.05-0.13	7.9-8.4	<2	Low----------	0.15		
13*:										
Granile----------	0-16	10-20	2.0-6.0	0.06-0.09	5.6-7.3	<2	Low----------	0.10	5	.5-1
	16-51	20-35	0.6-2.0	0.08-0.11	6.1-7.3	<2	Low----------	0.10		
	51-60	10-20	6.0-20	0.05-0.08	6.1-7.3	<2	Low----------	0.10		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
13*:										
Peeler	0-14	10-20	2.0-6.0	0.12-0.14	6.1-7.3	<2	Low	0.28	5	.5-1
	14-44	18-35	0.6-2.0	0.14-0.16	5.6-7.8	<2	Low	0.15		
	44-60	10-20	6.0-20	0.07-0.09	6.1-7.8	<2	Low	0.15		
14	0-3	10-15	2.0-6.0	0.08-0.10	6.6-7.8	<2	Low	0.17	5	2-4
Hoodle	3-17	20-30	0.6-2.0	0.10-0.13	6.6-8.4	<2	Low	0.17		
	17-45	10-25	0.6-2.0	0.09-0.12	7.4-8.4	<2	Low	0.17		
	45-60	10-20	2.0-6.0	0.07-0.09	7.4-8.4	<2	Low	0.17		
15*:										
Lake Creek	0-2	15-20	2.0-6.0	0.05-0.07	6.6-7.3	<2	Low	0.15	2	.5-1
	2-23	15-20	2.0-6.0	0.05-0.07	6.6-7.3	<2	Low	0.15		
	23-32	20-35	0.6-2.0	0.08-0.10	6.6-7.3	<2	Low	0.20		
	32	---	---	---	---	---	---	---		
Rock outcrop.										
16	0-14	20-27	0.6-2.0	0.18-0.21	6.1-7.3	<2	Low	0.28	5	2-4
Lamphier	14-60	20-35	0.6-2.0	0.18-0.21	6.1-7.3	<2	Moderate	0.32		
17	0-19	10-20	2.0-6.0	0.07-0.09	5.6-6.0	<2	Low	0.15	3	.5-1
Larand Variant	19-31	15-25	2.0-6.0	0.05-0.07	5.6-6.0	<2	Low	0.24		
	31-60	2-10	>20.0	0.04-0.05	5.6-6.0	<2	Low	0.10		
18	0-22	15-25	0.6-2.0	0.10-0.15	5.6-7.3	<2	Low	0.20	5	.5-1
Leadville	22-40	27-35	0.6-2.0	0.06-0.10	6.1-7.3	<2	Low	0.10		
	40-60	15-20	2.0-6.0	0.05-0.07	6.6-7.3	<2	Low	0.10		
19	0-10	10-20	2.0-6.0	0.04-0.08	6.1-7.3	<2	Low	0.17	5	2-4
Libeg	10-17	15-32	0.6-2.0	0.05-0.09	6.1-7.3	<2	Low	0.28		
	17-35	20-35	0.6-2.0	0.05-0.09	6.1-7.3	<2	Low	0.24		
	35-60	10-20	0.6-2.0	0.03-0.07	5.6-7.3	<2	Low	0.17		
20	0-7	15-30	0.6-2.0	0.10-0.14	6.6-7.8	<2	Low	0.17	5	---
Martinsdale	7-20	25-30	0.2-0.6	0.12-0.18	6.6-8.4	<2	Moderate	0.15		
	20-60	15-30	0.6-2.0	0.08-0.12	7.9-9.0	2-8	Low	0.22		
21, 22, 23	0-6	8-12	2.0-6.0	0.04-0.06	6.6-7.3	<2	Low	0.10	5	2-4
Norriston	6-18	14-18	6.0-20.0	0.03-0.05	6.6-7.3	<2	Low	0.15		
	18-60	0-10	>20.0	0.03-0.05	6.6-7.3	<2	Low	0.10		
24	0-35	15-27	0.6-2.0	0.14-0.16	6.1-7.3	<2	Low	0.17	5	3-6
Northwater	35-50	20-35	0.2-0.6	0.10-0.12	6.1-7.3	<2	Moderate	0.32		
	50-60	12-20	>6.0	0.07-0.09	6.6-7.3	<2	Low	0.17		
25	0-4	15-27	0.6-2.0	0.14-0.20	7.9-8.4	2-4	Low	0.24	---	---
Novary	4-60	22-35	0.2-0.6	0.14-0.20	7.9-8.4	2-4	Low	0.32		
26	0-7	20-27	0.6-2.0	0.20-0.22	6.6-7.8	<2	Moderate	0.24	5	2-5
Patent	7-60	20-35	0.2-0.6	0.14-0.19	7.9-8.4	<2	Moderate	0.24		
27	0-14	10-20	2.0-60	0.11-0.13	6.1-7.3	<2	Low	0.15	4	.5-1
Peeler	14-22	20-35	0.6-2.0	0.15-0.17	6.1-7.3	<2	Low	0.24		
	22-44	20-35	0.6-2.0	0.13-0.15	6.1-7.3	<2	Low	0.20		
	44	---	---	---	---	---	---	---		
28	0-14	18-27	0.6-2.0	0.14-0.16	6.6-7.8	<2	Low	0.24	2	2-4
Piltz	14-36	35-50	0.06-0.2	0.12-0.15	6.6-7.8	<2	Moderate	0.24		
	36	---	---	---	---	---	---	---		
29*:										
Redfeather	0-3	10-20	2.0-6.0	0.10-0.12	5.1-6.5	<2	Low	0.17	1	.5-1
	3-7	10-20	2.0-6.0	0.08-0.12	5.1-7.3	<2	Low	0.10		
	7-14	15-25	0.6-2.0	0.07-0.10	5.1-7.3	<2	Low	0.10		
	14	---	---	---	---	---	---	---		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
29*:										
Rock outcrop.										
30*:										
Rogert	0-5	5-15	2.0-6.0	0.05-0.07	6.1-7.8	<2	Low	0.10	1	2-4
	5-18	5-10	>6.0	0.05-0.07	6.1-7.8	<2	Low	0.10		
	18	---	---	---	---	---	---	---		
Rock outcrop.										
31*:										
Rogert	0-10	5-15	2.0-6.0	0.05-0.07	6.1-7.8	<2	Low	0.10	1	2-4
	10-15	5-10	>6.0	0.05-0.07	6.1-7.8	<2	Low	0.10		
	15	---	---	---	---	---	---	---		
Woodhall	0-10	10-20	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.20	2	2-4
	10-28	20-35	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.17		
	28	---	---	---	---	---	---	---		
32	0-8	10-20	2.0-6.0	0.09-0.11	6.6-7.8	<2	Low	0.15	5	2-4
Silvercliff	8-21	10-20	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low	0.15		
	21-60	5-20	>6.0	0.04-0.07	7.4-8.4	<2	Low	0.10		
33	0-8	10-20	2.0-6.0	0.09-0.11	6.6-7.8	<2	Low	0.15	5	2-4
Silvercliff	8-14	10-20	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low	0.15		
	14-60	5-20	>6.0	0.04-0.07	7.4-8.4	<2	Low	0.10		
34	0-8	10-20	2.0-6.0	0.08-0.10	7.4-7.8	<2	Low	0.15	5	2-4
Silvercliff	8-50	10-20	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low	0.15		
	50-60	3-8	>6.0	0.04-0.07	7.4-8.4	<2	Low	0.10		
35	0-16	10-15	0.6-2.0	0.09-0.11	6.1-7.3	<2	Low	0.24	3	3-5
Skutum	16-48	35-45	0.06-0.2	0.13-0.16	6.1-7.3	<2	Moderate	0.20		
	48-60	15-20	0.6-2.0	0.07-0.08	6.1-7.3	<2	Low	0.20		
36*:										
Splitro	0-8	10-20	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	1	2-4
	8-13	10-18	2.0-6.0	0.08-0.12	6.1-7.8	<2	Low	0.20		
	13	---	---	---	---	---	---	---		
Rock outcrop.										
37	0-5	10-25	0.6-2.0	0.07-0.09	7.4-9.0	8-16	Low	0.32	3	1-3
Stumpp Variant	5-19	35-60	0.06-0.2	0.06-0.08	>8.4	8-16	High	0.32		
	19-60	10-25	0.6-2.0	0.06-0.08	7.9-9.0	4-16	Low	0.37		
38.										
Terric Borosaprists										
39*:										
Tripit	0-18	10-20	0.6-2.0	0.16-0.18	6.6-7.8	<2	Low	0.37	3	2-4
	18-28	28-35	0.6-2.0	0.10-0.16	6.6-7.8	<2	Moderate	0.49		
	28	---	---	---	---	---	---	---		
Splitro	0-8	10-20	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	1	2-4
	8-13	10-18	2.0-6.0	0.08-0.12	6.1-7.8	<2	Low	0.20		
	16	---	---	---	---	---	---	---		
40*:										
Troutdale	0-14	10-20	2.0-6.0	0.13-0.15	6.1-7.3	<2	Low	0.17	3	2-5
	14-30	20-35	0.6-2.0	0.14-0.17	6.1-7.3	<2	Low	0.24		
	30-35	10-20	2.0-6.0	0.12-0.15	6.1-7.3	<2	Low	0.15		
	35	---	---	---	---	---	---	---		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				Pct
40*:										
Rogert	0-8	15-20	2.0-6.0	0.07-0.09	6.1-7.8	<2	Low	0.17	1	2-4
	8-15	5-10	>6.0	0.05-0.07	6.1-7.8	<2	Low	0.10		
	15	---	---	---	---	---	---	---		
41, 42	0-15	7-15	2.0-6.0	0.05-0.08	6.1-7.3	<2	Low	0.15	5	.5-1
Troutville	15-60	5-15	2.0-6.0	0.05-0.07	6.1-7.3	<2	Low	0.10		
43	0-5	10-20	2.0-6.0	0.11-0.13	6.1-7.3	<2	Low	0.15	2	2-3
Ula	5-17	10-20	2.0-6.0	0.10-0.12	6.1-7.3	<2	Low	0.17		
	17-37	20-35	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.20		
	37	---	---	---	---	---	---	---		
44*:										
Ula	0-5	10-20	2.0-6.0	0.11-0.13	6.1-7.3	<2	Low	0.15	2	2-3
	5-17	10-20	2.0-6.0	0.10-0.12	6.1-7.3	<2	Low	0.17		
	17-37	20-35	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.20		
	37	---	---	---	---	---	---	---		
Leadville	0-22	15-20	0.6-2.0	0.10-0.15	5.6-7.3	<2	Low	0.20	5	.5-1
	22-40	27-35	0.6-2.0	0.06-0.10	6.1-7.3	<2	Low	0.10		
	40-60	15-20	2.0-6.0	0.05-0.07	6.6-7.3	<2	Low	0.10		
45*:										
Ula	0-5	10-20	2.0-6.0	0.11-0.13	6.1-7.3	<2	Low	0.15	2	2-3
	5-17	10-20	2.0-6.0	0.10-0.12	6.1-7.3	<2	Low	0.17		
	17-37	20-35	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.20		
	37	---	---	---	---	---	---	---		
Splitro	0-4	10-20	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	1	2-4
	4-16	10-18	2.0-6.0	0.08-0.12	6.1-7.8	<2	Low	0.20		
	16	---	---	---	---	---	---	---		
46	0-23	15-25	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low	0.28	5	3-6
Venable	23-60	18-27	0.6-2.0	0.16-0.18	6.1-7.8	<2	Moderate	0.20		
47	0-17	30-40	0.2-0.6	0.15-0.17	6.1-7.8	<2	Moderate	0.28	5	2-5
Venable	17-30	20-35	0.6-2.0	0.13-0.15	6.1-7.8	<2	Moderate	0.20		
	30-60	30-40	0.6-2.0	0.13-0.15	6.1-7.8	<2	Moderate	0.32		
48	9-0	---	2.0-6.0	0.25-0.30	6.1-8.4	<2	Low	---	---	20-40
Wichup	0-13	15-25	2.0-6.0	0.13-0.18	6.1-7.8	<2	Low	---		
	13-60	10-18	0.6-2.0	0.11-0.13	6.1-7.8	<2	Low	---		
49	0-8	10-15	2.0-6.0	0.10-0.13	6.1-7.8	<2	Low	0.15	2	2-5
Wix	8-22	20-35	0.6-2.0	0.13-0.16	6.1-7.3	<2	Moderate	0.24		
	22-30	10-15	2.0-6.0	0.07-0.09	6.1-7.3	<2	Low	0.10		
	30	---	---	---	---	---	---	---		
50*:										
Woodhall	0-10	10-20	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.20	2	2-4
	10-28	20-35	0.6-2.0	0.10-0.14	6.1-7.3	<2	Low	0.17		
	28	---	---	---	---	---	---	---		
Rogert	0-10	5-15	2.0-6.0	0.05-0.07	6.1-7.8	<2	Low	0.10	1	2-4
	10-15	5-10	>6.0	0.05-0.07	6.1-7.8	<2	Low	0.10		
	15	---	---	---	---	---	---	---		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SOIL AND WATER FEATURES

["Flooding" and "bedrock" and terms such as "rare," "frequent," "occasional," "soft," and "hard" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding		High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
				Ft		In				
1----- Alvarado	B	None-----	---	2.0-4.0	Mar-Jun	>60	---	Moderate-----	Moderate	Low.
2----- Becks	C	None-----	---	2.5-4.0	Mar-Aug	>60	---	Moderate-----	High-----	Low.
3----- Boyle	D	None-----	---	>6.0	---	10-20	Soft	Moderate-----	Moderate	Low.
4*: Boyle-----	D	None-----	---	>6.0	---	10-20	Soft	Low----------	Moderate	Low.
Rock outcrop.										
5----- Buena Vista	B	None-----	---	>6.0	---	20-40	Hard	Moderate-----	Low------	Low.
6----- Buffork	C	None-----	---	>6.0	---	20-40	Soft	Moderate-----	High-----	Low.
7----- Buffork Variant	C	None-----	---	>6.0	---	20-40	Soft	Low----------	High-----	Low.
8, 9----- Coutis	A	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Low.
10----- Feltonia	B	None-----	---	>6.0	---	>60	---	Moderate-----	Moderate	Low.
11*: Feltonia-----	B	None-----	---	>6.0	---	>60	---	Moderate-----	Moderate	Low.
Coutis-----	A	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Low.
12----- Gelkie	B	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Low.
13*: Granile-----	B	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Moderate.
Peeler-----	B	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Low.
14----- Hoodle	B	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Low.
15*: Lake Creek-------	C	None-----	---	>6.0	---	20-40	Hard	Moderate-----	Moderate	Low.
Rock outcrop.										
16----- Lamphier	B	None-----	---	>6.0	---	>60	---	Moderate-----	High-----	Low.
17----- Larand Variant	B	None-----	---	>6.0	---	>60	---	Low----------	Moderate	Moderate.
18----- Leadville	B	None-----	---	>6.0	---	>60	---	Moderate-----	Moderate	Moderate.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding		High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
				Ft		In				
19---- Libeg	B	None	---	>6.0	---	>60	---	Moderate	High	Low.
20---- Martinsdale	B	None	---	>6.0	---	>60	---	Moderate	High	Moderate.
21, 22, 23---- Norriston	A	None	---	>6.0	---	>60	---	Low	Moderate	Low.
24---- Northwater	B	None	---	>6.0	---	>60	---	Moderate	Moderate	Low.
25---- Novary	B	Rare	---	0-2.0	Mar-Sep	>60	---	High	High	Moderate.
26---- Patent	C	None	---	>6.0	---	>60	---	Low	High	Low.
27---- Peeler	B	None	---	>6.0	---	40-60	Hard	Moderate	High	Low.
28---- Piltz	C	None	---	>6.0	---	20-40	Soft	Low	Moderate	Low.
29*: Redfeather----	D	None	---	>6.0	---	10-20	Hard	Moderate	Moderate	Moderate.
Rock outcrop.										
30*: Rogert----	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.
Rock outcrop.										
31*: Rogert----	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.
Woodhall----	D	None	---	>6.0	---	20-40	Hard	Low	Moderate	Low.
32, 33, 34---- Silvercliff	B	None	---	>6.0	---	>60	---	Low	High	Low.
35---- Skutum	C	None	---	>6.0	---	>60	---	Moderate	High	Moderate.
36*: Splitro----	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.
Rock outcrop.										
37---- Stumpp Variant	D	Occasional	Apr-Jun	3.5-5.0	Mar-Jun	>60	---	Moderate	High	High.
38---- Terric Borosaprists	D	Occasional	Apr-Jun	0-1.0	Apr-May	>60	---	High	Moderate	Low
39*: Tripit----	C	None	---	>6.0	---	20-40	Soft	Moderate	High	Low.
Splitro----	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.
40*: Troutdale----	C	None	---	>6.0	---	20-40	Soft	Moderate	Moderate	Low.
Rogert----	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding		High water table		Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Months	Depth	Months	Depth	Hardness		Uncoated steel	Concrete
				Ft		In				
41, 42--Troutville	B	None	---	>6.0	---	>60	---	Low	Moderate	Low.
43--Ula	C	None	---	>6.0	---	20-40	Soft	Moderate	Moderate	Low.
44*:										
Ula	C	None	---	>6.0	---	20-40	Soft	Moderate	Moderate	Low.
Leadville	B	None	---	>6.0	---	>60	---	Moderate	Moderate	Moderate.
45*:										
Ula	C	None	---	>6.0	---	20-40	Soft	Moderate	Moderate	Low.
Splitro	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.
46--Venable	B/D	Occasional	Apr-Jun	1.0-2.5	Apr-Aug	>60	---	High	Moderate	Low.
47--Venable	C	None	---	1.5-3.0	Jan-Dec	>60	---	High	Moderate	Low.
48--Wichup	D	Frequent	May-Jun	0-0.5	Apr-May	>60	---	High	Moderate	Low.
49--Wix	C	None	---	>6.0	---	20-40	Soft	Moderate	Moderate	Low.
50*:										
Woodhall	D	None	---	>6.0	---	20-40	Hard	Low	Moderate	Low.
Rogert	D	None	---	>6.0	---	10-20	Hard	Low	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Alvarado	Loamy-skeletal, mixed Argiaquic Cryoborolls
Becks	Loamy-skeletal, mixed Aquic Cryoborolls
Boyle	Loamy-skeletal, mixed, shallow Aridic Argiborolls
Buena Vista	Loamy-skeletal, mixed Argic Cryoborolls
Buffork	Fine-loamy, mixed Argic Cryoborolls
Buffork Variant	Fine-loamy, mixed Argic Cryoborolls
Coutis	Coarse-loamy, mixed Pachic Cryoborolls
Feltonia	Coarse-loamy, mixed Calcic Pachic Cryoborolls
Gelkie	Fine-loamy, mixed Argic Cryoborolls
Granile	Loamy-skeletal, mixed Typic Cryoboralfs
Hoodle	Loamy-skeletal, mixed Argic Cryoborolls
Lake Creek	Loamy-skeletal, mixed Typic Cryoboralfs
Lamphier	Fine-loamy, mixed Pachic Cryoborolls
Larand Variant	Loamy-skeletal, mixed Typic Cryoboralfs
Leadville	Loamy-skeletal, mixed Typic Cryoboralfs
Libeg	Loamy-skeletal, mixed Argic Cryoborolls
Martinsdale	Fine-loamy, mixed Typic Argiborolls
Norriston	Loamy-skeletal, mixed Argic Cryoborolls
Northwater	Loamy-skeletal, mixed Cryic Pachic Paleborolls
Novary	Fine-loamy, mixed (calcareous) Cumulic Cryaquolls
Patent	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents
Peeler	Fine-loamy, mixed Typic Cryoboralfs
Piltz	Fine, montmorillonitic Argic Cryoborolls
Redfeather	Loamy-skeletal, mixed Lithic Cryoboralfs
Rogert	Loamy-skeletal, mixed Lithic Cryoborolls
Silvercliff	Loamy-skeletal, mixed Typic Cryoborolls
Skutum	Fine, montmorillonitic Argic Pachic Cryoborolls
Splitro	Loamy, mixed Lithic Cryoborolls
Stumpp Variant	Fine montmorillonitic Natric Cryoborolls
Tripit	Fine-loamy, mixed Argic Cryoborolls
Troutdale	Fine-loamy, mixed Argic Cryoborolls
Troutville	Loamy-skeletal, mixed Psammentic Cryoboralfs
Ula	Fine-loamy, mixed Mollic Cryoboralfs
Venable	Fine-loamy, mixed Cumulic Cryaquolls
Wichup	Coarse-loamy, mixed Histic Cryaquolls
Wix	Fine-loamy, mixed Mollic Cryoboralfs
Woodhall	Loamy-skeletal, mixed Argic Cryoborolls

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