United States Department of Agriculture

United States Department of the Interior, National Park Service

Natural Resources Conservation Service
In cooperation with National Park Service

Soil Survey of Crater Lake National Park, Oregon

How to Use This Soil Survey

General Soil Map

The general soil map, which is a color map, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

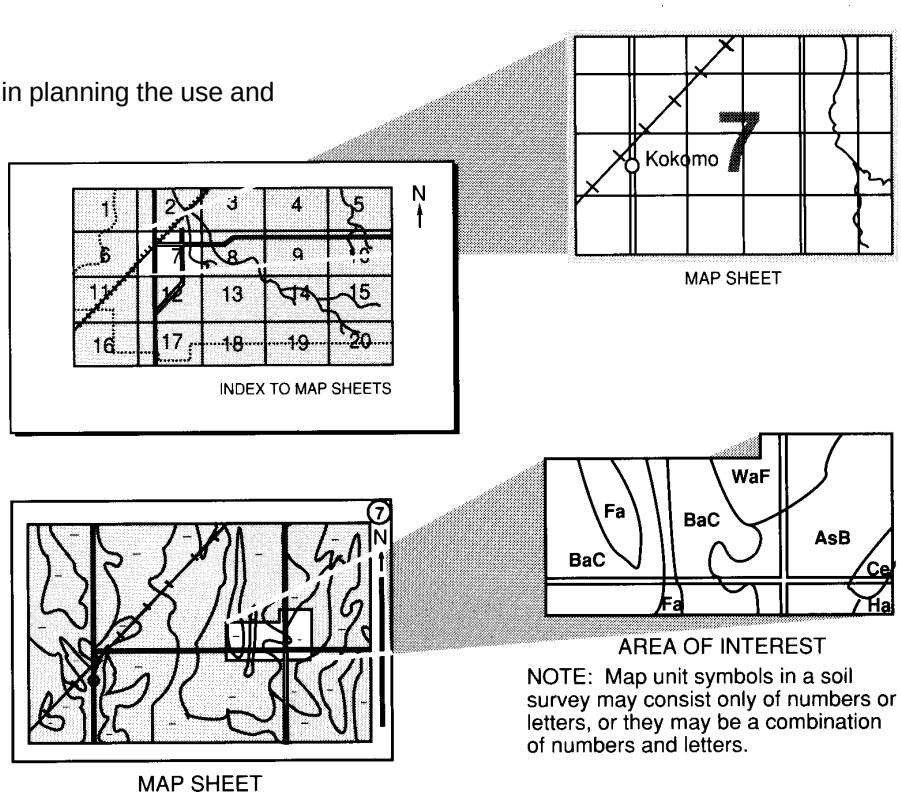
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

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 Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1999 through 2001. Soil names and descriptions were approved in 2001. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 2001. This survey was made cooperatively by the Natural Resources Conservation Service and the National Park Service.

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: Crater Lake with Wizard Island and Llaorock at right in background.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

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Foreword

This soil survey contains information that affects land use planning in the park. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for different users. Planners and engineers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in ecology, recreation, and wildlife management can use the survey to help them understand, protect, and enhance the environment.

The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations on various land uses.

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 park 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 Natural Resources Conservation Service or the Cooperative Extension Service.

Bob Graham
State Conservationist
Natural Resources Conservation Service

Chuck Lundy
Superintendent
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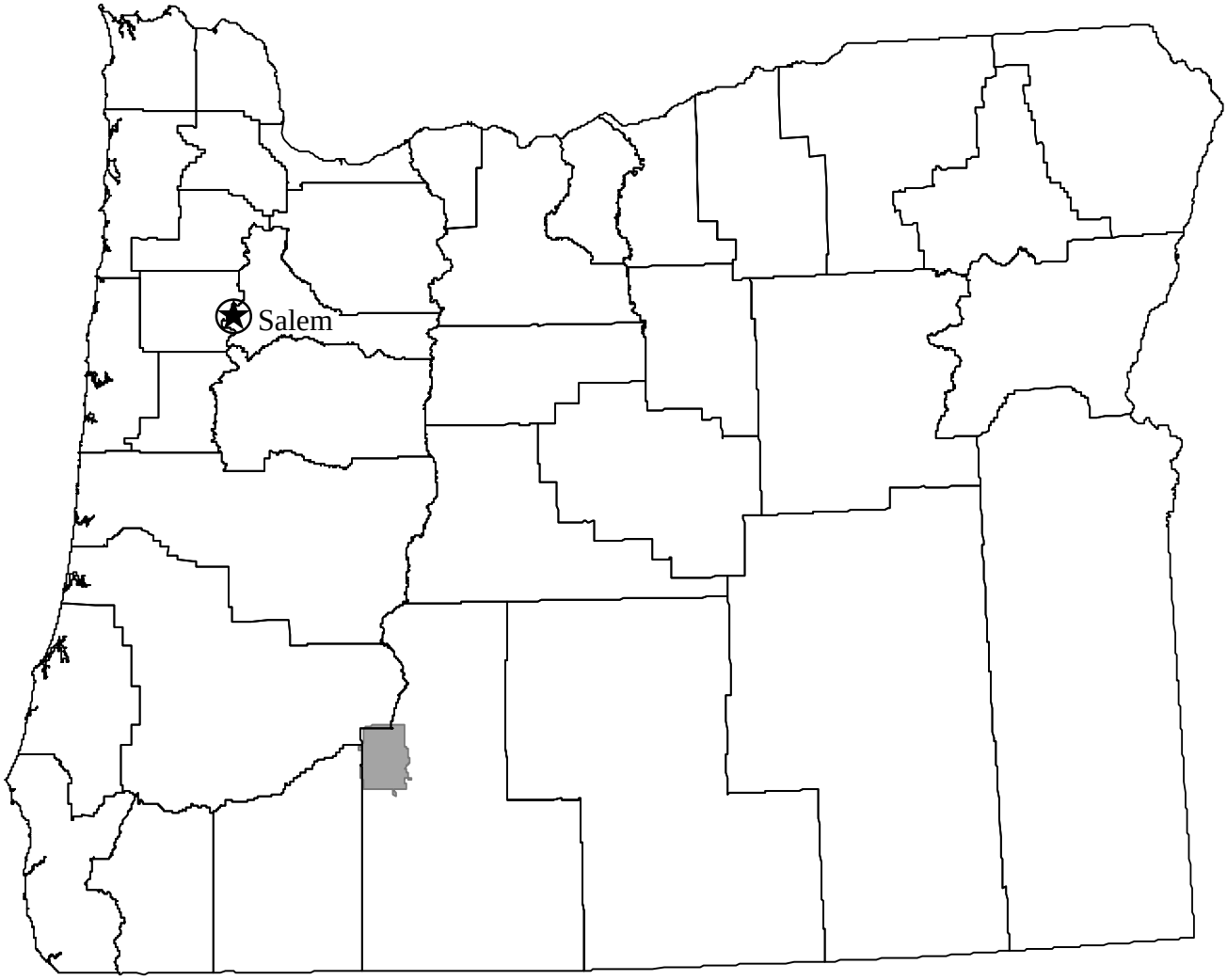

Location of Crater Lake National Park in Oregon.

Soil Survey of
Crater Lake National Park, Oregon

By Gerald Weinheimer

Fieldwork by Thomas Clark, Chris Jasper, Amanda Moore, and Gerald Weinheimer

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
United States Department of the Interior, National Park Service

Crater Lake National Park is in southwestern Oregon, on the divide of the High Cascades. It lies in a region with a long history of volcanic and glacial activity, extending from Lassen Peak in northern California northward into Canada. Crater Lake occupies the collapsed caldera of the once majestic Mount Mazama. The intense deep blue color of the lake combined with the physical relief and coloration of the rim of the caldera creates spectacular scenery.

The lake is 7.0 to 9.5 kilometers (4.5 to 6.0 miles) wide, has 32 kilometers (20 miles) of shoreline, and has a surface area of 5,339 hectares (13,192 acres). At its deepest point, the lake is 592 meters (1,943 feet) deep, making it the deepest lake in the United States. The landscape surrounding the rim of the caldera slopes downward and outward toward the boundaries of the park and is covered by volcanic debris of various ages. Streams originating on the slopes of Mount Mazama form the headwaters of the Rogue River to the west or join the Klamath River drainage system to the south and east.

The rectangular park surrounding the lake comprises approximately 74,552 hectares (184,144 acres) and is characterized by varied topography that rises from 1,219 meters (4,000 feet) in Red Blanket Canyon in the southwestern corner of the park to 2,720 meters (8,926 feet) at the summit of Mount Scott. Other topographic high points are Union Peak, Hillman Peak, and Timber Crater. Numerous cinder cones are in the park; these were fed from vents radiating outward from Mount Mazama. Most of the park is heavily forested, but there are a number of ash- and pumice-covered, treeless flats. Sparse understory of trees or brush is in the mature forests, and most of the terrain is open and parklike. Where natural forest fires have occurred, there are thick stands of lodgepole pine, manzanita, and snowbrush. Steep-walled canyons along Annie, Castle, and Sun Creeks expose the thick deposits of ash and pumice and contribute to the ruggedness of the terrain.

General Nature of the Survey Area

This section provides general information about the park. It discusses history and development, geology, and climate.

History and Development

Crater Lake National Park was established in 1902. It was “dedicated and set apart forever as a public park or pleasure ground for the benefit and enjoyment of the people of the United States” (16 USC 121). The act that established the park required that adequate measures be taken for the “preservation of the natural objects...the protection of the timber...the preservation of all kinds of game and fish.” The act required that the park be available, under regulations established by the U.S. Department of the Interior, for use by “scientists, excursionists, and pleasure seekers.”

Subsequent legislation, including the National Park Service Organic Act and the Redwood Act, emphasize the protection, preservation, and interpretation of the natural and historic objects, scenery, and wildlife of all national parks, including Crater Lake National Park. Park resources are to be managed in such a way as to maintain them in an unimpaired condition for the enjoyment of present and future generations.

The legislation enabling Crater Lake National Park

also provides for visitor accommodations by stating that “restaurant and hotel keepers, upon application to the Secretary of the Interior, may be permitted by him to establish places of entertainment within the Crater Lake National Park for the accommodation of visitors, at places and under regulations fixed by the Secretary of the Interior, and not otherwise.”

The park is a vital element in a diverse regional recreation complex. Many people visit the park as part of a north-south trip to various parks and scenic areas in Oregon and northern California. Crater Lake has historically been the leading draw for visitors to southern Oregon. More than 500,000 people visit the park annually, most of which visit during the brief summer season. A greater number each year, however, are making use of the winter recreation potential of the park. Long snowy winters and mild short summers dominate the seasonal weather pattern at Crater Lake National Park. The park receives abundant snow in October through May. The average annual snowfall is about 500 inches. Generally, snow lingers in areas at the higher elevations throughout the summer. Crater Lake National Park is almost entirely surrounded by National forests and wilderness areas. The Winema National Forest borders the park on the south and east, the Umpqua National Forest is along the northern border, the Rogue River National Forest is along the western and southwestern borders, and the Sky Lakes Wilderness Area is along the southern border.

The southern entrance station at Mazama Village is 76 miles from Medford, Oregon, and 56 miles from Klamath Falls, Oregon, on State Highway 62. The park can be accessed from the north by State Highway 138. Both the south and north access roads lead to Rim Drive, a 33-mile roadway that circles the caldera rim with pullouts that provide scenic views of the lake. Winter access is maintained only from the southern entrance to the park headquarters in Munson Valley and up to Rim Village. Road closures, particularly between the headquarters and the rim, are common in winter because of frequent snowstorms.

Rim Village is on the southern side of the caldera rim. It is at an elevation of 2,164 meters (7,100 feet). It has been in operation year round since 1948, with limited services in winter. Seasonal interpretive activities are provided at a small visitor facility near the rim and at the Sinnott Memorial overlook. Sinnott Memorial is 25 feet below the rim on a precipitous cliff overlooking the lake. It is significant architecturally because it is constructed mostly of large, uncoursed rock that blends into the wall of the rim. The memorial offers visitors a spectacular view of Crater Lake and is an ideal place from which to study the lake and caldera. Seasonal hotel accommodations are available at Crater Lake Lodge. Food, gifts, a picnic area, geology talks (summer only), and interpretive exhibits also are available at Rim Village.

The headquarters of the park is about 3 miles south of Rim Village, in Munson Valley. The headquarters serves as the center for administration and maintenance of the park and for housing of the National Park Service employees. The Steel Information Center at the headquarters serves as a year-round interpretation and orientation focal point for visitors. The headquarters is in an historic complex of buildings with a designed landscape. This complex was constructed over a 15-year period beginning in 1926. The historic buildings at the headquarters and at Rim Village are listed in the National Register of Historic Places.

Mazama Village is about 7 miles south of Rim Village, and it is the primary overnight use area in summer. A campground, motel accommodations, food services, a gas station, a camper service store, shower and laundry facilities, interpretive walks, and evening campfire programs are provided at Mazama Village.

The Cleetwood area, on the northern side of the caldera rim, is accessed from Rim Drive. It is about 6 miles east of the north junction of Rim Drive and the north entrance road. From the parking lot at the Cleetwood area, a walking trail descends down the side of the caldera to the lake, a drop of 800 vertical feet. Commercial boat tours of the lake are available from this area. Naturalists from the National Park Service accompany the tours.

Geology

The park is in a complex geologic region of the Cascade Range, in Southern Oregon. Mount Mazama, which is about 400,000 years old, is one of the younger generation volcanoes in the Cascade Range (Bacon and others, 1997). Mount Mazama formed in an area of older andesitic volcanoes. The older generation volcanoes are represented in the park by the weathered remnants of Union Peak and Timber Crater. These volcanoes were active about 1.2 million years ago, and they have undergone extensive erosion by water and ice. The less resistant ash and breccia deposits of the upper portions of the volcanoes have been eroded away leaving a central spire that formed from the resistant rock of the core plug and the surrounding andesite lava flows.

Mount Mazama formed as a result of five closely spaced volcanic vents that produced a composite

cone. Three volcanic vents are within the present-day caldera, and the other two are Mount Scott to the east and Williams Crater to the west. Regular eruptions of pumice, ashflows, and lava flows of andesite and dacite produced a peak reaching 10,000 to 12,000 feet in elevation. About 7,700 years ago, a major eruption covered much of Oregon and the rest of the Northwest with a layer of pumice and ash. Near the mountain, pyroclastic ash and cinder avalanches covered much of the flanks and nearby lowlands (Bacon and others, 1997). The massive eruption emptied the magma chamber under Mount Mazama, and the mountain collapsed. This collapse formed a caldera that is about 4,000 feet deep. The caldera has partially filled with water, creating the spectacular Crater Lake. Approximately 7,400 years ago, eruptions within the caldera formed several cones. One of these is called Wizard Island, which is visible above the lake.

The present landscape is dominated by the lake-filled caldera and the pumice- and ash-covered flanks of truncated Mount Mazama. Exposed in and around the caldera is andesitic and dacitic bedrock from previous eruptions. The ash, cinders, and pumice ejected from the mountain produced landscapes with characteristics related to the relative size and amount of these deposits. The initial eruption produced a plume of pumice and ash that covered a large portion of Oregon and the rest of the Northwest. The finer, sand-sized pumice and ash in the park is mainly on the drier part of the eastern flank of Timber Crater. This airfall material also produced thick accumulations of gravel-sized pumice to the north and east of Mount Mazama. The first pumice and ash pyroclastic flows, which traveled within the park and far beyond its boundaries, were mainly restricted to the valleys and the low-lying lava plains. These thick flows typically were dominated by cobble-sized pumice. Cross-sections of these flows can be seen in truncated stream terraces and roadcut embankments to the west of the park. During later eruptions, the ashflows were of smaller extent and were dominated by ash and cinders and a smaller percentage of pumice. These flows, on the outer flanks of the caldera, partially covered and filled in around the andesite and dacite bedrock (Williams, 1942). Today, the layered ashflows can be seen in the steep downcut canyonsides of Castle, Annie, Sand, and Sun Creeks.

Somewhat overshadowed by the effects of the volcanic eruptions is the long history of glaciation in the park. During the height of the Ice Age, large icecaps covered most the Cascade Range. Valley glaciers were on Mount Mazama throughout its pre-eruption history. Between eruptions, the mountain commonly had many valley glaciers. Slowly, large valleys were carved out by the glaciers. Some of these valleys were totally or partially filled in by tephra, particularly those on the northern side of Mount Mazama.

The cataclysmic eruption of Mount Mazama occurred during a period that was warmer than the present climate and in which the valley glaciers had retreated beyond the present caldera rim. The collapse of the mountain truncated the glacial valleys, and most of the glacial deposits in the valleys have been incorporated into or covered by eruption debris. Remnants of deposits from the icecaps remain, however, mainly in areas upwind of the airfall deposits and at elevations high enough to escape burial by the ashflows. These remnants lie to the west and south, near the border of the park. They consist of the oldest parent material in the park, the ice having receded about 15,000 to 25,000 years ago (Harris, 1988).

Detailed descriptions of ongoing geologic investigations within the park can be obtained from the Crater Lake Data Clearinghouse website maintained by the U.S. Geological Survey (Anonymous, 2000). (http://craterlake.wr.usgs.gov)

Climate

Prepared by the Natural Resources Conservation Service, National Water and Climate Center, Portland, Oregon.

The climate tables for this survey were created from data collected at the climate station at the headquarters of Crater Lake National Park, Oregon.

Thunderstorm days, relative humidity, percent sunshine, and wind information were estimated from data collected at the First Order station at Medford, Oregon, and from upper air data.

Table 1 gives data on temperature and precipitation for the park as recorded at Crater Lake in the period 1971 to 2000. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season. The extremes given in this section are for the entire period of record, which is 1931 to 2000.

In winter, the average temperature is 26.5 degrees F and the average daily minimum temperature is 18.4 degrees. The lowest temperature on record, which occurred at Crater Lake on January 21, 1962, was -21 degrees. In summer, the average temperature is 51.1 degrees and the average daily maximum temperature is 64.5 degrees. The highest temperature, which occurred at Crater Lake on August 8, 1981, was 90 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). 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 average annual precipitation is about 66.88 inches at the park headquarters. The average annual precipitation varies significantly across the park. Most of the western half of the park receives about 60 to 70 inches of precipitation annually. East of the rim, precipitation declines rapidly, with the northeastern corner of the park receiving only about 35 to 45 inches annually. Only about 2 inches, or 3 percent, of the annual total falls during the frost-free period in July and August. The frost-free season typically is only about 40 days, from mid-July to mid-August. The heaviest 1-day rainfall during the period of record was 7.3 inches on June 12, 1950. Thunderstorms occur on about 15 days each year, and most occur in May through August.

The average seasonal snowfall at the park headquarters is 482.7 inches, but it is higher along the rim. The average snowfall decreases to the northeast; the lowest amounts typically are in the northeastern corner of the park. The greatest snow depth at any one time during the period of record was 252 inches recorded on April 3, 1983. On an average, 234 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record is 37 inches recorded on February 28, 1971. Snowfall has been recorded in every month, and in some years snow has remained on the ground until August in the coolest, shaded areas.

The average relative humidity in midafternoon is about 40 percent. Humidity is highest at night, and the average at dawn is about 80 percent. The sun shines about 80 percent of the time possible in summer and about 45 percent of the time in winter. The prevailing wind is from the west. The average windspeed is highest, about 15 miles per hour, in winter and early in spring. The windspeed varies significantly, depending upon local topography. The windspeed is highest over exposed ridges, such as in the western and eastern high-lying areas of the rim.

How This Survey Was Made

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

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

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

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

areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Data are assembled from other sources, such as research information and field experience of specialists.

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

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

General Soil Map Units

The general soil map in 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, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another 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 detailed planning and management. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soils That Are on Uplands and Formed in Airfall-Deposited Ash and Pumice

Number of map units: 3
Percentage of park: 29 percent

1. Lapine-Steiger (ponderosa pine/fir)

Percentage of park: 7 percent
Location in park: Eastern side, primarily on the eastern flank of Timber Crater
Depth class: Very deep
Position on landscape: Pumice- and ash-mantled lava plains, hills, ridges, and cinder cones
Parent material: Pumice and ash
Elevation: 4,200 to 6,500 feet
Average annual precipitation: 25 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days
Minor components: 10 percent Wuksi soils and 5 percent Rock outcrop
Present vegetation: Ponderosa pine, white fir, and lodgepole pine

Lapine soils

Drainage class: Excessively drained
Permeability: Very rapid
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Very paragravelly ashy sand
Substratum texture: Extremely paragravelly ashy sand
Slope range: 2 to 70 percent

Steiger soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Surface texture: Ashy loamy coarse sand
Subsoil texture: Paragravelly ashy loamy coarse sand
Substratum texture: Paragravelly ashy coarse sand
Slope range: 2 to 25 percent

2. Timbercrater-Llaorock-Castlecrest (mountain hemlock)

Percentage of park: 17 percent
Location in park: Primarily north and east of Mount Mazama, downwind of the eruption
Depth class: Very deep
Position on landscape: Ridges, mountain flanks, and mountainsides
Slope range: 2 to 80 percent
Elevation: 5,500 to 8,900 feet
Average annual precipitation: 50 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 7 percent Rubble land, 3 percent Unionpeak soils, and 5 percent Rock outcrop
Present vegetation: Mountain hemlock, whitebark pine, and lodgepole pine

Timbercrater soils

Drainage class: Excessively drained
Permeability: Very rapid
Parent material: Airfall deposits of pumice and ash
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Very paragravelly ashy loamy sand
Substratum texture: Extremely paragravelly ashy sand

Llaorock soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Parent material: Residuum and colluvium derived from andesite mixed with ash
Surface texture: Gravelly ashy sandy loam
Subsoil texture: Extremely stony medial sandy loam

Castlecrest soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Parent material: Airfall deposits of pumice and ash
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Paragravelly ashy loamy sand
Substratum texture: Ashy coarse sand

3. Timbercrater-Castlecrest-Llaorock (Shasta red fir)

Percentage of park: 5 percent
Location in park: Southeastern flank of Mount Mazama and nearby hills and cinder cones
Depth class: Very deep
Position on landscape: Ridges, mountain flanks, and mountainsides
Slope range: 2 to 80 percent
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 5 percent Rock outcrop
Present vegetation: Shasta red fir and lodgepole pine

Timbercrater soils

Drainage class: Excessively drained
Permeability: Very rapid
Parent material: Airfall deposits of pumice and ash
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Very paragravelly ashy sand
Substratum texture: Extremely paragravelly ashy loamy sand

Castlecrest soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Parent material: Airfall deposits of pumice and ash
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Paragravelly ashy loamy sand
Substratum texture: Ashy coarse sand

Llaorock soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Parent material: Residuum and colluvium derived from andesite mixed with ash
Surface texture: Gravelly ashy sandy loam
Subsoil texture: Extremely stony medial sandy loam

Soils That Are in Valleys and Formed in Ash and Pumice Flow Deposits of Ash, Pumice, and Cinders

Number of map units: 4
Percentage of park: 42 percent

4. Maklak-Collier (ponderosa pine/fir with lodgepole pine)

Percentage of park: 5 percent
Location in park: Lowlands and valleys, mainly near the eastern and southeastern boundaries
Depth class: Very deep
Position on landscape: Pumice flows and ashflows
Parent material: Pumice, ash, and cinders
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 20 to 60 inches
Average annual air temperature: 38 to 44 degrees F
Frost-free period: 0 to 50 days
Minor components: 5 percent Lapine soils
Present vegetation: Ponderosa pine, white fir, and lodgepole pine

Maklak soils

Drainage class: Excessively drained
Permeability: Very rapid
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Very paragravelly ashy loamy sand
Substratum texture: Extremely paragravelly ashy loamy sand
Slope range: 0 to 10 percent

Collier soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Surface texture: Ashy sandy loam
Subsoil texture: Paragravelly ashy loamy sand
Substratum texture: Paragravelly ashy sand
Slope range: 0 to 80 percent

5. Castlecrest-Umak (mountain hemlock with lodgepole pine)

Percentage of park: 25 percent
Location in park: Lowlands and valleys near the northern, western, and southern boundaries

Depth class: Very deep
Elevation: 4,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 5 percent Timbercrater soils, 5 percent Unionpeak soils, 5 percent Sunnotch soils, and 5 percent Llaorock soils
Present vegetation: Mountain hemlock and lodgepole pine

Castlecrest soils

Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Mountain flanks and mountainsides
Parent material: Ash and pumice
Surface and subsoil texture: Paragravelly ashy loamy sand
Substratum texture: Ashy coarse sand and ashy sand
Slope range: 0 to 80 percent

Umak soils

Drainage class: Excessively drained
Permeability: Very rapid
Position on landscape: Pumice flows
Parent material: Pumice and ash
Surface texture: Paragravelly ashy fine sandy loam
Subsoil texture: Extremely paracobbly ashy loamy sand
Slope range: 0 to 10 percent

6. Unionpeak-Castlecrest (mountain hemlock)

Percentage of park: 7 percent
Location in park: Along the northern, eastern, and southern flanks of the caldera rim
Drainage class: Somewhat excessively drained
Slope range: 0 to 35 percent
Elevation: 5,000 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 10 percent Sunnotch soils and 5 percent Rock outcrop
Present vegetation: Mountain hemlock and lodgepole pine

Unionpeak soils

Depth class: Moderately deep to a duripan
Permeability: Rapid throughout the solum and moderately rapid in the weakly cemented duripan
Position on landscape: Ashflows
Parent material: Pumice, ash, andesite, and dacite
Surface texture: Ashy sandy loam
Subsoil texture: Gravelly ashy loamy sand

Castlecrest soils

Depth class: Very deep
Permeability: Rapid
Position on landscape: Mountain flanks and mountainsides
Parent material: Pumice and ash
Surface and subsoil texture: Paragravelly ashy loamy sand
Substratum texture: Ashy coarse sand and ashy sand

7. Castlecrest (Shasta red fir)

Percentage of park: 5 percent
Location in park: Eastern and southern valleys and lowlands
Slope range: 0 to 35 percent
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 3 percent Cleetwood soils, 5 percent Sunnotch soils, and 7 percent Unionpeak soils
Present vegetation: Shasta red fir and lodgepole pine

Castlecrest soils

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Mountain flanks and mountainsides
Parent material: Pumice and ash
Surface and subsoil texture: Paragravelly ashy loamy sand
Substratum texture: Ashy coarse sand and ashy sand

Soils That Are on Uplands and Formed in Airfall-Deposited Ash and Pumice Over Glacial Deposits

Number of map units: 2
Percentage of park: 10 percent

8. Lapine-Oatman

Percentage of park: 4 percent
Location in park: Southeastern corner

Slope range: 5 to 60 percent
Elevation: 4,300 to 6,000 feet
Average annual precipitation: 25 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days
Minor components: 5 percent Collier soils
Present vegetation: White fir and ponderosa pine

Lapine soils

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Position on landscape: Pumice- and ash-mantled lava plains and hills
Parent material: Pumice and ash
Surface texture: Paragravelly ashy loamy sand
Subsoil texture: Paragravelly ashy loamy sand and very paragravelly ashy sand
Substratum texture: Extremely paragravelly ashy sand

Oatman soils

Depth class: Deep to a duripan
Drainage class: Well drained
Permeability: Moderate
Position on landscape: Glaciated volcanic uplands
Parent material: Glacial deposits derived from andesite and mantled with ash
Surface texture: Gravelly medial sandy loam
Subsoil texture: Very gravelly medial sandy loam over extremely gravelly medial fine sandy loam

9. Grousehill

Percentage of park: 6 percent
Location in park: Uplands along the western boundary
Slope range: 0 to 35 percent
Elevation: 4,500 to 7,000 feet
Average annual precipitation: 45 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 35 days
Minor components: 10 percent Llaorock soils and 5 percent Timbercrater soils
Present vegetation: Mountain hemlock, Shasta red fir, Douglas fir, and lodgepole pine

Grousehill soils

Depth class: Moderately deep to a duripan
Drainage class: Moderately well drained
Permeability: Moderate
Position on landscape: Ridges and benches
Parent material: Ash over glacial till
Surface texture: Gravelly medial loam
Subsoil texture: Very cobbly medial loam

Soils on Cinder Cones

Number of map units: 1
Percentage of park: 3 percent

10. Redcone-Cinder land

Percentage of park: 3 percent
Location in park: Cinder cones throughout park
Slope range: 30 to 60 percent
Elevation: 5,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 5 percent Rock outcrop and 5 percent Timbercrater soils

Redcone soils

Depth class: Moderately deep to a duripan
Drainage class: Somewhat excessively drained
Permeability: Rapid over moderate
Position on landscape: Cinder cones
Parent material: Cinders and ash
Surface texture: Very gravelly ashy sandy loam
Subsoil texture: Very gravelly ashy coarse sandy loam

Cinder land

Kind of rock: Andesite and basaltic andesite cinders

Soils on Alpine Meadows With Intermingled Forests

Number of map units: 1
Percentage of park: 15 percent

11. Cleetwood-Llaorock-Dyarock

Percentage of park: 15 percent
Location in park: Alpine and subalpine meadows throughout park
Depth class: Very deep
Permeability: Rapid
Elevation: 5,700 to 8,000 feet
Average annual precipitation: 40 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 5 percent Castlecrest soils, 3 percent Rock outcrop, and 2 percent Timbercrater soils
Present vegetation: Cleetwood—mountain buckwheat, western needlegrass, Shasta buckwheat,

Newberry knotweed, mountain heath, and Hall's sedge; Llaorock—mountain hemlock, whitebark pine, and Shasta red fir; Dyarock—Brewer's sedge, bottlebrush squirreltail, Parry rush, and western needlegrass

Cleetwood soils

Drainage class: Excessively drained
Position on landscape: Mountainsides and benches and valleys on mountains in the Pumice Desert
Parent material: Ash, and andesite and pumice fragments
Surface texture: Very gravelly ashy loamy coarse sand
Substratum texture: Ashy sand and ashy coarse sand

Llaorock soils

Drainage class: Somewhat excessively drained
Position on landscape: Ridges and backslopes of mountains
Parent material: Residuum and colluvium derived from andesite mixed with ash
Surface texture: Gravelly ashy sandy loam
Subsoil texture: Extremely stony medial sandy loam

Dyarock soils

Drainage class: Moderately well drained
Position on landscape: Swales and drainageways on mountains
Parent material: Ash, pumice, cinders, and andesite fragments
Surface texture: Very gravelly ashy loamy sand
Subsoil texture: Ashy loamy sand
Substratum texture: Gravelly ashy loamy coarse sand

Soils in Seeps and on Stream Terraces

Number of map units: 1
Percentage of park: 1 percent

12. Stirfry-Mariel-Anniecreek

Percentage of park: 1 percent
Location in park: Stream terraces, seeps flowing from canyonsides, and bogs scattered throughout park
Depth class: Very deep
Slope range: 0 to 15 percent
Elevation: 4,100 to 6,500 feet
Average annual precipitation: 25 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days
Minor components: 5 percent Llaorock soils, 5 percent Grousehill soils, and 5 percent Riverwash
Present vegetation: Sphagnum moss, sedges, rushes, grasses, shrubs, and lodgepole pine

Mariel soils

Drainage class: Very poorly drained
Permeability: Moderate
Position on landscape: Bogs in mountain basins
Parent material: Organic material
Surface texture: Mucky peak
Subsoil texture: Muck

Stirfry soils

Drainage class: Very poorly drained
Permeability: Moderately rapid
Position on landscape: Drainageways
Parent material: Mossy organic material over ash and pumice
Surface texture: Peat
Subsoil texture: Muck
Substratum texture: Gravelly ashy very coarse sand

Anniecreek soils

Drainage class: Somewhat poorly drained
Permeability: Rapid
Position on landscape: Stream terraces
Parent material: Ash and pumice
Surface texture: Ashy fine sandy loam
Subsoil texture: Ashy sand

Detailed Soil Map Units

The map units delineated on the detailed soil maps in this survey represent the soils or miscellaneous areas in the park. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses.

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

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

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

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

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, 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, slope, elevation, aspect, landscape position, 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, management, or interpretation. For example, Maklak paragravelly ashy loamy sand, 0 to 10 percent slopes, is a phase of the Maklak series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Llaorock-Castlecrest complex, 0 to 15 percent slopes, is an example.

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

Table 4 gives the acreage and proportionate extent

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

1—Anniecreek-Stirfry-Riverwash complex, 0 to 2 percent slopes

Map Unit Setting

General location: Stream terraces
Major land resource area (MLRA): 6
Elevation: 4,100 to 5,500 feet
Average annual precipitation: 25 to 40 inches
Average annual air temperature: 40 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Anniecreek and similar soils: 60 percent
Stirfry and similar soils: 20 percent
Riverwash: 15 percent
Minor components: 5 percent

Characteristics of the Anniecreek and Similar Soils

Setting

Landform: Stream terrace
Geomorphic position: Stream terraces in narrow ravines
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 2 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat poorly drained
Permeability: Rapid
Flooding: Present (see table 20)
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 7.2 inches

Interpretive groups

Ecological site: Forestland—(006XY706OR) Picea engelmannii/Alnus incana ssp. tenuifolia/Carex

Typical profile

Oi—0 to 4 inches; slightly decomposed plant material
A1—4 to 12 inches; ashy fine sandy loam
2A2—12 to 24 inches; very gravelly ashy sand
3Ab—24 to 32 inches; ashy fine sand
4Bg1—32 to 55 inches; ashy sand
5Bg2—55 to 71 inches; very gravelly ashy coarse sand

Characteristics of the Stirfry and Similar Soils

Setting

Landform: Stream terrace
Geomorphic position: Stream terraces and seeps in ravines
Parent material: Mossy organic material over ash and pumice

Properties and qualities

Slope: 0 to 2 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Depth to mineral soil: 40 to 60 inches
Drainage class: Very poorly drained
Permeability: Moderately rapid
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 8.5 inches

Interpretive groups

Ecological site: Rangeland—(003XY015OR) Meadow Fen 40-60 PZ

Typical profile

Oi—0 to 2 inches; peat
Oe—2 to 8 inches; mucky peat
Oa1—8 to 18 inches; muck
Oa2—18 to 51 inches; muck
2A—51 to 60 inches; gravelly ashy coarse sand

Characteristics of the Riverwash

Setting

Landform: Stream terrace
Geomorphic position: Narrow flood plain
Parent material: Sandy and gravelly alluvium

Properties and qualities

Slope: 0 to 2 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Flooding: Present (see table 20)
Water table: Present (see table 20)

Characteristics of the Minor Components

Stirfry taxadjunct

Percentage of map unit: 5 percent
Landform: Stream terrace
Geomorphic position: Seep and spring areas in narrow ravines

Major Soil Features and Properties Affecting Management

Anniecreek soil

- Occasional flooding
- Dustiness if vegetation is removed
- Water erosion
- Frost hazard
- Wetness

Stirfry soil

- Wetness
- Organic soil material throughout profile
- Frost hazard

Riverwash

- Wetness
- Frequent flooding
- Rock fragments
- Water erosion

2—Badland, 50 to 100 percent slopes

Map Unit Setting

General location: Ravines in valleys
Major land resource area (MLRA): 3
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Badland: 80 percent
Minor components: 20 percent

Characteristics of the Badland

Setting

Landform: Ashflow
Geomorphic position: Nonvegetated ashflow deposits in valleys
Parent material: Ash, cinders, pumice, and andesite

Properties and qualities

Slope: 50 to 100 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Forested side slopes of ravines

Stirfry soils

Percentage of map unit: 5 percent
Landform: Drainageway
Geomorphic position: Base of side slopes of ravines, and narrow stream terraces

Rock outcrop

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Welded tuff outcroppings on side slopes of ravines

Major Features and Properties Affecting Management

Badland

- Steep and unstable slopes
- Dustiness
- Wind erosion
- Water erosion
- Low water-holding capacity

3—Badland-Stirfry complex, 0 to 70 percent slopes

Map Unit Setting

General location: Ravines in valleys
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 30 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Badland: 70 percent
Stirfry and similar soils: 25 percent
Minor components: 5 percent

Characteristics of the Badland

Setting

Landform: Ashflow

Geomorphic position: Nonvegetated ashflow deposits in valleys
Parent material: Ash, cinders, pumice, and andesite

Properties and qualities

Slope: 0 to 70 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained

Characteristics of the Stirfry and Similar Soils

Setting

Landform: Drainageway
Geomorphic position: Base of side slopes of ravines, and stream terraces
Parent material: Mossy organic material over pumice and ash

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Depth to mineral soil: 40 to 60 inches
Drainage class: Very poorly drained
Permeability: Moderately rapid
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 8.5 inches

Interpretive groups

Ecological site: Rangeland—(003XY015OR) Meadow Fen 40-60 PZ

Typical profile

Oi—0 to 2 inches; peat
Oe—2 to 8 inches; mucky peat
Oa1—8 to 18 inches; muck
Oa2—18 to 51 inches; muck
2A—51 to 60 inches; gravelly ashy coarse sand

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Forested side slopes of ravines

Major Features and Properties Affecting Management

Badland

- Dustiness
- Wind erosion
- Water erosion
- Steep and unstable slopes
- Low water-holding capacity

Stirfry soil

- Wetness
- Organic soil material throughout profile
- Frost hazard

4—Castlecrest gravelly ashy sandy loam, 2 to 10 percent slopes

Map Unit Setting

General location: Mountainsides
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Castlecrest and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Mountainsides and valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 2 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; gravelly ashy sandy loam
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 7 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides and in valleys

Unionpeak soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Mountainsides and valleys

Grousehill soils

Percentage of map unit: 3 percent
Landform: Ground moraine
Geomorphic position: Glacial till on side slopes of mountains and ridges

Major Soil Features and Properties Affecting Management

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

5—Castlecrest ashy loamy sand, dry, 0 to 15 percent slopes

Map Unit Setting

General location: Ashflows in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Castlecrest and similar soils: 80 percent
Minor components: 20 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Mountainsides and valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 10 percent
Landform: Debris flow
Geomorphic position: Debris flow deposits on mountainsides and in valleys

Llaorock soils

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Ash mixed with residuum and colluvium derived from andesite on mountainsides

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall deposits on mountainsides

Major Soil Features and Properties Affecting Management

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

6—Castlecrest ashy loamy sand, low, 0 to 7 percent slopes

Map Unit Setting

General location: Basins on ashflows in valleys
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Castlecrest and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 7 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY707OR) Pinus contorta/Carex

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 10 percent
Landform: Debris flow
Geomorphic position: Debris flows in valleys

Cleetwood soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Nonforested ashflows with meadow or desert vegetation in valleys

Major Soil Features and Properties Affecting Management

Castlecrest soil

- Cold air drainage
- Dustiness
- Sandy textures
- Low soil strength

7—Castlecrest gravelly ashy loamy sand, high elevation, 5 to 45 percent slopes

Map Unit Setting

General location: High-elevation whitebark pine sites on Mount Mazama
Major land resource area (MLRA): 3
Elevation: 7,000 to 8,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Castlecrest and similar soils: 90 percent
Minor components: 10 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Side slopes of Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 5 to 45 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present

Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY700OR) Pinus albicaulis/Luzula-Carex

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; gravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Pumice flows, ashflows, and ashfall deposits on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion

8—Castlecrest-Badland complex, 60 to 100 percent slopes

Map Unit Setting

General location: Ravines in valleys
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Castlecrest and similar soils: 50 percent
Badland: 40 percent
Minor components: 10 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Side slopes on eroded ashflows in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 60 to 80 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Badland

Setting

Landform: Ashflow
Geomorphic position: Nonvegetated side slopes of ravines
Parent material: Ash, cinders, pumice, and andesite

Properties and qualities

Slope: 60 to 100 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Andesite and welded tuff outcroppings on sides of canyons

Stirfry soils

Percentage of map unit: 5 percent
Landform: Stream terrace

Geomorphic position: Stream terraces and seeps in ravines

Major Features and Properties Affecting Management

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion
- Steep and unstable slopes

Badland

- Wind erosion
- Steep and unstable slopes
- Dustiness
- Water erosion
- Low water-holding capacity

9—Castlecrest-Llaorock complex, 2 to 25 percent slopes

Map Unit Setting

General location: Mountainsides
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Castlecrest and similar soils: 60 percent
Llaorock and similar soils: 25 percent
Minor components: 15 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 2 to 25 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 2 to 25 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Grousehill soils

Percentage of map unit: 8 percent

Landform: Ground moraine
Geomorphic position: Glacial moraines on mountainsides and in valleys

Sunnotch soils

Percentage of map unit: 4 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Rock outcrop

Percentage of map unit: 3 percent
Landform: Lava flow
Geomorphic position: Andesitic lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

10—Castlecrest-Sunnotch complex, 5 to 45 percent slopes

Map Unit Setting

General location: Southern and western side slopes of Mount Mazama
Major land resource area (MLRA): 3
Elevation: 6,000 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 30 days

Map Unit Composition

Castlecrest and similar soils: 45 percent
Sunnotch and similar soils: 40 percent
Minor components: 15 percent

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 5 to 45 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Sunnotch and Similar Soils

Setting

Landform: Debris flow
Geomorphic position: Side slopes of Mount Mazama
Parent material: Cinders and ash

Properties and qualities

Slope: 5 to 45 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.6 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 3 inches; gravelly ashy sandy loam
A2—3 to 11 inches; ashy loamy sand
Bw—11 to 25 inches; very gravelly ashy loamy sand
2C—25 to 61 inches; very gravelly ashy sand

Characteristics of the Minor Components

Llaorock soils

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Ash mixed with residuum and colluvium derived from andesite on side slopes of Mount Mazama

Rock outcrop

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Lava flows on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion

Sunnotch soil

- Rock fragments in soil profile
- Water erosion

11—Cleetwood very gravelly ashy loamy coarse sand, depressional, 0 to 7 percent slopes

Map Unit Setting

General location: Depressional areas in Pumice Desert
Major land resource area (MLRA): 3
Elevation: 5,800 to 6,200 feet
Average annual precipitation: 60 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 30 days

Map Unit Composition

Cleetwood and similar soils: 95 percent
Minor components: 5 percent

Characteristics of the Cleetwood and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows in valleys
Parent material: Ash, pumice, and andesite fragments

Properties and qualities

Slope: 0 to 7 percent
Percentage of surface covered with stones and boulders: 1 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.1 inches

Interpretive groups

Ecological site: Rangeland—(003XY010OR) Pumice Desert 40-60 PZ

Typical profile

A1—0 to 2 inches; very gravelly ashy loamy coarse sand
A2—2 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows in Pumice Desert

Major Soil Features and Properties Affecting Management

Cleetwood soil

- Sandy textures
- Desert pavement (high amount of surface rock fragments)
- Low soil strength
- Dustiness
- Wind erosion

12—Cleetwood-Castlecrest complex, dry, 10 to 30 percent slopes

Map Unit Setting

General location: Meadows and forests in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,700 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Cleetwood and similar soils: 55 percent
Castlecrest and similar soils: 35 percent
Minor components: 10 percent

Characteristics of the Cleetwood and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Side slopes and benches of Mount Mazama
Parent material: Ash, and andesite and pumice fragments

Properties and qualities

Slope: 10 to 20 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Rangeland—(003XY012OR) Ashy Alpine Meadow 50-70 PZ

Typical profile

A1—0 to 4 inches; gravelly ashy sandy loam
A2—4 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Side slopes of Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 10 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Pumice and ashflow deposits on mountainsides

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Major Soil Features and Properties Affecting Management

Cleetwood soil

- Wind erosion
- Dustiness
- Low soil strength

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

13—Cleetwood-Castlecrest-Llaorock complex, 5 to 30 percent slopes

Map Unit Setting

General location: Meadows and forests on Mount Mazama
Major land resource area (MLRA): 3
Elevation: 5,500 to 7,200 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Cleetwood and similar soils: 45 percent
Castlecrest and similar soils: 25 percent
Llaorock and similar soils: 20 percent
Minor components: 10 percent

Characteristics of the Cleetwood and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Side slopes and benches of Mount Mazama
Parent material: Ash, and pumice and andesite deposits

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.1 inches

Interpretive groups

Ecological site: Rangeland—(003XY012OR) Ashy Alpine Meadow 50-70 PZ

Typical profile

A1—0 to 4 inches; gravelly ashy sandy loam
A2—4 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Side slopes of Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of Mount Mazama
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Cleetwood soils, thin surface

Percentage of map unit: 5 percent
Landform: Ashflow

Geomorphic position: Side slopes of Mount Mazama; associated with the Ashy Alpine Desert ecological site

Dyarock soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Swales on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Cleetwood soil

- Wind erosion
- Dustiness
- Low soil strength

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

14—Cleetwood, thin surface-Cleetwood-Dyarock complex, 2 to 20 percent slopes

Map Unit Setting

General location: Meadows and deserts on side slopes of Mount Mazama
Major land resource area (MLRA): 3
Elevation: 6,000 to 7,500 feet
Average annual precipitation: 60 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 30 days

Map Unit Composition

Cleetwood, thin surface, and similar soils: 60 percent
Cleetwood and similar soils: 15 percent
Dyarock and similar soils: 10 percent
Minor components: 15 percent

Characteristics of the Cleetwood, Thin Surface, and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on side slopes and benches of Mount Mazama
Parent material: Ash, and pumice and andesite fragments

Properties and qualities

Slope: 2 to 20 percent
Percentage of surface covered with stones and boulders: 1 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.1 inches

Interpretive groups

Ecological site: Rangeland—(003XY011OR) Ashy Alpine Desert 50-70 PZ

Typical profile

A1—0 to 2 inches; very gravelly ashy loamy coarse sand
A2—2 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Cleetwood and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on side slopes and benches of Mount Mazama
Parent material: Ash, and pumice and andesite fragments

Properties and qualities

Slope: 2 to 20 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Rangeland—(003XY012OR) Ashy Alpine Meadow 50-70 PZ

Typical profile

A1—0 to 4 inches; gravelly ashy sandy loam

A2—4 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Dyarock and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Swales on side slopes of Mount Mazama
Parent material: Ash, pumice, cinders, and andesite fragments

Properties and qualities

Slope: 2 to 20 percent
Percentage of surface covered with stones and boulders: 4 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Moderately well drained
Permeability: Rapid
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 8.3 inches

Interpretive groups

Ecological site: Rangeland—(003XY013OR) Ashy Alpine Swale 50-70 PZ

Typical profile

A1—0 to 1 inch; very gravelly ashy loamy sand
A2—1 inch to 7 inches; ashy sandy loam
AB—7 to 17 inches; ashy sandy loam
Bw—17 to 30 inches; ashy loamy sand
C1—30 to 44 inches; gravelly ashy loamy coarse sand
C2—44 to 62 inches; ashy coarse sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 10 percent
Landform: Debris flow
Geomorphic position: Forested debris flows on side slopes of Mount Mazama

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Forested ashflows on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Cleetwood soil, thin surface

- Wind erosion
- Dustiness
- Sandy textures
- Low soil strength
- Desert pavement (high amount of rock fragments on surface)

Cleetwood soil

- Wind erosion
- Dustiness
- Low soil strength

Dyarock soil

- Wetness in spring
- Dustiness
- Sandy textures
- Low soil strength
- Desert pavement (high amount of rock fragments on surface)

15—Cleetwood, thin surface-Llaorock-Cleetwood complex, 5 to 30 percent slopes

Map Unit Setting

General location: Deserts, forests, and meadows on Mount Mazama
Major land resource area (MLRA): 3
Elevation: 6,000 to 7,500 feet
Average annual precipitation: 60 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Cleetwood, thin surface, and similar soils: 40 percent
Llaorock and similar soils: 40 percent
Cleetwood and similar soils: 15 percent
Minor components: 5 percent

Characteristics of the Cleetwood, Thin Surface, and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on side slopes and benches of Mount Mazama
Parent material: Ash, pumice, and andesite fragments

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: 1 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.1 inches

Interpretive groups

Ecological site: Rangeland—(003XY011OR) Ashy Alpine Desert 50-70 PZ

Typical profile

A1—0 to 2 inches; very gravelly ashy loamy coarse sand
A2—2 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Forested side slopes of stratovolcanoes
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
Bw1—7 to 14 inches; very stony ashy sandy loam
Bw2—14 to 24 inches; extremely stony ashy sandy loam
Bw3—24 to 61 inches; extremely stony ashy sandy loam

Characteristics of the Cleetwood and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on side slopes and benches of Mount Mazama
Parent material: Ash, pumice, and andesite fragments

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Rangeland—(003XY012OR) Ashy Alpine Meadow 50-70 PZ

Typical profile

A1—0 to 4 inches; gravelly ashy sandy loam
A2—4 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Forested ashflows on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Cleetwood soil, thin surface

- Wind erosion
- Dustiness
- Sandy textures

- Low soil strength
- Desert pavement (high amount of rock fragments on surface)

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

Cleetwood soil

- Dustiness
- Low soil strength
- Wind erosion

16—Cleetwood-Sunnotch-Castlecrest complex, high elevation, 15 to 30 percent slopes

Map Unit Setting

General location: Meadows and whitebark pine forests on Mount Mazama
Major land resource area (MLRA): 3
Elevation: 7,000 to 8,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 30 days

Map Unit Composition

Cleetwood and similar soils: 50 percent
Sunnotch and similar soils: 20 percent
Castlecrest and similar soils: 15 percent
Minor components: 15 percent

Characteristics of the Cleetwood and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on side slopes and benches of Mount Mazama
Parent material: Ash, pumice, and andesite fragments

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Rangeland—(003XY012OR) Ashy Alpine Meadow 50-70 PZ

Typical profile

A1—0 to 4 inches; gravelly ashy sandy loam
A2—4 to 10 inches; ashy loamy sand
C1—10 to 36 inches; ashy sand
C2—36 to 50 inches; ashy coarse sand
C3—50 to 60 inches; gravelly ashy sand

Characteristics of the Sunnotch and Similar Soils

Setting

Landform: Debris flow
Geomorphic position: Forested debris flows on side slopes of Mount Mazama
Parent material: Cinders and ash

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.6 inches

Interpretive groups

Ecological site: Forestland—(003XY700OR) Pinus albicaulis/Luzula-Carex

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 3 inches; gravelly ashy sandy loam
A2—3 to 11 inches; ashy loamy sand
Bw—11 to 25 inches; very gravelly ashy loamy sand
2C—25 to 61 inches; very gravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Forested ashfall and ashflows on Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 15 to 30 percent

Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY700OR) Pinus albicaulis/Luzula-Carex

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 8 percent
Landform: Lava flow
Geomorphic position: Andesite lava flow outcroppings on side slopes of Mount Mazama

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Forested pumice flow and ashflow deposits on side slopes of Mount Mazama

Dyarock soils

Percentage of map unit: 2 percent
Landform: Ashflow
Geomorphic position: Swales on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Cleetwood soil

- Wind erosion
- Dustiness
- Low soil strength

Sunnotch soil

- Rock fragments in soil profile

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

17—Collier ashy loamy sand, 0 to 7 percent slopes

Map Unit Setting

General location: Ashflows in valleys
Major land resource area (MLRA): 6
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 20 to 60 inches
Average annual air temperature: 41 to 44 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Collier and similar soils: 90 percent
Minor components: 10 percent

Characteristics of the Collier and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows in valleys
Parent material: Ash and cinders

Properties and qualities

Slope: 0 to 7 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.1 inches

Interpretive groups

Ecological site: Forestland—(006XY703OR) Pinus ponderosa/Symphoricarpos hesperius/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; ashy loamy sand
BA—5 to 12 inches; ashy loamy sand
Bw—12 to 23 inches; paragravelly ashy loamy sand
C—23 to 62 inches; paragravelly ashy sand

Characteristics of the Minor Components

Maklak soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Pumice flows and ashflows in valleys

Lapine soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Pumice flows and ashflows in valleys

Major Soil Features and Properties Affecting Management

Collier soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

18—Collier ashy loamy sand, dry, 0 to 10 percent slopes

Map Unit Setting

General location: Ashflows in valleys
Major land resource area (MLRA): 6
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 20 to 40 inches
Average annual air temperature: 41 to 44 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Collier and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Collier and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows in valleys
Parent material: Ash and cinders

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.1 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Arctostaphylos patula/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; ashy loamy sand
BA—5 to 12 inches; ashy loamy sand
Bw—12 to 23 inches; paragravelly ashy loamy sand
C—23 to 62 inches; paragravelly ashy sand

Characteristics of the Minor Components

Steiger soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashflows in valleys

Maklak soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Pumice flows and ashflows in valleys

Major Soil Features and Properties Affecting Management

Collier soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

19—Collier very gravelly ashy loamy sand, low, 0 to 7 percent slopes

Map Unit Setting

General location: Basins on ashflows in valleys
Major land resource area (MLRA): 6
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 20 to 60 inches
Average annual air temperature: 41 to 44 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Collier and similar soils: 90 percent
Minor components: 10 percent

Characteristics of the Collier and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Basins on ashflows in valleys
Parent material: Ash and cinders

Properties and qualities

Slope: 0 to 7 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.1 inches

Interpretive groups

Ecological site: Forestland—(006XY704OR) Pinus contorta/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; very gravelly ashy loamy sand
BA—5 to 12 inches; ashy loamy sand
Bw—12 to 23 inches; paragravelly ashy loamy sand
C—23 to 62 inches; paragravelly ashy sand

Characteristics of the Minor Components

Lapine soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Basins on pumice flows and ashflows in valleys

Steiger soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Basins on ashflows in valleys

Major Soil Features and Properties Affecting Management

Collier soil

- Cold air drainage
- Dustiness
- Sandy textures
- Low soil strength
- Desert pavement (high amount of rock fragments on surface)
- Wind erosion

20—Collier-Badland complex, 60 to 100 percent slopes

Map Unit Setting

General location: Ravines in valley ashflows
Major land resource area (MLRA): 6
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 20 to 60 inches
Average annual air temperature: 41 to 44 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Collier and similar soils: 50 percent
Badland: 45 percent
Minor components: 5 percent

Characteristics of the Collier and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Forested side slopes of ravines in valleys
Parent material: Ash and cinders

Properties and qualities

Slope: 60 to 80 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.1 inches

Interpretive groups

Ecological site: Forestland—(006XY703OR) Pinus ponderosa/Symphoricarpos hesperius/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; ashy sandy loam
BA—5 to 12 inches; ashy loamy sand
Bw—12 to 23 inches; paragravelly ashy loamy sand
C—23 to 62 inches; paragravelly ashy sand

Characteristics of the Badland

Setting

Landform: Ashflow
Geomorphic position: Nonvegetated side slopes of ravines in valleys
Parent material: Ash and cinders

Properties and qualities

Slope: 60 to 100 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained

Characteristics of the Minor Components

Stirfry taxadjunct

Percentage of map unit: 5 percent
Landform: Stream terrace
Geomorphic position: Springs and seeps near the base of ravines

Major Soil Features and Properties Affecting Management

Collier soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion
- Steep and unstable slopes

Badland

- Dustiness
- Wind erosion
- Steep and unstable slopes
- Low water-holding capacity
- Water erosion

21—Donegan very gravelly ashy sandy loam, 30 to 65 percent south slopes

Map Unit Setting

General location: Mountainsides in the southwestern corner of the park
Major land resource area (MLRA): 5
Elevation: 4,000 to 5,100 feet
Average annual precipitation: 40 to 50 inches
Average annual air temperature: 41 to 45 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Donegan and similar soils: 90 percent
Minor components: 10 percent

Characteristics of the Donegan and Similar Soils

Setting

Landform: Mountains
Geomorphic position: Side slopes
Parent material: Ash mixed with colluvium derived from andesite

Properties and qualities

Slope: 30 to 65 percent
Percentage of surface covered with stones and boulders: 15 percent
Restrictive feature: Bedrock (paralithic) at a depth of 20 to 40 inches
Drainage class: Well drained
Permeability: Moderately slow
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(005XY700OR) Psuedotsuga menziesii/Mahonia nervosa/ Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; very gravelly ashy sandy loam
Bw1—5 to 14 inches; very gravelly loam
Bw2—14 to 30 inches; extremely gravelly loam
Bw3—30 to 39 inches; extremely gravelly loam
Cr—39 to 43 inches; weathered bedrock

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 10 percent
Landform: Lava flow
Geomorphic position: Andesitic lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Donegan soil

- Steep and unstable slopes
- Rock fragments on surface

- Rock fragments in soil profile
- Water erosion

22—Grousehill gravelly medial loam, 0 to 25 percent slopes

Map Unit Setting

General location: Glaciated side slopes and summits of mountains and ridges
Major land resource area (MLRA): 3
Elevation: 4,500 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 35 days

Map Unit Composition

Grousehill and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Grousehill and Similar Soils

Setting

Landform: Ground moraine
Geomorphic position: Glacial moraine on summits of ridges
Parent material: Ash over glacial till

Properties and qualities

Slope: 0 to 25 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Moderately well drained
Permeability: Moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 12.8 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 3 inches; slightly decomposed plant material
A—3 to 10 inches; gravelly medial loam
Bw1—10 to 31 inches; very cobbly medial loam
Bw2—31 to 39 inches; very cobbly medial loam
Bqm—39 to 56 inches; moderately cemented duripan

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Ashfall deposits on summits and side slopes of mountains

Llaorock soils

Percentage of map unit: 3 percent
Landform: Lava flow
Geomorphic position: Ash mixed with residuum and colluvium derived from andesite on summits and side slopes of mountains

Racing soils

Percentage of map unit: 2 percent
Landform: Drainageway
Geomorphic position: Depressions on glaciated ridges

Major Soil Features and Properties Affecting Management

Grousehill soil

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan
- Wetness

23—Grousehill-Llaorock complex, 5 to 35 percent slopes

Map Unit Setting

General location: Glaciated side slopes of mountains and ridges
Major land resource area (MLRA): 3
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Grousehill and similar soils: 65 percent
Llaorock and similar soils: 20 percent
Minor components: 15 percent

Characteristics of the Grousehill and Similar Soils

Setting

Landform: Ground moraine

Geomorphic position: Glacial moraine on ridges and mountainsides
Parent material: Ash over glacial till

Properties and qualities

Slope: 5 to 35 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Moderately well drained
Permeability: Moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 12.8 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 3 inches; slightly decomposed plant material
A—3 to 10 inches; gravelly medial loam
Bw1—10 to 31 inches; very cobbly medial loam
Bw2—31 to 39 inches; very cobbly medial loam
Bqm—39 to 56 inches; moderately cemented duripan

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Lava flow
Geomorphic position: Side slopes of glaciated valleys
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 5 to 35 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Ashfall deposits on mountainsides

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Andesitic lava flows on side slopes of ridges and mountains

Major Soil Features and Properties Affecting Management

Grousehill soil

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan
- Wetness

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

24—Grousehill-Llaorock complex, dry, 0 to 30 percent slopes

Map Unit Setting

General location: Side slopes of mountains and ridges in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,000 feet
Average annual precipitation: 45 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Grousehill and similar soils: 65 percent
Llaorock and similar soils: 20 percent
Minor components: 15 percent

Characteristics of the Grousehill and Similar Soils

Setting

Landform: Ground moraine
Geomorphic position: Glacial moraines on ridges and mountainsides
Parent material: Ash over glacial till

Properties and qualities

Slope: 0 to 30 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Moderately well drained
Permeability: Moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 12.8 inches

Interpretive groups

Ecological site: Forestland—(003XY703OR) Abies/ Carex inops

Typical profile

Oi—0 to 3 inches; slightly decomposed plant material
A—3 to 10 inches; gravelly medial loam
Bw1—10 to 31 inches; very cobbly medial loam
Bw2—31 to 39 inches; very cobbly medial loam
Bqm—39 to 56 inches; moderately cemented duripan

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of glaciated valleys
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 0 to 30 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Ashfall
Geomorphic position: Ashfall deposits on mountainsides

Rock outcrop

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Side slopes of glaciated valleys

Major Soil Features and Properties Affecting Management

Grousehill soil

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan
- Wetness

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

25—Grousehill-Racing complex, 0 to 5 percent slopes

Map Unit Setting

General location: Meadows on glaciated ridges
Major land resource area (MLRA): 3
Elevation: 4,000 to 5,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Grousehill and similar soils: 50 percent
Racing and similar soils: 40 percent
Minor components: 10 percent

Characteristics of the Grousehill Taxadjunct and Similar Soils

Setting

Landform: Mountain
Geomorphic position: Drainageways on glaciated ridges
Parent material: Ash over glacial till

Properties and qualities

Slope: 0 to 5 percent
Percentage of surface covered with stones and boulders: None
Restrictive feature: Duripan at a depth of 40 to 60 inches
Drainage class: Moderately well drained
Permeability: Moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Rangeland—(003XY020OR) Ashy Glacial Prairie 40-60 PZ

Typical profile

A1—0 to 2 inches; ashy loamy sand
A2—2 to 12 inches; ashy sandy loam
2Bw1—12 to 30 inches; very gravelly medial loam
2Bw2—30 to 36 inches; very gravelly medial clay loam
2BC—36 to 45 inches; very gravelly medial sandy clay loam
2Bqm—45 to 60 inches; moderately cemented duripan

Characteristics of the Racing and Similar Soils

Setting

Landform: Mountain
Geomorphic position: Drainageways on glaciated ridges
Parent material: Ash over glacial till

Properties and qualities

Slope: 0 to 3 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Poorly drained
Permeability: Slow or moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Present (see table 20)
Available water capacity: About 8.5 inches

Interpretive groups

Ecological site: Rangeland—(003XY019OR) Ashy Glacial Meadow 40-60 PZ

Typical profile

Oa—0 to 4 inches; muck
A—4 to 6 inches; silt loam
Bw—6 to 18 inches; ashy very fine sandy loam
Bg1—18 to 28 inches; ashy sandy clay loam
Bg2—28 to 34 inches; ashy sandy clay loam
2Bg3—34 to 50 inches; very gravelly ashy sandy loam
3Bq—50 to 60 inches; extremely gravelly loamy sand

Characteristics of the Minor Components

Grousehill soils

Percentage of map unit: 10 percent
Landform: Ground moraine
Geomorphic position: Glacial moraine on mountainsides

Major Soil Features and Properties Affecting Management

Grousehill taxadjunct

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan
- Wetness

Racing soil

- Wetness
- Frost hazard

26—Lapine paragravelly ashy loamy coarse sand, 10 to 35 percent south slopes

Map Unit Setting

General location: Mountainsides in the southeastern corner of the park
Major land resource area (MLRA): 6
Elevation: 4,200 to 5,300 feet
Average annual precipitation: 30 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 75 percent
Minor components: 25 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Pumice and ashfall and ashflow material on mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 10 to 35 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY700OR) Pinus ponderosa-Abies/Symphoricarpos hesperius

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 8 inches; paragravelly ashy loamy coarse sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand
Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Minor Components

Similar soils that have buried soil material at a depth of 25 to 40 inches

Percentage of map unit: 14 percent
Landform: Ashfall
Geomorphic position: Mountainsides

Steiger soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashfall on mountainsides

Rock outcrop

Percentage of map unit: 1 percent
Landform: Mountains
Geomorphic position: Lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Lapine soil

- Low soil strength
- High pumice content
- Very rapid permeability

27—Lapine paragravelly ashy loamy coarse sand, 35 to 55 percent south slopes

Map Unit Setting

General location: Mountainsides in the southeastern corner of the park
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,500 feet
Average annual precipitation: 30 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 90 percent
Minor components: 10 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Pumice and ashfall and ashflow material on mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 35 to 55 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY700OR) Pinus ponderosa-Abies/Symphoricarpos hesperius

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material

A—2 to 8 inches; paragravelly ashy loamy coarse sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand
Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Minor Components

Similar soils that have buried soil material at a depth of 25 to 40 inches

Percentage of map unit: 9 percent
Landform: Ashfall
Geomorphic position: Mountainsides

Rock outcrop

Percentage of map unit: 1 percent
Landform: Mountain
Geomorphic position: Lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Lapine soil

- Low soil strength
- Steepness of slope
- High pumice content
- Water erosion
- Very rapid permeability

28—Lapine-Oatman complex, 5 to 30 percent slopes

Map Unit Setting

General location: Glacial moraines in the southeastern corner of the park
Major land resource area (MLRA): 6
Elevation: 4,300 to 6,000 feet
Average annual precipitation: 30 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 45 percent
Oatman and similar soils: 45 percent
Minor components: 10 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY700OR) Pinus ponderosa-Abies/Symphoricarpos hesperius

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 8 inches; paragravelly ashy loamy sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand
Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Oatman and Similar Soils

Setting

Landform: Ground moraine
Geomorphic position: Glacial moraines on ridges and mountainsides
Parent material: Ash mixed with glacial till derived from andesite

Properties and qualities

Slope: 5 to 30 percent
Percentage of surface covered with stones and boulders: 4 percent
Restrictive feature: Duripan at a depth of 40 to 60 inches
Drainage class: Well drained
Permeability: Moderate
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7 inches

Interpretive groups

Ecological site: Forestland—(006XY700OR) Pinus ponderosa-Abies/Symphoricarpos hesperius

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
Oe—1 inch to 2 inches; moderately decomposed plant material

A—2 to 3 inches; gravelly medial sandy loam
AB—3 to 12 inches; very cobbly medial sandy loam
Bw1—12 to 31 inches; very gravelly medial fine sandy loam
Bw2—31 to 45 inches; very gravelly medial sandy loam
Bw3—45 to 51 inches; extremely gravelly medial fine sandy loam
Bqm—51 to 61 inches; indurated duripan

Characteristics of the Minor Components

Oatman soils, noncemented substratum

Percentage of map unit: 5 percent
Landform: Ground moraine
Geomorphic position: Glacial moraines on ridges and mountainsides

Steiger soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides

Major Soil Features and Properties Affecting Management

Lapine soil

- Low soil strength
- High pumice content
- Very rapid permeability

Oatman soil

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan

29—Lapine-Oatman complex, 30 to 60 percent south slopes

Map Unit Setting

General location: Glacial moraines in the southeastern corner of the park
Major land resource area (MLRA): 6
Elevation: 4,300 to 6,000 feet
Average annual precipitation: 25 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 45 percent
Oatman and similar soils: 45 percent
Minor components: 10 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Pumice and ashfall and ashflow material on mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY700OR) Pinus ponderosa-Abies/Symphoricarpos hesperius

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 8 inches; paragravelly ashy loamy sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand
Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Oatman and Similar Soils

Setting

Landform: Ground moraine
Geomorphic position: Glacial moraines on ridges and mountainsides
Parent material: Ash mixed with glacial till

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 4 percent
Restrictive feature: Duripan at a depth of 40 to 60 inches
Drainage class: Well drained
Permeability: Moderate

Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7 inches

Interpretive groups

Ecological site: Forestland—(006XY700OR) Pinus ponderosa-Abies/Symphoricarpos hesperius

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
Oe—1 inch to 2 inches; moderately decomposed plant material
A—2 to 3 inches; gravelly medial sandy loam
AB—3 to 12 inches; very cobbly medial sandy loam
Bw1—12 to 31 inches; very gravelly medial fine sandy loam
Bw2—31 to 45 inches; very gravelly medial sandy loam
Bw3—45 to 51 inches; extremely gravelly medial fine sandy loam
Bqm—51 to 61 inches; indurated duripan

Characteristics of the Minor Components

Wuksi soils

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Ash mixed with colluvium derived from andesite on mountainsides

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Andesitic lava flows on side slopes of mountains and ridges

Major Soil Features and Properties Affecting Management

Lapine soil

- Low soil strength
- High pumice content
- Water erosion
- Very rapid permeability

Oatman soil

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan
- Water erosion
- Unstable slopes

30—Lapine-Rock outcrop-Wuksi complex, 30 to 70 percent south slopes

Map Unit Setting

General location: Buttes in the Sharp Peak area
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,500 feet
Average annual precipitation: 25 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 40 percent
Rock outcrop: 30 percent
Wuksi and similar soils: 20 percent
Minor components: 10 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashfall
Geomorphic position: Side slopes of buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 70 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Arctostaphylos patula/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 8 inches; paragravelly ashy loamy sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand
Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Rock Outcrop

Landform: Butte
*Geomorphic position: R*ock outcroppings on side slopes of buttes

Parent material: Andesite
Slope: 30 to 70 percent; northeast to northwest aspects

Characteristics of the Wuksi and Similar Soils

Setting

Landform: Butte
Geomorphic position: Side slopes of buttes
Parent material: Ash mixed with colluvium derived from andesite

Properties and qualities

Slope: 30 to 70 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 10 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.2 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Arctostaphylos patula/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; cobbly ashy loamy sand
AB—5 to 14 inches; very cobbly ashy loamy coarse sand
Bw1—14 to 29 inches; very cobbly ashy sand
Bw2—29 to 37 inches; very cobbly ashy sandy loam
Bw3—37 to 60 inches; extremely cobbly ashy sandy loam

Characteristics of the Minor Components

Collier soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashflow material at the base of buttes

Major Features and Properties Affecting Management

Lapine soil

- Low soil strength
- High pumice content
- Water erosion
- Very rapid permeability

Rock outcrop

- Lack of soil material

Wuksi soil

- Rock fragments on surface
- Rock fragments in soil profile
- Water erosion

31—Lapine-Steiger-Wuksi complex, high elevation, 2 to 25 percent slopes

Map Unit Setting

General location: Eastern side of Timber Crater
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 25 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 35 percent
Steiger and similar soils: 30 percent
Wuksi and similar soils: 30 percent
Minor components: 5 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashfall
Geomorphic position: Mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 2 to 25 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Ceanothus velutinus/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 8 inches; paragravelly ashy loamy sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand

Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Steiger and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 2 to 25 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Ceanothus velutinus/Carex inops

Typical profile

A—0 to 4 inches; ashy loamy coarse sand
Bw1—4 to 10 inches; paragravelly ashy loamy coarse sand
Bw2—10 to 19 inches; paragravelly ashy loamy coarse sand
BC—19 to 29 inches; paragravelly ashy coarse sand
C1—29 to 35 inches; paragravelly ashy coarse sand
C2—35 to 60 inches; paragravelly ashy coarse sand

Characteristics of the Wuksi and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Mountainsides
Parent material: Ash mixed with colluvium derived from andesite

Properties and qualities

Slope: 2 to 25 percent
Percentage of surface covered with stones and boulders: 10 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.2 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Ceanothus velutinus/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; cobbly ashy loamy sand
AB—5 to 14 inches; very cobbly ashy loamy coarse sand
Bw1—14 to 29 inches; very cobbly ashy sand
Bw2—29 to 37 inches; very cobbly ashy sandy loam
Bw3—37 to 60 inches; extremely cobbly ashy sandy loam

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Mountainsides

Major Soil Features and Properties Affecting Management

Lapine soil

- Low soil strength
- High pumice content
- Very rapid permeability

Steiger soil

- Sandy textures
- Low soil strength

Wuksi soil

- Rock fragments on surface
- Rock fragments in soil profile

32—Lapine-Wuksi-Rock outcrop complex, 30 to 70 percent north slopes

Map Unit Setting

General location: Buttes in the Sharp Peak area
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,500 feet
Average annual precipitation: 25 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Lapine and similar soils: 40 percent
Wuksi and similar soils: 25 percent

Rock outcrop: 25 percent
Minor components: 10 percent

Characteristics of the Lapine and Similar Soils

Setting

Landform: Ashfall
Geomorphic position: Side slopes of buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 70 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY705OR) Pinus ponderosa/Arctostaphylos patula-Chrysolepis chrysophylia

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 8 inches; paragravelly ashy loamy sand
Bw1—8 to 15 inches; paragravelly ashy loamy sand
Bw2—15 to 24 inches; very paragravelly ashy sand
C—24 to 60 inches; extremely paragravelly ashy sand

Characteristics of the Wuksi and Similar Soils

Setting

Landform: Butte
Geomorphic position: Side slopes of buttes
Parent material: Ash mixed with colluvium derived from andesite

Properties and qualities

Slope: 30 to 70 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: 10 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.2 inches

Interpretive groups

Ecological site: Forestland—(006XY705OR) Pinus ponderosa/Arctostaphylos patula-Chrysolepis chrysophylia

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; cobbly ashy loamy sand
AB—5 to 14 inches; very cobbly ashy loamy coarse sand
Bw1—14 to 29 inches; very cobbly ashy sand
Bw2—29 to 37 inches; very cobbly ashy sandy loam
Bw3—37 to 60 inches; extremely cobbly ashy sandy loam

Characteristics of the Rock Outcrop

Landform: Butte
Geomorphic position: Rock outcroppings on side slopes of buttes
Parent material: Andesite
Slope: 30 to 70 percent; northwest to northeast aspects

Characteristics of the Minor Components

Collier soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashflow material at the base of buttes

Major Features and Properties Affecting Management

Lapine soil

- Low soil strength
- High pumice content
- Water erosion
- Very rapid permeability

Rock outcrop

- Lack of soil material

Wuksi soil

- Rock fragments on surface
- Rock fragments in soil profile
- Water erosion

33—Lava flows, 0 to 15 percent slopes

Map Unit Setting

General location: Lower slopes of Wizard Island
Major land resource area (MLRA): 3
Elevation: 6,100 to 6,300 feet
Average annual precipitation: 60 to 80 inches
Average annual air temperature: 37 to 43 degrees F
Frost-free period: 0 to 30 days

Map Unit Composition

Lava flows: 95 percent
Minor components: 5 percent

Characteristics of the Lava Flows

Landform: Lava flow
Geomorphic position: Andesitic basalt and andesite lava flows on Wizard Island
Parent material: Andesitic basalt

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Residuum derived from andesitic basalt and andesite on Wizard Island

Major Features and Properties Affecting Management

Lava flows

- Rock fragments
- Lack of soil material

34—Llaorock-Castlecrest complex, 0 to 15 percent slopes

Map Unit Setting

General location: Side slopes of mountains and ridges
Major land resource area (MLRA): 3
Elevation: 4,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 40 percent
Castlecrest and similar soils: 40 percent
Minor components: 20 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash over residuum and colluvium derived from andesite

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: 16 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides and ridges
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present

Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Grousehill soils

Percentage of map unit: 10 percent
Landform: Ground moraine
Geomorphic position: Ash over glacial till on mountainsides

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall on mountainsides

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Andesitic lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

35—Llaorock-Castlecrest complex, 15 to 30 percent slopes

Map Unit Setting

General location: Side slopes of mountains and ridges
Major land resource area (MLRA): 3
Elevation: 5,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 45 percent
Castlecrest and similar soils: 35 percent
Minor components: 20 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash over residuum and colluvium derived from andesite

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: 16 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides and ridges
Parent material: Ash and pumice

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Andesitic lava flows on mountainsides

Cleetwood soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ash on mountainsides that support meadow or desert vegetation

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Grousehill soils

Percentage of map unit: 5 percent
Landform: Ground moraine
Geomorphic position: Ash over glacial till on mountainsides

Major Soil Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

36—Llaorock-Castlecrest-Rock outcrop complex, 30 to 60 percent north slopes

Map Unit Setting

General location: Side slopes of mountains and ridges
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 35 percent
Castlecrest and similar soils: 30 percent
Rock outcrop: 20 percent
Minor components: 15 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash over residuum and colluvium derived from andesite

Properties and qualities

Slope: 30 to 60 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam

Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflows on mountainsides and ridges
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 60 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Rock Outcrop

Landform: Stratovolcano
Geomorphic position: Lava flows on mountainsides and ridges
Parent material: Andesite
Slope: 30 to 60 percent

Characteristics of the Minor Components

Grousehill soils

Percentage of map unit: 5 percent
Landform: Ground moraine
Geomorphic position: Ash over glacial till on mountainsides

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Ashfall and ashflow material on side slopes of mountains and ridges

Major Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Steepness of slope
- Water erosion
- Rock fragments in soil profile

Castlecrest soil

- Steepness of slope
- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion

Rock outcrop

- Lack of soil material

37—Llaorock-Castlecrest-Rock outcrop complex, 30 to 60 percent south slopes

Map Unit Setting

General location: Side slopes of mountains and ridges
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 35 percent
Castlecrest and similar soils: 25 percent
Rock outcrop: 25 percent
Minor components: 15 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges

Parent material: Ash over residuum and colluvium derived from andesite

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/ Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides and ridges
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/ Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Rock outcrop

Landform: Stratovolcano
Geomorphic position: Lava flows on side slopes of mountains and ridges
Parent material: Andesite
Slope: 30 to 60 percent; northeast to northwest aspects

Characteristics of the Minor Components

Grousehill soils

Percentage of map unit: 10 percent
Landform: Ground moraine
Geomorphic position: Ash over glacial till on mountainsides

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Major Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile
- Steepness of slope
- Water erosion

Castlecrest soil

- Steepness of slope
- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion

Rock outcrop

- Lack of soil material

38—Llaorock-Rubble land-Rock outcrop complex, 60 to 90 percent north slopes

Map Unit Setting

General location: Steep side slopes, mainly of the caldera rim
Major land resource area (MLRA): 3
Elevation: 6,000 to 8,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 50 percent
Rubble land: 30 percent
Rock outcrop: 15 percent
Minor components: 5 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Steep side slopes of mountains, ridges, and the caldera rim
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 60 to 80 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: 7 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Rubble Land

Landform: Talus slope
Geomorphic position: Talus on side slopes of mountains, ridges, and the caldera rim
Parent material: Colluvium derived from andesite
Slope: 60 to 90 percent

Characteristics of the Rock Outcrop

Landform: Stratovolcano
Geomorphic position: Rock outcroppings on side slopes of mountains, ridges, and the caldera rim
Parent material: Andesite
Slope: 60 to 90 percent

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall deposits on side slopes of mountains, ridges, and the caldera rim

Major Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Steep and unstable slopes
- Rock fragments in soil profile
- Water erosion

Rubble land

- Steep and unstable slopes
- Rock fragments
- Lack of soil material

Rock outcrop

- Lack of soil material

39—Llaorock-Rubble land-Rock outcrop complex, 60 to 90 percent south slopes

Map Unit Setting

General location: Side slopes of buttes, ridges, and the caldera rim

Major land resource area (MLRA): 3
Elevation: 6,000 to 8,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 40 percent
Rubble land: 35 percent
Rock outcrop: 20 percent
Minor components: 5 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of buttes, ridges, and the caldera rim
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 60 to 80 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/ Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Rubble Land

Landform: Talus slope
Geomorphic position: Talus slopes on side slopes of buttes, ridges, and the caldera rim
Parent material: Colluvium derived from andesite
Slope: 60 to 90 percent

Characteristics of the Rock Outcrop

Landform: Stratovolcano
Geomorphic position: Rock outcroppings on side slopes of buttes, ridges, and the caldera rim
Parent material: Andesite
Slope: 60 to 90 percent

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Pumice and ash deposits on side slopes of buttes, ridges, and the caldera rim

Major Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Steep and unstable slopes
- Rock fragments in soil profile
- Water erosion

Rubble land

- Steep and unstable slopes
- Rock fragments
- Lack of soil material

Rock outcrop

- Lack of soil material

40—Llaorock-Timbercrater-Rubble land complex, dry, 60 to 90 percent south slopes

Map Unit Setting

General location: Steep side slopes of mountains and ridges in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Llaorock and similar soils: 30 percent
Timbercrater and similar soils: 25 percent
Rubble land: 25 percent
Minor components: 20 percent

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 60 to 80 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Ashfall
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash and pumice

Properties and qualities

Slope: 60 to 80 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Rubble Land

Landform: Talus slope
Geomorphic position: Talus on side slopes of mountains and ridges
Parent material: Colluvium derived from andesite
Slope: 60 to 90 percent

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Andesite lava flows on side slopes of mountains and ridges

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on side slopes of mountains and ridges

Major Features and Properties Affecting Management

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile
- Steep and unstable slopes
- Water erosion

Timbercrater soil

- High pumice content
- Water erosion
- Steep and unstable slopes
- Very rapid permeability

Rubble land

- Rock fragments
- Steep and unstable slopes
- Lack of soil material

41—Maklak paragravelly ashy loamy sand, 0 to 10 percent slopes

Map Unit Setting

General location: Valleys and lava plains in the northeastern part of the park
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 30 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Maklak and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Maklak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Pumice flows and ashflows in valleys and on lava plains
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY701OR) Pinus ponderosa/Arctostaphylos patula/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 4 inches; paragravelly ashy loamy sand
Bw—4 to 15 inches; very paragravelly ashy loamy sand
C1—15 to 25 inches; extremely paracobbly ashy loamy sand
C2—25 to 60 inches; extremely paragravelly ashy loamy sand

Characteristics of the Minor Components

Lapine soils

Percentage of map unit: 10 percent
Landform: Ashfall
Geomorphic position: Pumice and ash in valleys and on lava plains

Steiger soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Ash and pumice in valleys and on lava plains

Major Soil Features and Properties Affecting Management

Maklak soil

- High pumice content
- Paracobbles throughout the profile
- Very rapid permeability

42—Maklak paragravelly ashy loamy sand, low, 0 to 10 percent slopes

Map Unit Setting

General location: Basins near Sand Creek
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 30 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Maklak and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Maklak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Pumice flows and ashflows in valleys and on lava plains
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained

Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY702OR) Pinus contorta/Ribes cereum-Purshia tridentata/ Achnatherum occidentale ssp. occidentale

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 4 inches; paragravelly ashy loamy sand
Bw—4 to 15 inches; very paragravelly ashy loamy sand
C1—15 to 25 inches; extremely paracobbly ashy loamy sand
C2—25 to 60 inches; extremely paragravelly ashy loamy sand

Characteristics of the Minor Components

Lapine soils

Percentage of map unit: 10 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall material in valleys and on lava plains

Steiger soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Ash and pumice in valleys and on lava plains

Major Soil Features and Properties Affecting Management

Maklak soil

- High pumice content
- Paracobbles throughout the profile
- Cold air drainage
- Very rapid permeability

43—Maklak paragravelly ashy loamy sand, high precipitation, 0 to 10 percent slopes

Map Unit Setting

General location: Valleys in the southeastern part of the park
Major land resource area (MLRA): 6
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 30 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Maklak and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Maklak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Pumice flows and ashflows in valleys and on lava plains
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.2 inches

Interpretive groups

Ecological site: Forestland—(006XY703OR) Pinus ponderosa/Symphoricarpos hesperius/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 4 inches; paragravelly ashy loamy sand
Bw—4 to 15 inches; very paragravelly ashy loamy sand
C1—15 to 25 inches; extremely paracobbly ashy loamy sand
C2—25 to 60 inches; extremely paragravelly ashy loamy sand

Characteristics of the Minor Components

Lapine soils

Percentage of map unit: 10 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall material in valleys and on lava plains

Collier soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ashflow material in valleys and on lava plains

Major Soil Features and Properties Affecting Management

Maklak soil

- High pumice content
- Paracobbles throughout the profile
- Very rapid permeability

44—Mariel-Stirfry complex, 0 to 3 percent slopes

Map Unit Setting

General location: Mainly in Sphagnum Bog
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Map Unit Composition

Mariel and similar soils: 50 percent
Stirfry and similar soils: 40 percent
Minor components: 10 percent

Characteristics of the Mariel and Similar Soils

Setting

Landform: Bog
Geomorphic position: Bogs and seeps in mountain basins and drainageways
Parent material: Organic material

Properties and qualities

Slope: 0 to 3 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Very poorly drained
Permeability: Moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Present (see table 20)
Available water capacity: About 9.2 inches

Interpretive groups

Ecological site: Rangeland—(003XY017OR) Sphagnum Fen 40-60 PZ

Typical profile

Oe1—0 to 5 inches; mucky peat
Oe2—5 to 15 inches; mucky peat
Oa—15 to 61 inches; muck

Characteristics of the Stirfry and Similar Soils

Setting

Landform: Drainageway
Geomorphic position: Bogs and seeps in mountain basins and drainageways
Parent material: Mossy organic material over ash and pumice

Properties and qualities

Slope: 0 to 3 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Depth to mineral soil: 40 to 60 inches
Drainage class: Very poorly drained
Permeability: Moderately rapid
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 8.5 inches

Interpretive groups

Ecological site: Rangeland—(003XY015OR) Meadow Fen 40-60 PZ

Typical profile

Oi—0 to 2 inches; peat
Oe—2 to 8 inches; mucky peat
Oa1—8 to 18 inches; muck
Oa2—18 to 51 inches; muck
2A—51 to 60 inches; gravelly ashy coarse sand

Characteristics of the Minor Components

Stirfry taxadjunct

Percentage of map unit: 10 percent
Landform: Drainageway
Geomorphic position: Mountain basins and drainageways

Major Soil Features and Properties Affecting Management

Mariel soil

- Wetness
- Organic soil material throughout profile
- Frost hazard

Stirfry soil

- Wetness
- Organic soil material over mineral soil material
- Frost hazard

45—Redcone-Cinder land complex, 30 to 60 percent south slopes

Map Unit Setting

General location: Side slopes of cinder cones
Major land resource area (MLRA): 3
Elevation: 5,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Redcone and similar soils: 70 percent
Cinder land: 15 percent
Minor components: 15 percent

Characteristics of the Redcone and Similar Soils

Setting

Landform: Cinder cone
Geomorphic position: Side slopes of cinder cones
Parent material: Colluvial material consisting of ash and cinders

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid over moderate
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 3.9 inches

Interpretive groups

Ecological site: Forestland—(003XY702OR) Tsuga mertensiana/Arctostaphylos patula-Holodiscus discolor/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; very gravelly ashy sandy loam
Bw1—7 to 24 inches; very gravelly ashy coarse sandy loam
Bw2—24 to 27 inches; very gravelly ashy loamy sand
2Bsqm—27 to 38 inches; cemented gravelly ashy loamy sand
2BC—38 to 61 inches; extremely gravelly ashy loamy sand

Characteristics of the Cinder Land

Landform: Cinder cone
Geomorphic position: Cinder deposits on side slopes of cinder cones
Parent material: Andesite
Slope: 30 to 60 percent

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 10 percent
Landform: Cinder cone
Geomorphic position: Andesite lava flows on side slopes of cinder cones

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Cinder cone
Geomorphic position: Airfall deposits of pumice and ash on side slopes of cinder cones

Major Features and Properties Affecting Management

Redcone soil

- Steep and unstable slopes
- Rock fragments on surface
- Rock fragments in soil profile
- Dustiness
- Depth to hardpan
- Low soil strength
- Water erosion
- Low water-holding capacity

Cinder land

- Steep and unstable slopes
- Rock fragments
- Dustiness
- Low strength
- Lack of soil material
- Low water-holding capacity

46—Redcone-Rock outcrop complex, 30 to 60 percent north slopes

Map Unit Setting

General location: Side slopes of cinder cones
Major land resource area (MLRA): 3
Elevation: 5,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Redcone and similar soils: 70 percent
Rock outcrop: 15 percent
Minor components: 15 percent

Characteristics of the Redcone and Similar Soils

Setting

Landform: Cinder cone
Geomorphic position: Side slopes of cinder cones
Parent material: Colluvial material consisting of ash and cinders

Properties and qualities

Slope: 30 to 60 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid over moderate
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 3.9 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; very gravelly ashy sandy loam
Bw1—7 to 24 inches; very gravelly ashy coarse sandy loam
Bw2—24 to 27 inches; very gravelly ashy loamy sand
2Bsqm—27 to 38 inches; cemented gravelly ashy loamy sand
2BC—38 to 61 inches; extremely gravelly ashy loamy sand

Characteristics of the Rock Outcrop

Landform: Cinder cone
Geomorphic position: Rock outcroppings on side slopes of cinder cones
Parent material: Andesite
Slope: 30 to 60 percent

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 10 percent
Landform: Cinder cone
Geomorphic position: Airfall deposits of pumice and ash on cinder cones

Cinder land

Percentage of map unit: 5 percent
Landform: Cinder cone
Geomorphic position: Cinders and ash on side slopes of cinder cones

Major Features and Properties Affecting Management

Redcone soil

- Steep and unstable slopes
- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan
- Low soil strength
- Low water-holding capacity
- Water erosion

Rock outcrop

- Lack of soil material

47—Rock outcrop-Rubble land complex, 60 to 90 percent slopes

Map Unit Setting

General location: Steep side slopes, mainly on the caldera rim
Major land resource area (MLRA): 3
Elevation: 6,000 to 8,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Rock outcrop: 50 percent
Rubble land: 45 percent
Minor components: 5 percent

Characteristics of the Rock Outcrop

Landform: Stratovolcano
Geomorphic position: Rock outcroppings on side slopes of mountains and the caldera rim
Parent material: Andesite

Characteristics of the Rubble Land

Landform: Talus slope
Geomorphic position: Talus on side slopes of mountains and the caldera rim
Parent material: Colluvium derived from andesite

Characteristics of the Minor Components

Llaorock soils

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and the caldera rim

Major Features and Properties Affecting Management

Rock outcrop

- Steep slopes
- Lack of soil material

Rubble land

- Steep and unstable slopes
- Rock fragments
- Lack of soil material

48—Stirfry mucky peat, 0 to 7 percent slopes

Map Unit Setting

General location: Seeps and stream terraces
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 30 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Stirfry and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Stirfry and Similar Soils

Setting

Landform: Drainageway
Geomorphic position: Bogs and seeps in mountain basins and drainageways
Parent material: Mossy organic material over ash and pumice

Properties and qualities

Slope: 0 to 7 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Depth to mineral soil: 40 to 60 inches
Drainage class: Very poorly drained
Permeability: Moderately rapid
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 8.5 inches

Interpretive groups

Ecological site: Rangeland—(003XY015OR) Meadow Fen 40-60 PZ

Typical profile

Oe—0 to 8 inches; mucky peat
Oa1—8 to 18 inches; muck
Oa2—18 to 51 inches; muck
2A—51 to 60 inches; gravelly ashy coarse sand

Characteristics of the Minor Components

Anniecreek soils

Percentage of map unit: 10 percent
Landform: Stream terrace
Geomorphic position: Stream terraces in bottoms of ravines

Riverwash

Percentage of map unit: 5 percent
Landform: Active flood plain
Geomorphic position: Sand and gravel in drainageways

Major Soil Features and Properties Affecting Management

Stirfry soil

- Wetness
- Organic soil material over mineral soil material
- Frost hazard

49—Stirfry-Grousehill complex, 0 to 10 percent slopes

Map Unit Setting

General location: Bogs and seeps
Major land resource area (MLRA): 3
Elevation: 4,800 to 5,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Stirfry and similar soils: 40 percent
Grousehill and similar soils: 40 percent
Minor components: 20 percent

Characteristics of the Stirfry and Similar Soils

Setting

Landform: Drainageway
Geomorphic position: Bogs and seeps in mountain basins and drainageways
Parent material: Mossy organic material over ash, pumice, and andesite fragments

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Depth to mineral soil: 20 to 40 inches
Drainage class: Very poorly drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Rangeland—(003XY018OR) Woodland Fen 40-60 PZ

Typical profile

Oe—0 to 2 inches; peat
Oa1—2 to 12 inches; mucky peat
Oa2—12 to 26 inches; mucky peat
2C1—26 to 30 inches; mucky ashy sandy loam
2C2—30 to 60 inches; very gravelly mucky ashy loamy coarse sand

Characteristics of the Grousehill and Similar Soils

Setting

Landform: Moraine
Geomorphic position: Glacial moraines in valleys
Parent material: Ash over glacial till

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Moderately well drained
Permeability: Moderate
Flooding: Not present
Water table: Present (see table 20)
Ponding: Not present
Available water capacity: About 12.8 inches

Interpretive groups

Ecological site: Forestland—(003XY709OR) Pseudotsuga menziesii/Vaccinium membranaceum/Chimaphila umbellata

Typical profile

Oi—0 to 3 inches; slightly decomposed plant material
A—3 to 10 inches; gravelly medial loam
Bw1—10 to 31 inches; very cobbly medial loam
Bw2—31 to 39 inches; very cobbly medial loam
Bqm—39 to 56 inches; cemented very cobbly medial sandy loam

Characteristics of the Minor Components

Stirfry soils

Percentage of map unit: 10 percent
Landform: Drainageway
Geomorphic position: Mossy organic material to a depth of 40 to 60 inches in bogs and seeps

Mariel soils

Percentage of map unit: 5 percent
Landform: Drainageway
Geomorphic position: Sphagnum moss and organic material in seeps and bogs

Umak soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Pumice and ash deposits in valleys

Major Soil Features and Properties Affecting Management

Stirfry soil

- Wetness
- Organic soil material over mineral soil material
- Frost hazard

Grousehill soil

- Rock fragments on surface
- Rock fragments in soil profile
- Depth to hardpan

50—Sunnotch gravelly ashy sandy loam, dry, 0 to 35 percent slopes

Map Unit Setting

General location: Valleys on the eastern side of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,000 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Sunnotch and similar soils: 80 percent
Minor components: 20 percent

Characteristics of the Sunnotch and Similar Soils

Setting

Landform: Debris flow
Geomorphic position: Mountainsides and valleys
Parent material: Cinders and ash

Properties and qualities

Slope: 0 to 35 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.6 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 3 inches; gravelly ashy sandy loam
A2—3 to 11 inches; ashy loamy sand
Bw—11 to 25 inches; very gravelly ashy loamy sand
2C—25 to 61 inches; very gravelly ashy sand

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Ashflow and ashfall deposits on mountainsides

Timbercrater soils

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Airfall deposits of pumice and ash on mountainsides

Major Soil Features and Properties Affecting Management

Sunnotch soil

- Rock fragments in soil profile
- Sandy textures

51—Sunnotch-Unionpeak complex, 15 to 35 percent slopes

Map Unit Setting

General location: Ash and cinder flows on side slopes of Mount Mazama
Major land resource area (MLRA): 3
Elevation: 5,000 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Sunnotch and similar soils: 50 percent
Unionpeak and similar soils: 40 percent
Minor components: 10 percent

Characteristics of the Sunnotch and Similar Soils

Setting

Landform: Debris flow
Geomorphic position: Side slopes of Mount Mazama
Parent material: Cinders and ash

Properties and qualities

Slope: 15 to 35 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.6 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 3 inches; gravelly ashy sandy loam
A2—3 to 11 inches; ashy loamy sand
Bw—11 to 25 inches; very gravelly ashy loamy sand
2C—25 to 61 inches; very gravelly ashy sand

Characteristics of the Unionpeak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflow material on side slopes of Mount Mazama
Parent material: Pumice, ash, and dacite and andesite fragments

Properties and qualities

Slope: 15 to 35 percent
Percentage of surface covered with stones and boulders: None
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 4.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 4 inches; ashy sandy loam
A2—4 to 8 inches; ashy loamy sand
Bw—8 to 30 inches; gravelly ashy loamy sand
Bqm—30 to 45 inches; cemented ashy loamy sand
C—45 to 65 inches; gravelly ashy loamy sand

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ashflow material on side slopes of Mount Mazama

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Sunnotch soil

- Rock fragments in soil profile
- Sandy textures

Unionpeak soil

- Depth to hardpan
- Dustiness if vegetation is removed
- Low water-holding capacity

52—Timbercrater paragravelly ashy loamy sand, dry, 25 to 60 percent north slopes

Map Unit Setting

General location: Side slopes of mountains and ridges on the eastern side of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and ridges
Parent material: Ash and pumice

Properties and qualities

Slope: 25 to 60 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Airfall deposits of ash on mountainsides

Llaorock soils

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Ash mixed with residuum and colluvium derived from andesite on side slopes of mountains and ridges

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

53—Timbercrater-Castlecrest complex, 0 to 10 percent slopes

Map Unit Setting

General location: Side slopes and benches of mountains and buttes
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 50 percent
Castlecrest and similar soils: 30 percent
Minor components: 20 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Llaorock soils

Percentage of map unit: 13 percent
Landform: Lava flow
Geomorphic position: Ash mixed with residuum and colluvium derived from andesite on side slopes of stratovolcanoes

Rock outcrop

Percentage of map unit: 7 percent
Landform: Stratovolcano
Geomorphic position: Andesitic lava flows on side slopes of stratovolcanoes

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

54—Timbercrater-Castlecrest complex, dry, 2 to 15 percent slopes

Map Unit Setting

General location: Side slopes of mountains and ridges in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 50 percent
Castlecrest and similar soils: 45 percent
Minor components: 5 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 2 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides and in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 2 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid

Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flow deposits on mountainsides and in valleys

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

55—Timbercrater-Castlecrest complex, dry, 15 to 30 percent south slopes

Map Unit Setting

General location: Side slopes of mountains and ridges in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 55 percent
Castlecrest and similar soils: 40 percent
Minor components: 5 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 15 to 30 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides and in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 15 to 30 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present

Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Sunnotch soils

Percentage of map unit: 5 percent
Landform: Debris flow
Geomorphic position: Debris flows on mountainsides

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

56—Timbercrater-Castlecrest-Llaorock complex, 10 to 30 percent south slopes

Map Unit Setting

General location: Side slopes of mountains and buttes
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 60 percent
Castlecrest and similar soils: 20 percent
Llaorock and similar soils: 15 percent
Minor components: 5 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 10 to 30 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/ Chimaphila umbellata

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashfall
Geomorphic position: Ashfall and ashflow material on mountainsides and in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 10 to 30 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present

Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/ Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Mountainsides
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 10 to 30 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY705OR) Tsuga mertensiana/Arctostaphylos nevadensis/ Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Andesitic lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

57—Timbercrater-Llaorock complex, 10 to 30 percent north slopes

Map Unit Setting

General location: Side slopes of mountains and buttes
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 55 percent
Llaorock and similar soils: 40 percent
Minor components: 5 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Ashfall
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 10 to 30 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: None

Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 10 to 30 percent; northwest to northeast aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Andesitic lava flows on side slopes of mountains and buttes

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

58—Timbercrater-Llaorock complex, dry, 30 to 60 percent south slopes

Map Unit Setting

General location: Side slopes of mountains and ridges in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 50 percent
Llaorock and similar soils: 35 percent
Minor components: 15 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Mountain
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained

Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Lava flow
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 30 to 60 percent; northeast to northwest aspects
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashfall and ashflow material on mountainsides

Rock outcrop

Percentage of map unit: 5 percent
Landform: Lava flow
Geomorphic position: Andesite lava flows on mountainsides

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Water erosion
- Very rapid permeability

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile
- Water erosion

59—Timbercrater-Llaorock complex, high elevation, 30 to 80 percent slopes

Map Unit Setting

General location: Side slopes of Mount Scott
Major land resource area (MLRA): 3
Elevation: 7,000 to 8,900 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 25 days

Map Unit Composition

Timbercrater and similar soils: 55 percent
Llaorock and similar soils: 30 percent
Minor components: 15 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of Mount Scott
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 80 percent
Percentage of surface covered with stones and boulders: None

Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY700OR) Pinus albicaulis/Luzula-Carex

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of Mount Scott
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 30 to 80 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY700OR) Pinus albicaulis/Luzula-Carex

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 10 percent
Landform: Stratovolcano
Geomorphic position: Andesitic lava flows on side slopes of Mount Scott

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Airfall ash deposits on side slopes of Mount Scott

Major Soil Features and Properties Affecting Management

Timbercrater soil

- Steep and unstable slopes
- High pumice content
- Water erosion
- Very rapid permeability

Llaorock soil

- Rock fragments on surface
- Steep and unstable slopes
- Rock fragments in soil profile
- Water erosion

60—Timbercrater-Llaorock-Castlecrest complex, 30 to 60 percent slopes

Map Unit Setting

General location: Side slopes of mountains and buttes
Major land resource area (MLRA): 3
Elevation: 5,500 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 60 percent
Llaorock and similar soils: 20 percent
Castlecrest and similar soils: 15 percent
Minor components: 5 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of mountains and buttes
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 60 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Mountainsides
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 30 to 60 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Ashfall and ashflow material on mountainsides
Parent material: Ash and pumice

Properties and qualities

Slope: 30 to 60 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Rock outcrop

Percentage of map unit: 5 percent
Landform: Stratovolcano
Geomorphic position: Andesitic lava flows on side slopes of stratovolcanoes

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Water erosion
- Very rapid permeability

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile
- Water erosion

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed
- Water erosion

61—Timbercrater-Sunnotch-Castlecrest complex, 0 to 10 percent slopes

Map Unit Setting

General location: Pumice and ashflow deposits north of Pumice Desert
Major land resource area (MLRA): 3
Elevation: 5,500 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Timbercrater and similar soils: 45 percent
Sunnotch and similar soils: 25 percent
Castlecrest and similar soils: 20 percent
Minor components: 10 percent

Characteristics of the Timbercrater and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow deposits in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 8.1 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 2 inches; slightly decomposed plant material
A—2 to 5 inches; paragravelly ashy loamy sand
Bw—5 to 16 inches; very paragravelly ashy loamy sand
C1—16 to 20 inches; extremely paragravelly ashy sand
C2—20 to 62 inches; extremely paragravelly ashy sand

Characteristics of the Sunnotch and Similar Soils

Setting

Landform: Debris flow
Geomorphic position: Debris flows in valleys
Parent material: Cinders and ash

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.6 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 3 inches; gravelly ashy sandy loam
A2—3 to 11 inches; ashy loamy sand
Bw—11 to 25 inches; very gravelly ashy loamy sand
2C—25 to 61 inches; very gravelly ashy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashfall and ashflow deposits in valleys
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None

Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Umak soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Pumice flow and ashflow deposits in valleys

Major Soil Features and Properties Affecting Management

Timbercrater soil

- High pumice content
- Very rapid permeability

Sunnotch soil

- Rock fragments in soil profile

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

62—Umak paragravelly ashy fine sandy loam, 0 to 7 percent slopes

Map Unit Setting

General location: Pumice flows in valleys
Major land resource area (MLRA): 3
Elevation: 4,500 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Umak and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Umak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Valleys
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 7 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.8 inches

Interpretive groups

Ecological site: Forestland—(003XY701OR) Tsuga mertensiana/Vaccinium scoparium/Chimaphila umbellata

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; paragravelly ashy fine sandy loam
Bw1—5 to 21 inches; very paracobbly ashy coarse sandy loam
Bw2—21 to 43 inches; extremely paracobbly ashy loamy coarse sand
Bw3—43 to 62 inches; extremely paracobbly ashy loamy coarse sand

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 10 percent
Landform: Ashfall
Geomorphic position: Ashfall and ashflow deposits with gravel-sized pumice in valleys

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ash deposits in valleys

Major Soil Features and Properties Affecting Management

Umak soil

- High pumice content
- Paracobbles on surface and in profile
- Very rapid permeability

63—Umak paragravelly ashy fine sandy loam, dry, 0 to 10 percent slopes

Map Unit Setting

General location: Pumice flows in valleys in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 5,000 to 5,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Umak and similar soils: 85 percent
Minor components: 15 percent

Characteristics of the Umak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Valleys
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 10 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.8 inches

Interpretive groups

Ecological site: Forestland—(003XY708OR) Abies-Pinus monticola/Arctostaphylos nevadensis

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; paragravelly ashy fine sandy loam
Bw1—5 to 21 inches; very paracobbly ashy coarse sandy loam
Bw2—21 to 43 inches; extremely paracobbly ashy loamy coarse sand
Bw3—43 to 62 inches; extremely paracobbly ashy loamy coarse sand

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ashfall and ashflow deposits with gravel-sized pumice in valleys

Castlecrest soils

Percentage of map unit: 5 percent
Landform: Ashflow
Geomorphic position: Ash deposits in valleys

Major Soil Features and Properties Affecting Management

Umak soil

- High pumice content
- Paracobbles on surface and in profile
- Very rapid permeability

64—Umak paragravelly ashy fine sandy loam, low, 0 to 5 percent slopes

Map Unit Setting

General location: Mainly in Pumice Valley
Major land resource area (MLRA): 3
Elevation: 6,000 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Umak and similar soils: 90 percent
Minor components: 10 percent

Characteristics of the Umak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Valleys
Parent material: Pumice and ash

Properties and qualities

Slope: 0 to 5 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches

Drainage class: Excessively drained
Permeability: Very rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 7.8 inches

Interpretive groups

Ecological site: Forestland—(003XY707OR) Pinus contorta/Carex

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 5 inches; paragravelly ashy fine sandy loam
Bw1—5 to 21 inches; very paracobbly ashy coarse sandy loam
Bw2—21 to 43 inches; extremely paracobbly ashy loamy coarse sand
Bw3—43 to 62 inches; extremely paracobbly ashy loamy coarse sand

Characteristics of the Minor Components

Castlecrest soils

Percentage of map unit: 10 percent
Landform: Ashflow
Geomorphic position: Ash deposits in valleys

Major Soil Features and Properties Affecting Management

Umak soil

- High pumice content
- Paracobbles on surface and in profile
- Cold air drainage
- Very rapid permeability

65—Unionpeak-Castlecrest complex, dry, 5 to 15 percent slopes

Map Unit Setting

General location: Ashflows in the southeastern part of the park
Major land resource area (MLRA): 3
Elevation: 4,500 to 6,500 feet
Average annual precipitation: 40 to 60 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Unionpeak and similar soils: 50 percent
Castlecrest and similar soils: 40 percent
Minor components: 10 percent

Characteristics of the Unionpeak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on mountainsides and in valleys of Mount Mazama
Parent material: Ash, pumice, and andesite and dacite fragments

Properties and qualities

Slope: 5 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 4.3 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 4 inches; ashy sandy loam
A2—4 to 8 inches; ashy loamy sand
Bw—8 to 30 inches; gravelly ashy loamy sand
Bqm—30 to 45 inches; cemented ashy loamy sand
C—45 to 65 inches; gravelly ashy loamy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on mountainsides and in valleys of Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 5 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY704OR) Abies/ Arctostaphylos nevadensis/Carex inops

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 10 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall deposits on mountainsides and in valleys of Mount Mazama

Major Soil Features and Properties Affecting Management

Unionpeak soil

- Depth to hardpan
- Dustiness if vegetation is removed
- Low water-holding capacity

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

66—Unionpeak-Castlecrest-Llaorock complex, 15 to 30 percent slopes

Map Unit Setting

General location: Ashflows on mountainsides and in valleys of Mount Mazama
Major land resource area (MLRA): 3
Elevation: 5,500 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Unionpeak and similar soils: 35 percent
Castlecrest and similar soils: 30 percent
Llaorock and similar soils: 25 percent
Minor components: 10 percent

Characteristics of the Unionpeak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on mountainsides and in valleys of Mount Mazama
Parent material: Ash, pumice, and andesite and dacite fragments

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 4.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 4 inches; ashy sandy loam
A2—4 to 8 inches; ashy loamy sand
Bw—8 to 30 inches; gravelly ashy loamy sand
Bqm—30 to 45 inches; cemented ashy loamy sand
C—45 to 65 inches; gravelly ashy loamy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on mountainsides and in valleys of Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches

Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Llaorock and Similar Soils

Setting

Landform: Stratovolcano
Geomorphic position: Side slopes of Mount Mazama
Parent material: Ash mixed with residuum and colluvium derived from andesite

Properties and qualities

Slope: 15 to 30 percent
Percentage of surface covered with stones and boulders: 3 percent
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 9 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 7 inches; gravelly ashy sandy loam
AB—7 to 14 inches; very stony ashy sandy loam
Bw1—14 to 24 inches; extremely stony medial sandy loam
Bw2—24 to 61 inches; extremely stony medial sandy loam

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 4 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall on side slopes of Mount Mazama

Sunnotch soils

Percentage of map unit: 3 percent
Landform: Ashflow
Geomorphic position: Debris flows on side slopes and in valleys of Mount Mazama

Rock outcrop

Percentage of map unit: 3 percent
Landform: Lava flow
Geomorphic position: Andesite lava flows on side slopes of Mount Mazama

Major Soil Features and Properties Affecting Management

Unionpeak soil

- Depth to hardpan
- Dustiness if vegetation is removed
- Low water-holding capacity

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

Llaorock soil

- Rock fragments on surface
- Rock fragments in soil profile

67—Unionpeak-Castlecrest-Sunnotch complex, 0 to 15 percent slopes

Map Unit Setting

General location: Ashflows on mountainsides and in valleys of Mount Mazama
Major land resource area (MLRA): 3
Elevation: 5,000 to 7,000 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Map Unit Composition

Unionpeak and similar soils: 45 percent
Castlecrest and similar soils: 30 percent

Sunnotch and similar soils: 20 percent
Minor components: 5 percent

Characteristics of the Unionpeak and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on mountainsides and in valleys of Mount Mazama
Parent material: Ash, pumice, and andesite and dacite fragments

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive feature: Duripan at a depth of 20 to 40 inches
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid or rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 4.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 4 inches; ashy sandy loam
A2—4 to 8 inches; ashy loamy sand
Bw—8 to 30 inches; gravelly ashy loamy sand
Bqm—30 to 45 inches; cemented ashy loamy sand
C—45 to 65 inches; gravelly ashy loamy sand

Characteristics of the Castlecrest and Similar Soils

Setting

Landform: Ashflow
Geomorphic position: Ashflows on mountainsides and in valleys of Mount Mazama
Parent material: Ash and pumice

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.3 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A—1 inch to 3 inches; paragravelly ashy loamy sand
Bw—3 to 19 inches; paragravelly ashy loamy sand
C1—19 to 26 inches; ashy sand
C2—26 to 38 inches; ashy coarse sand
C3—38 to 64 inches; ashy coarse sand

Characteristics of the Sunnotch and Similar Soils

Setting

Landform: Debris flow
Geomorphic position: Debris flows on side slopes of Mount Mazama
Parent material: Cinders and ash

Properties and qualities

Slope: 0 to 15 percent
Percentage of surface covered with stones and boulders: None
Restrictive features: None within a depth of 60 inches
Drainage class: Somewhat excessively drained
Permeability: Rapid
Flooding: Not present
Water table: Not present
Ponding: Not present
Available water capacity: About 6.6 inches

Interpretive groups

Ecological site: Forestland—(003XY706OR) Tsuga mertensiana/Luzula glabrata var. hitchcockii

Typical profile

Oi—0 to 1 inch; slightly decomposed plant material
A1—1 inch to 3 inches; gravelly ashy sandy loam
A2—3 to 11 inches; ashy loamy sand
Bw—11 to 25 inches; very gravelly ashy loamy sand
2C—25 to 61 inches; very gravelly ashy sand

Characteristics of the Minor Components

Timbercrater soils

Percentage of map unit: 5 percent
Landform: Ashfall
Geomorphic position: Pumice and ashfall deposits on mountainsides and in valleys

Major Soil Features and Properties Affecting Management

Unionpeak soil

- Depth to hardpan
- Dustiness if vegetation is removed
- Low water-holding capacity

Castlecrest soil

- Sandy textures
- Low soil strength
- Dustiness if vegetation is removed

Sunnotch soil

- Rock fragments on surface
- Rock fragments in soil profile

68—Water

Map Unit Setting

General location: Crater Lake
Landform: Caldera lake
Geomorphic position: Lakes in the volcanic caldera and in a few scattered small depressional areas
Major land resource area (MLRA): 3
Elevation: 4,700 to 6,200 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F

Map Unit Composition

Water: 100 percent

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the park. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils as rangeland and forestland; as sites for buildings, sanitary facilities, highways, and parks and other recreational facilities; and as 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 park. 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, campgrounds, and trees and shrubs.

Interpretive Ratings

The interpretive tables in this survey rate the soils in the park for various uses. Many of the tables identify the limitations that affect specified uses and indicate the severity of those limitations. The ratings in these tables are both verbal and numerical.

Rating Class Terms

Rating classes are expressed in the tables in terms that indicate the extent to which the soils are limited by all of the soil features that affect a specified use or in terms that indicate the suitability of the soils for the use. Thus, the tables may show limitation classes or suitability classes. Terms for the limitation classes are *not limited, somewhat limited,* and *very limited*. The suitability ratings are expressed as *well suited, moderately well suited, poorly suited,* and *unsuited* or as *good, fair,* and *poor*.

Numerical Ratings

Numerical ratings in the tables indicate the relative severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use and the point at which the soil feature is not a limitation. The limitations appear in order from the most limiting to the least limiting. Thus, if more than one limitation is identified, the most severe limitation is listed first and the least severe one is listed last.

Ecological Sites

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During this survey, the relationship between the soils and vegetation was established. Each detailed soil map unit component was correlated to an ecological site, a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation. An ecological site is the product of many environmental factors—soils, climate, hydrology, landscape position, time, and living organisms. Each ecological site is recognized and described on the basis of the characteristics that differentiate it from other sites in its ability to produce and support a characteristic plant community.

Most ecological sites evolved with a characteristic kind of herbivory (kinds and numbers of herbivores,

seasons of use, and intensity of use) and a characteristic fire regime. The frequency and intensity of fires contributed to the characteristic plant community of each site. Soils with similar properties that support a similar native plant community are grouped in an ecological site.

The ecological site descriptions are provided in the Natural Resources Conservation Service Ecological Site Inventory Information System (ESIS)-Ecological Site Inventory (ESI) database. (http://plants.usda.gov/esis)

Each detailed soil map unit component in this survey has been correlated to a rangeland or forestland ecological site. This information is given in table 5.

Vegetative information about the historic climax plant community for each ecological site is also given in table 5. The table includes the characteristic vegetation for each ecological site, species composition, and for the rangeland sites only, total dry-weight production. The historic climax plant community is the plant community that is best adapted to the unique combination of factors associated with an ecological site. It is a natural dynamic equilibrium with the historic biotic, abiotic, and climatic factors on an ecological site in North America at the time of European immigration and settlement.

Total dry-weight production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the climax natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture. Yields are adjusted to a common percent of air-dry moisture content.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the historic climax plant community on each soil—is listed by common name. Under *range composition*, the expected percentage of the species is based on annual production of vegetation (air-dry weight). Under *forest composition*, the expected percentage of the species is based on canopy cover.

The characteristic overstory vegetation for the forested ecological sites is shown in table 6. This table includes the ecological site name, overstory vegetation, and composition. Under *composition*, the expected percentage of the species is based on canopy cover.

Vegetation

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Crater Lake National Park is in three major land resource areas (USDA, 1981). A major land resource area (MLRA) is a geographically associated land resource unit that is characterized by a particular pattern of soils, climate, water resources, and land uses. Most of the park is in the Olympic and Cascade Mountains area (MLRA 3). The drier eastern part is in the Cascade Mountains, Eastern Slope, area (MLRA 6), and the extreme southwestern corner is in the Siskiyou-Trinity area (MLRA 5).

The part of the park in the Olympic and Cascade Mountains area (MLRA 3) is nearly all forested, but there are areas of open alpine meadows and swales and rock outcroppings. Typical tree species are mountain hemlock (*Tsuga mertensiana*), Shasta red fir (*Abies x shastensis*), whitebark pine (*Pinus albicaulis*), and lodgepole pine (*Pinus contorta*) and to a lesser extent western white pine (*Pinus monticola*), subalpine fir (*Abies lasiocarpa*), and white fir (*Abies concolor*). The understory vegetation is highly variable. The elevation, precipitation, type of soil, and overstory canopy influence the composition and abundance of the understory vegetation. Most of the precipitation is received in the form of snow.

The soils in the Cascade Mountains, Eastern Slope, area (MLRA 6) consist dominantly of ash and pumice. These soils support forests that have varying degrees of density. Ponderosa pine (*Pinus ponderosa*), western white pine, Shasta red fir, white fir, and lodgepole pine are the most common tree species. The understory plant cover varies depending on the amount of precipitation and the overstory canopy cover. In the northeastern part of the park, sedges and grasses are most abundant, but in the southeastern part, brush and sedges are most common.

The small part of the park in the Siskiyou-Trinity area (MLRA 5) also is forested. The dominant tree species is Douglas fir (*Psuedotsuga menziesii*) with some white fir and sugar pine (*Pinus lambertiana*). The composition and abundance of the understory vegetation can be highly variable. Because this area is at the lower elevations and is characterized by a warmer climate, the abundance of the understory

generally is higher than that in MLRA 6. Precipitation is received mainly in the form of rain, but some snow falls in winter. Rainfall generally is distributed throughout the year, but little is received in summer.

The rangeland ecological sites in the park can be placed into two broad historic plant associations—alpine meadows with intermingled forests and wetlands with intermingled forests. The forestland ecological sites can be placed in six broad historic plant associations—whitebark pine, mountain hemlock, Shasta red fir, ponderosa pine/fir, lodgepole pine, and Douglas fir. The location and distribution of these associations is shown on the General Vegetation Map included in this survey. A discussion of each plant association follows.

Alpine Meadows with Intermingled Forests

This association is around the rim of Crater Lake and extends northward to Pumice Desert and southward to Union Peak and Crater Peak. Precipitation ranges from 40 to 80 inches per year, occurring mainly as snow. The average annual temperature is very cold (38 to 42 degrees F), and the growing season is very short (less than 30 days). Except on southern exposures, the snowpack usually remains on the ground well into summer.

The meadow areas of this association are parklike, and they are surrounded by forest areas of mountain hemlock (*Tsuga mertensiana*) and whitebark pine (*Pinus albicaulis*). These meadow areas are strongly correlated to soil types and are thought to be relatively permanent, although the structure of the historic plant community may have been different (Lynch, 1998). The boundaries between the forest areas and the meadow areas in this association generally are abrupt, and rarely are there significant intrusions of tree species in the meadow areas. Historically, a long period of time has elapsed between catastrophic fires in areas of this association. Local Indian tribes, who used these areas frequently in summer, may have set fires to freshen the vegetation to attract big game.

The rangeland ecological sites in this association consist of grass-dominated meadows, sedge-dominated swales, and very sparsely vegetated alpine deserts. The meadows have the greatest diversity of plant species; thus, they also have higher value as wildlife habitat. The pumice flats and deserts are nearly barren, but they support some low-growing, compact plants that have large taproots (Franklin and Dyrness, 1973). All of the rangeland ecological sites in this association have cryic soil temperatures and a udic moisture regime.

The *Pumice Desert* ecological site occurs at slightly lower elevations northwest of the rim. This site supports very sparse vegetation comprised of nearly equal amounts of marumleaf buckwheat (*Eriogonum marifolium*), western needlegrass (*Achnatherum occidentale ssp. californicum*), and Brewer's sedge (*Carex breweri*). This site is in depressional areas surrounded by lodgepole pine forests. The soil surface consists mainly of cinder fragments. Horn concluded that a severe climatic regime characterized by widely varying daytime and nighttime temperatures and low soil fertility resulted in the paucity of vegetation (only 14 species have been observed) (Franklin and Dyrness, 1973). Soil moisture is available to plants throughout the growing season.

The *Ashy Alpine Desert* ecological site is at the higher elevations (see fig.1, page 97). It is associated with the Ashy Alpine Meadow and Ashy Alpine Swale ecological sites and may support interspersed areas of mountain hemlock (*Tsuga mertensiana*) and whitebark pine (*Pinus albicaulis*). This site supports very sparse vegetation because of the rock and pararock fragments on the thin soil surface, an extremely wide range of diurnal temperatures, and low soil fertility. The site is extensive on some south- and southwest-facing slopes. It can occur on slopes where the snowpack stays well into summer in most years, limiting germination and establishment of plants. The dominant plant species are small, shrubby Shasta buckwheat (*Erigonium pyrolifolium*) and Newberry knotweed (*Polygonum davisiae*), which has a distinctive late-season red color.

The *Ashy Alpine Meadow* ecological site is the most widespread of the alpine sites. It is a relatively productive grassy meadow site that supports dominantly western needlegrass (*Achnatherum occidentale ssp. californicum*), Hall's sedge (*Carex halliana*), bottlebrush squirreltail (*Elymus elymoides ssp. elymoides*), and shrubby Bloomer's goldenweed (*Ericameria bloomeri*), which has brilliant yellow flowers in July and August. This site occurs around the caldera rim, especially in the southern, southwestern, and southeastern areas, and extends to areas around Union Peak and Crater Peak to the south. It is associated with the Ashy Alpine Desert and Ashy Alpine Swale sites. It is arrayed in a parklike setting surrounded by and interspersed with stringers of mountain hemlock. It provides important forage in summer for large ungulates and for rodents, which attract raptors.

The *Ashy Alpine Swale* ecological site occurs around the caldera rim in association primarily with the Ashy Alpine Meadow and Ashy Alpine Desert

sites (see fig. 2, page 98). This site occurs in small depressions and on flat terraces. The soils in this site have a slightly impermeable subsoil. Snowpack and snowmelt tend to collect on the soils. Areas of this site are patchy and support dominantly Brewer's sedge (*Carex breweri*) or Parry's rush (*Juncus parryi*) with minor amounts of western needlegrass (*Achnatherum occidentale ssp. californicum*) and bottlebrush squirreltail (*Elymus elymoides ssp. elymoides*). Brewer's sedge and Parry's rush can occur together or separately, depending on the length of time that the snowpack stays on the surface. Parry's rush tends to grow in areas that are colder and wetter and have longer periods of ponding, and Brewer's sedge tends to grow in areas that dry out quicker.

Wetlands with Intermingled Forests

This association is confined to riparian areas, seeps, and fens. Precipitation ranges from 25 to 70 inches per year, occurring mainly as snow. The average annual temperature is very cold (38 to 42 degrees), and the growing season is very short (less than 70 days).

The riparian areas along Annie Creek, Sand Creek, and the Rogue River commonly are at the contact with the older, buried glaciated sediment present before the latest eruptions of Mount Mazama. Precipitation filters down through sometimes hundreds of feet of volcanic ash, comes into contact with the much less permeable glaciated sediment, and then moves laterally, eventually surfacing as springs, seeps, and riparian areas.

All of the ecological sites in this association are influenced by a fluctuating water table, varying degrees of an anaerobic condition, and generally thick-surfaced organic soils (35 to 70 inches deep or more to mineral soil). The wetlands at the headwaters of National Creek and at Sphagnum Bog are fens that are characterized by a high water table, an accumulation of peaty organic matter, and low availability of nutrients. The nutrient supply for fens is primarily provided by precipitation, surface water, and groundwater, whereas the nutrient supply for bogs is provided by precipitation only (Aerts, 1999; Johnson and others, 1995; Radforth and Brawner, 1977).

The fens in this association support two distinct historic climax plant communities. Studies have shown that the accumulation of organic matter on the surface from litter and windthrown trees affects the characteristic plant community. Brock suggested that peat hummocks accumulate on top of the organic soil surface in the absence of fire, but in dry, hot years the hummocks are consumed by fire, leaving the saturated organic soil surface (Dorr and others, 2000). An accumulation of peat 4 to 6 inches thick is sufficient for tufted hairgrass and sedges to root above permanently saturated layers. An accumulation of more than 6 inches allows for colonization of blueberry, alder, and willows. Lodgepole pine can grow in accumulations of 16 inches or more. There is also some evidence that conifer litter has an allelopathic effect on mosses, meaning mosses are killed by the accumulation or decomposition of this litter.

The ecological sites in this association are located only along the boundary in the west-central part of the park, in the Poison Meadow area. These sites have a greater influence of glaciated sediment, and they may be present in larger areas at lower elevations in the adjacent Rogue River and Winema National Forests. These sites have either an aquic soil moisture regime and support dominantly sedges or a udic soil moisture regime and support dominantly grasses. All of the ecological sites in this association have cryic soil temperatures.

The *Meadow Fen* ecological site is along perennial streams and the edges of the wetter fen sites. Some areas of this site have relatively deep accumulations of rubbed fibers and mucky peat soils with a layer of ashy sand in the subsoil. This site supports dominantly lush stands of water sedge (*Carex aquatilis*) and smaller amounts of bluejoint reedgrass (*Calomagrostis canadensis*) and arrowleaf ragwort (*Senecio triangularis*). It has a sparse canopy of lodgepole pine. It occurs in association with the Sphagnum Fen ecological site.

Lodgepole pine (*Pinus contorta*)/Shasta red fir (*Abies shastensis*) and mountain hemlock (*Tsuga mertensiana*) forests are on the surrounding drier soils. Historic fires and seasonal ponding may keep the lodgepole pine, mountain hemlock, and Shasta red fir from encroaching onto the Meadow Fen site. Many small trees are on this site. Many older trees, 80 to 100 years old, are in the bog areas, but the trees in the riparian areas are much younger, suggesting an occasional purge of conifers from the wet areas as a result of a relatively hot fire. The frequency of fire is probably similar to that of the surrounding forest sites. Fire suppression efforts since 1900 possibly have decreased the extent of the Meadow Fen site because the canopy cover of woody species has increased and the cover of grasses and sedges has decreased.

The Meadow Fen site provides important cover and food for wildlife. Elk feed extensively in areas of this site in summer. It is the most productive rangeland site in the park. Production of air-dry vegetation is estimated at 7,500 to 9,500 pounds per acre per year.

The *Sphagnum Fen* ecological site occurs in

association with the Meadow Fen site, but the Sphagnum Fen site generally is wetter. Some areas of this site have very deep accumulations of rubbed fibers and mucky peat soils. This site is the most diverse rangeland site in the park. It supports a large number of species, but dominantly water sedge (*Carex aquatilis*), fewflower spikerush (*Eleocharis quinqueflora*), pullup muhly (*Muhlenbergia filiformis*), and tufted hairgrass (*Deschampsia caespitosa*). The more "boggy" areas of this site support carnivorous sundew (*Drosera anglica* and *D. rotundifolia*) and a discontinuous carpet of sphagnum moss.

This site shares a natural dynamic relationship with a slightly higher lying plant community of bog blueberry (*Vaccinium uliginosum*). This plant community develops in areas where organic matter accumulates into hummocks. These hummocks are slightly higher lying and drier than the surrounding areas; thus, they provide the microenvironment necessary for bog blueberry. Windthrown pine and fir slowly decompose and form the hummocks and the substrate necessary for establishment of the shrubby species. In some areas the hummocks support an almost pure stand of bog blueberry and water sedge. Wildfire probably plays a role in removing the hummocks, which "evens out" the microtopography, and returning the plant community to sedges and grasses.

The *Woodland Fen* ecological site is similar to the Sphagnum Fen site. Areas of the Woodland Fen site occur near high-volume springs, commonly are small in size, and are surrounded by Douglas fir, mountain hemlock, western hemlock, and Shasta red fir sites. This site is subject to active and continuous water movement on and below the surface. It is in the Boundary Springs area, the Thousand Springs area, and other spring-fed areas.

Because of the small size of the areas and the adjacent mature forests, this site is comprised of more shade-tolerant plants and has a continuous carpet of sphagnum moss. The dominant plants include panicled bulrush (*Scirpus microcarpus*), water sedge (*Carex aquatilis*), bog blueberry (*Vaccinium uliginosum*), and gray alder (*Alnus incana*). Areas of this site are very diverse and support an abundance of forbs and few grasses. Because this site grades from fen to forest, in some areas it is difficult to differentiate this true site type from adjacent areas that are transitional to forest sites. Many forbs of the adjacent forest sites are in the transitional zone.

Soils on this site consist of mucky peat about 25 to 30 inches thick over mineral soil material. Although the soils on this site are similar to those of the Sphagnum Fen sites, the organic layer of these soils is not as thick and the soils generally are better drained.

The accumulation of organic matter and substrate from windthrown timber on this site is similar to that of the Sphagnum Fen site. In many areas, fallen timber serves to incubate the shrubby phase of the site. In areas where the organic matter is about 35 inches thick over mineral soil material or gravel, a plant community of booth willow (*Salix boothii*), bog blueberry (*Vaccinium uliginosum*), and water sedge (*Carex aquatilis*) can become established. Occasional fires can consume the extra organic matter and return the plant community to dominantly wet bulrush (Dorr and others, 2000).

The *Ashy Glacial Meadow* ecological site occurs at lower elevations on the western edge of the park, in the Poison Meadow area. This site occurs at the contact between the volcanic, ashy soils and the older glaciated sediment. The site generally is moist, is in shallow depressions and along intermittent streams, and is influenced by adjacent moving freshwater and a local high water table.

The dominant plant community on this site consists of widefruit sedge (*Carex angustata*), tufted hairgrass (*Deschampsia caespitosa*), pullup muhly (*Muhlenbergia filiformis*), and bog blueberry (*Vaccinium uliginosum*). The presence of widefruit sedge rather than the more ubiquitous water sedge may be attributable to the lower anaerobic condition of the site. Water sedge has the ability to absorb amino acids from the surrounding organic soils, which may make it more competitive in these cold, wet areas (Raab, 1999). Widefruit sedge also is common in moist areas at lower elevations in the Rogue River and Winema National Forests.

The Ashy Glacial Meadow site is associated with the Ashy Glacial Prairie site and is surrounded by western hemlock and Shasta red fir forest sites and an occasional incense cedar site. The Ashy Glacial Meadow site has a rich forb component, and it provides significant amounts of forage for ungulates in summer. It can produce 4,800 to 6,300 pounds of air-dry vegetation per acre per year. The proximity of hiding and thermal cover make this site attractive to elk and mule deer.

The *Ashy Glacial Prairie* ecological site is in the Poison Meadow area. This site is adjacent to the Ashy Glacial Meadow site and is transitional into the forest sites. Soils in the Ashy Glacial Prairie site are similar to those in the western hemlock forest sites, but they are more moist, have a thicker solum, and are more than 40 inches deep to a duripan.

This site is significantly drier than the Ashy Glacial

Meadow site, and it supports dominantly grasses rather than sedges. The dominant plants include western needlegrass (*Achnatherum occidentale ssp. californicum*), blue wildrye (*Elymus glaucus ssp. glaucus*), pullup muhly (*Muhlenbergia filiformis*), and western coneflower (*Rudbeckia occidentalis*). The large bunchgrass and taller western coneflower distinguish this site. Tree species regularly invade the site (within the confines of the duripan at a depth of 40 inches), and it has probably remained as a rangeland site as a result of occasional fire. A slightly higher frequency of fire can be expected on this site than on adjacent forest sites.

The "poison" in the meadow commonly is tall larkspur (*Delphinium occidentale*), which is very toxic to cattle early in the season. Another toxic plant on this site is false hellebore (*Veratrum californicum*), which can poison livestock if the young shoots are eaten. There is considerable evidence of a long history of livestock grazing on this site before the area became part of Crater Lake National Park. In some areas the forbs are very abundant, and the historic climax plant community probably had less western coneflower and more western needlegrass.

Two forested areas are in this plant association. One is the forested riparian zone along Annie Creek (see fig. 3, page 99). The ecological site in this zone is Engelmann spruce/gray alder/sedge (*Picea engelmannii/Alnus incana/Carex*). Engelmann spruce is considered to be the historic climax tree species in the plant community. Natural fire occurs infrequently in this riparian area. Fire-sensitive Engelmann spruce trees that are as much as 300 years old have been found on this site, indicating long periods without fire (Kovalchik, 1987). The fires that do occur generally consume all of the vegetation and the successional process is restarted.

There are four plant community successional stages on this site. The first plant community to become established after a fire typically is a brush/forb/grass-sedge community. The second commonly consists of lodgepole pine, which is a pioneer species and thus becomes established easily. When the lodgepole pine stand approaches maturity, white fir is already established in the understory and growing into the overstory. Over time, the lodgepole pine dies and white fir becomes the major tree species. Given more time and no major disturbances, Engelmann spruce becomes established and is dominant in the stand.

The second forested area in this plant association is associated with the Thousand Springs area. In this area, the climatic environment is influenced by the continual overland flow of water. The year-round climate is moderate with few annual fluctuations. This favorable climate allows for growth of more diverse vegetation. Tree species present in the overstory and understory include Douglas fir, Engelmann spruce (*Picea engelmannii*), Shasta red fir, western hemlock (*Tsuga heterophylla*), white fir, and mountain hemlock. The understory composition is extremely diverse. The major plants are queenscup beadlily (*Clintonia uniflora*), prince's pine (*Chimaphila umbellata*), northern twinflower (*Linnaea borealis*), western teaberry (*Gaultheria ovatifolia*), blue huckleberry (*Vaccinium membranaceum*), sidebells pyrola (*Orthilia secunda*), and coolwort foamflower (*Tiarella trifoliata var. trifoliata*). Ground fires in this area appear to have occurred very infrequently. Wetness and the abundant green vegetation make it difficult for ground fires to move through this area. The fires that did occur probably were stand-replacing crown fires that produced enough heat to preheat the taller vegetation, allowing the fires to burn through and consume all the material down to the saturated zone. These infrequent, widespread, stand-replacing fires occurred at intervals of perhaps 400 to 500 years (Hemstrom and Franklin 1982; Lotan and others, 1981).

Whitebark Pine

The whitebark pine historic plant association occurs at the highest elevations in the park. This association is in a narrow band around the rim of the lake and on high, wind-exposed ridges and mountainsides. Tree species included in this association are whitebark pine, mountain hemlock, and lodgepole pine. Elevation typically ranges from 7,000 to 8,000 feet. Because of the cold temperatures in winter, exposure to high winds, long periods of snow cover, and frost in summer, the growing environment is harsh.

Whitebark pine is moderately fire resistant and can survive moderately intense fires and slow-moving ground fires. These types of fires kill other associated tree species that are more shade tolerant and more sensitive to fire. Studies of fire scars have shown that fires occurred infrequently (intervals of 50 to 300 years) in whitebark pine communities (Arno, 1980; Fischer and Clayton, 1983). Regeneration occurs in openings that probably were caused by fire. As a result of fire suppression activities, whitebark pine stands are older and more susceptible to pine beetle epidemics, which advance the succession toward dominantly shade-tolerant species (Arno, 1986).

Whitebark pine is also susceptible to white pine blister rust (*Cronartium ribicola*). Because infected trees do not produce cones or the trees die before they reach cone-bearing age, blister rust inhibits the regeneration of whitebark pine.

The ecological site in the whitebark pine association is whitebark pine/woodrush-carex (*Pinus albicaulis/Luzula-Carex*).

Mountain Hemlock

Mountain hemlock is the dominant historic plant association in the park (see fig. 4, page 100). Areas of this association are at elevations of 5,200 to 7,500 feet. At the higher elevations, whitebark pine, subalpine fir, Shasta red fir, and western white pine are in the overstory. At the lower elevations, Shasta red fir, western white pine, white fir, and some Douglas fir are present. Precipitation is received mainly as snow, with snow depths as much as 8 feet. Snow can be on the ground from October through June, depending on elevation and aspect.

Because of the cool, wet environment, fires in this association typically occur as crown fires about every 400 to 800 years (Atzet and Wheeler, 1982; Booth, 1991; Habeck, 1985). Mountain hemlock is not adapted to fire. Its relatively thick bark provides some protection, but its low-hanging branches, highly flammable foliage, and tendency to grow in dense groups make it very susceptible to fire injury (Arno and Hammerly, 1977). Fires in mountain hemlock forests commonly occur as severe stand-replacing fires.

Fire suppression practices allow for growth of older mountain hemlock stands. Old-growth stands, 460 years old or more, are very susceptible to stand-replacing fires (Dickman and Cook, 1989). After a stand-replacing fire, lodgepole pine usually becomes established, restarting the succession. Lodgepole pine stands may persist for as long as 200 years before being replaced by mountain hemlock (Dickman and Cook, 1989). In areas where fires occur repeatedly, the succession can be slowed tremendously, allowing fire-related shrub communities to become dominant and thrive.

The ecological sites in the mountain hemlock association are mountain hemlock/grouse blueberry/prince's pine (*Tsuga mertensiana/vaccinium scoparium/Chimaphila umbellata*); mountain hemlock/greenleaf manzanita-creambush oceanspray/longstolon sedge (*Tsuga mertensiana/Arctostaphylos patuala-Holodiscus discolor/Carex inops*); mountain hemlock/pinemat manzanita/princes's pine (*Tsuga mertensiana/Arctostaphylos nevadensis/Chimaphila umbellata*), and mountain hemlock/Hitchcock's smooth woodrush (*Tsuga mertensiana/Luzula glabrata var. hitchcockii*).

The understory vegetation in the mountain hemlock association varies widely. In some stands understory vegetation is almost nonexistent, and in other stands the understory vegetation is abundant.

Shasta Red Fir

The Shasta red fir historic plant association is at the southeastern and eastern edges of the park. This association is a transitional area from a udic (wet) soil moisture regime to a xeric (dry) regime. This association is at slightly lower elevations than the udic mountain hemlock association and at higher elevations than the xeric ponderosa pine/fir association. The understory vegetation in most of the Shasta red fir association is limited, but grasses and sedges are most common.

Because of the sparse understory vegetation, fires spread slowly in this association and seldom destroy large areas of trees. Naturally occurring fires commonly are patchy and of low intensity. Shasta red fir sustains moderate damage from low-intensity fires (Atzet and Wheeler, 1982). Stand-replacing fires in Shasta red fir stands are rare; the interval between fires is 70 to 130 years (Atzet and McCrimmon, 1990). Fire suppression practices allow the Shasta red fir stands to become older. As the older trees die and accumulate on the forest floor, the potential for stand-replacing fires increases.

If a large stand-replacing fire occurs, lodgepole pine typically is the first tree species to become re-established. As the lodgepole pine matures, Shasta red fir becomes re-established. If the fires are small and a seed source is nearby, Shasta red fir typically becomes re-established with some lodgepole pine.

Fire exclusion on this association can lead to invasion by shade-tolerant tree species. At the higher elevations, mountain hemlock invades, and at the lower elevations, white fir invades. On north aspects, the mountain hemlock association can become established.

The ecological sites in the Shasta red fir plant association are Shasta red fir/longstolon sedge (*Abies x shastensis/Carex inops*), Shasta red fir/pinemat manzanita/longstolon sedge (*Abies x shastensis/Arctostaphylos nevadensis/Carex inops*), and Shasta red fir-western white pine/pinemat manzanita (*Abies x shastensis-Pinus monticola/Arctostaphylos nevadensis*).

Ponderosa Pine/Fir

The ponderosa pine/fir historic plant association is in the northeastern and southeastern corners of the park (see fig. 5, page 101). Ponderosa pine is the historic climax tree species in areas frequently burned because it is more fire resistant than other associated tree species. In the northeastern corner of the park are other tree species, including Shasta red fir, white fir, and lodgepole pine. Research has shown that the average fire-free interval was 4.4 years during 1501 through 1850 (Mastrogiuseppe and Mastrogiuseppe, n.d.). The frequent fires resulted in open stands with few trees in the understory. In areas where fires occurred extremely frequently, the understory vegetation was mostly grasses and sedges. In areas where the fire interval was longest, a mixture of shrubs, forbs, grasses, and sedges was present. Use of fire suppression practices in the moister areas has allowed white fir to become a more common component in the overstory and understory.

The ecological sites in the part of the ponderosa pine/fir association in the northeastern corner of the park include ponderosa pine/greenleaf manzanita/ longstolon sedge (*Pinus ponderosa/Arctostaphylos nevadensis/Carex inops*) and ponderosa pine/ greenleaf manzanita-golden chinquapin (*Pinus ponderosa/Arctostaphylos nevadensis-Chrysolepis chrysophylla*).

In the southeastern corner of the park, ponderosa pine is the historic climax species at the lower elevations and ponderosa pine and Shasta red fir are the climax species at the higher elevations (4,800 to 5,600 feet). Other tree species include sugar pine, Douglas fir, and lodgepole pine. As a result of fire suppression practices, white fir and Shasta red fir successfully regenerate and make up a large component of the stand. If fire is suppressed for an extended period of time, white fir will become the dominant tree species in the overstory. As shade from the overstory increases, the understory composition changes. Shade-intolerant shrubs decrease in abundance, and shade-tolerant plants increase.

Large white fir trees have become established at the lower elevations (4,400 to 5,000 feet); thus, white fir is thought to be part of the historic climax plant community. If the average period between fires is 9 to 42 years, however, white fir trees would make up only a small to moderate component of the overstory (McNeil and Zobel, 1980). Because white fir seedlings, saplings, and poles have a thin bark and the resin on the surface of the bark blisters, these trees are highly susceptible to damage and death from fire (Laacke, 1990). Fires burn in a natural mosaic pattern, so white fir can survive and grow in the unburned areas. Other tree species at the lower elevations include sugar pine, Douglas fir, and lodgepole pine.

The ecological sites in the part of the ponderosa pine/fir association in the southeastern corner of the park are ponderosa pine-fir/trailing snowberry (*Pinus ponderosa-Abies/Symphoricarpos hesperius*), ponderosa pine/greenleaf manzanita/ longstolon sedge (*Pinus ponderosa/Arctostaphylos nevadensis/ Carex inops*), and ponderosa pine/trailing snowberry/ longstolon sedge (*Pinus ponderosa/Symphoricarpos hesperius/Carex inops*).

Lodgepole Pine

The lodgepole pine historic plant association occurs in areas where cold air accumulates and frequent frosts occur (see fig. 6, page 102). The harsh environment in this association restricts establishment of shade-tolerant species in the understory, and the understory vegetation is very sparse. Because lodgepole pine is tolerant of cold air and cold soil temperatures and is resistant to frost and drought, it is the climax tree species in this association.

Lodgepole pine is very sensitive to fire. Because of its thin bark, it is easily killed by moderate- and severe-intensity fires. The frequency of fires in lodgepole pine forests varies. In the drier (xeric) areas, these fires may occur at intervals of less than 20 years (Atzet and McCrimmon, 1990). In the moister (udic) areas, these fires generally occur less frequently. Because lodgepole pine is such a prolific seed producer, regeneration after a severe-intensity fire normally is not a concern. Thick, even-aged stands usually become established after fires.

The ecological sites in areas of the lodgepole pine plant association are lodgepole pine/sedge (*Pinus contorta/Carex*), lodgepole pine/longstolon sedge (*Pinus contorta/Carex inops*), and lodgepole pine/ squaw currant-antelope bitterbrush/western needlegrass (*Pinus contorta/Ribes cereum cereum-Purshia tridentata/ Achnatherum occidentale ssp. occidentale*).

Douglas Fir

The Douglas fir historic plant association occurs in the southwestern corner of the park, at the lowest and warmest elevations (see fig. 7, page 103). Douglas fir is the historic climax tree species. Other tree species are sugar pine and white fir. Some Shasta red fir is in the stands at the higher elevations.

Because of its thick bark, Douglas fir can withstand

low- and moderate-intensity ground fires that would kill other tree species. Ground fires create openings and clear away vegetation, exposing the mineral soil material and allowing Douglas fir to regenerate. In the mixed evergreen forests of southern Oregon and northern California, fires occurred every 5 to 25 years (Lotan and others, 1981). The interval between the fires and the resistance of Douglas fir to fire allows it to occupy the stand until the next stand-replacing fire. If fire is excluded for a long period of time, white fir, which is a shade-tolerant species, will eventually invade and become the dominant overstory tree species. Even though the life span of Douglas fir trees is longer than that of white fir, the inability of Douglas fir to regenerate under heavy shade allows white fir to become dominant in the stand.

The ecological sites in this plant association are Douglas-fir/cascade Oregongrape/prince's pine (*Pseudotsuga menziesii/Mahonia nervosa/Chimaphila umbellata*) on steep, south-facing slopes and Douglas-fir/blue huckleberry/prince's pine (*Pseudotsuga menziesii/vaccinium membranaceum/ Chimaphila umbellata*) on west-facing slopes.

Much of the western edge of the park is a transition zone from Douglas fir to Shasta red fir to mountain hemlock plant communities. The elevation ranges from approximately 4,800 to 5,200 feet. Below an elevation of about 5,000 feet, the stand is a mixture of Shasta red fir, Douglas fir, white fir, and ponderosa pine. Above an elevation of 5,000 feet, Shasta red fir is more dominant and the abundance of mountain hemlock is higher. The Douglas fir association extends to elevations of as high as 5,300 feet on the warmer, west- and south-facing slopes.

Figure 1.—Ashy Alpine Desert 50-70 PZ ecological site in an area of Cleetwood soil, thin surface phase.

Figure 2.—Ashy Alpine Swale 50-70 PZ ecological site in an area of Dyarock soil.

Figure 3.—Engelmann spruce and sedges in an area of Anniecreek soil.

Figure 4.—Mountain hemlock and woodrush in an area of Castlecrest soil.

Figure 5.—Ponderosa pine and antelope bitterbrush in an area of Collier soil.

Figure 6.—Lodgepole pine in an area of Maklak soil, low phase.

Figure 7.—Douglas fir and white fir in an area of Donegan soil.

Rangeland

By Jeffrey P. Repp, State rangeland management specialist, Natural Resources Conservation Service.

The rangeland in the park is in the Cascade Range of Central Oregon. Approximately 5 percent of the park is rangeland. The rangeland is in the cold alpine and subalpine climatic regimes in the higher elevation alpine areas and in meadows and fens interspersed in the extensive subalpine forests. Seasonal wildlife use patterns in summer reflect the value of the forage. The inherent productivity and diversity of the vegetation in the subalpine fens and meadows is especially high.

The vegetation produced on rangeland helps to control erosion, conserve water, and maintain watershed; provides habitat for wildlife; and offers scenic and recreational value. Rangeland is an integral part of healthy, functional watersheds. Range plant communities protect and stabilize soils during periods of runoff. They contribute to soil structure and improve the soil water intake rate. Clean water slowly released from uplands over a period of time, recharged aquifers, and excellent riparian areas are indicators of healthy rangeland.

Historical use of the rangeland in the park has been limited to transient livestock use and seasonal wildlife use. Domestic livestock grazed sporadically in the area before it became a National park. The rangeland at the lower elevations and in the alpine meadows near the caldera rim was used for grazing in summer. Expansion of the park in the latter part of the 20th century added land that was seasonally grazed by livestock, particularly the grassy meadows in the southeastern and southwestern parts. Native tribes used the area extensively in summer for hunting, gathering, and other cultural activities.

Plant Community Dynamics

Primary plant succession occurs as the historical development of the ecological site takes place. Plant succession is the progressive replacement of plant communities on an ecological site that leads to a climax or characteristic plant community. Succession occurs over time and is a result of environmental factors, including natural disturbances. Retrogression is the degradation of, or shift away from, the historic plant community and is a reflection of changes in the site condition. Commonly, the site condition changes irreversibly and a different vegetative state develops. This vegetative state may be relatively steady and resistant to change.

Range similarity index is a rating used to evaluate an ecological site. It is based on a comparison of the present plant community to either the historic climax plant community or another vegetative state community. The similarity index is a percentage, in annual weight, of a specific vegetative state plant community that is presently on a site. The index serves to describe the seral stage of the plant community when compared to the historic climax plant community and indicates its position in the state and transition model when compared to other plant communities in the site description. It provides an indication of the extent of change needed to establish the desired plant community state or the historic climax plant community.

Rangeland health assessment is an inventory method used to determine the overall health of a site. Seventeen attributes are evaluated against a matrix of conditions and are placed in one of five categories—extreme, moderate to extreme, moderate, slight to none, and none. The rating of a rangeland site is compared to the potential for that site. The attributes impact the biotic integrity, soil site stability, and hydrologic function of a rangeland site. The assessment identifies the attributes that are not functioning properly and the overall functions that might be at risk. It gives managers the ability to focus limited resources on repairing or redirecting only the indicated attributes. Generally, if an attribute is rated extreme, moderate to extreme, or in some cases, moderate, it can be considered to be at risk and requires some management changes to improve the overall health of the site.

Characteristics That Affect Management

Rangeland is fragile by nature because of limitations in climate, topography, and soil characteristics. These limitations alone or in combination can make an area unsuitable or less suitable for particular management practices. Important limitations are given in the section “Detailed Soil Map Units.” Certain characteristics that can affect management are described in this section.

Aspect is the direction in which a slope faces. In a given precipitation zone, the north-facing slopes are cooler, have deeper soils, and are more productive than the south-facing slopes. Depending on the elevation, north-facing slopes generally are well suited to grazing by livestock and wildlife late in spring and in summer. South-facing slopes provide excellent range in spring, but they are poorly suited to livestock grazing in summer. South-facing slopes are important to big game in winter because less snow accumulates on these slopes and they are the first to green up in spring. Southeast- and west-facing slopes have

similar vegetative site characteristics as south-facing slopes.

The *steepness of slope* affects livestock use and the feasibility of applying improvement practices. Areas that have slopes of 30 percent or less are most preferred by livestock. Areas that have slopes of more than about 50 percent receive very little use, even if the forage is abundant. Limited livestock use on steep slopes normally is anticipated, and stocking rates are adjusted accordingly. Ground equipment use is impractical on slopes of more than 30 percent.

Droughtiness reduces the production of forage and limits the choice of species for reseeding. Droughtiness is a result of low annual precipitation or the low water-holding capacity of the soil. Soil characteristics such as coarse texture, shallow depth, or high rock fragment content limit the water-holding capacity. *Cold temperatures* limit the length of the growing season, suppress plant growth, and delay plant development.

The amount of *stones and cobbles on the surface* can influence both grazing management and the potential for revegetation. Some soils have so many stones and cobbles on the surface that livestock avoid them if possible. Stones on the soil surface affect the feasibility of mechanical seedbed preparation and seeding.

Soil surface textures can limit use or the season of use. Soils that have a sandy surface texture have a high hazard of wind erosion. Grazing should occur late in fall, in winter, and early in spring when the soils are moist and the potential for wind erosion is low. Soils that have a silty surface texture and low organic matter content are subject to crusting. A vesicular crust can form, which restricts infiltration and seedling emergence. Soils that have a clayey surface texture have a very slow infiltration rate and very slow permeability. In cold areas, soils that have a silty or clayey surface texture are subject to frost heaving. Vegetation is subject to trampling and crown damage during wet periods in winter and spring.

A *high water table* can occur seasonally or year round. Wetness, even if the root zone is saturated only briefly, impacts the composition and production of vegetation. This is readily apparent in soils that are ponded or have a water table at or near the surface. Under these conditions, grazing can cause soil compaction, soil displacement, and plant crown damage. Soils are not suited to mechanical site preparation during wet periods, and they are subject to erosion from concentrated flows. Seeding techniques should be tailored to the site conditions, and species that can tolerate seasonal wetness should be seeded.

Rock outcrop and escarpments occur throughout the park. They occur most typically on steep, south-, east-, and west-facing slopes. Most formed as a result of geologic faults or glacial action or are made up of exposed sedimentary and igneous rock. Areas of Rock outcrop and escarpments can be several hundred feet in length and ten to several hundred feet in height. They act as physical barriers to domestic livestock and many species of wildlife by preventing or restricting vertical movement. Some wildlife species, such as raptors and bighorn sheep, prefer habitat associated with areas of Rock outcrop and escarpments.

Loss of site potential in some of the soils in the park has occurred as a result of a significant loss of the surface layer from wind or water erosion. The loss of this layer can cause major changes in the composition of the plant community. This irreversible change in the plant community as a result of soil erosion is most evident in soils that are shallow or have a claypan and a thin surface layer and an underlying subsoil that has low permeability and restricts the growth of roots. Depending on the extent of the erosion, losses in total production can be as much as 25 to 50 percent or more.

Wildlife Habitat

By Jeffrey P. Repp, State rangeland management specialist, Natural Resources Conservation Service.

Wildlife use patterns and numbers in areas of rangeland have varied considerably over time. Before 1900, wildlife numbers were low. California bighorn sheep and Rocky Mountain elk were eliminated from their historic range in the park. Improved wildlife management since that time has resulted in an increase in wildlife populations and diversity. Although the rangeland in the park is not extensive, it provides high-quality habitat for grazing ungulates. The combination of forage in the meadows and fens and the proximity of hiding, calving, and thermal cover make the area especially favorable for mule deer and Rocky Mountain elk. Bighorn sheep may have made use of the alpine areas in the rim area and on Union Peak and Mount Scott.

Wildlife extensively use range and forest areas for food and cover. The park provides excellent forage for grazing in summer and fall. The alpine meadows surrounding the rim and on Union Peak support dominantly western needlegrass (*Achnatherum occidentale ssp. Californicum*) with Hall's sedge (*Carex halliana*) and Brewer's sedge (*Carex Breweri*). In some areas bottlebrush squirreltail (*Elymus elymoides ssp. elymoides*) is also present. These

species all provide nutritive value for grazing ungulates from greenup in June or July through September or early in October. In winter and spring, the deep snow cover and very cold temperatures make grazing of these areas impractical. The forest areas interspersed with the alpine meadows provide hiding and thermal cover as well as transportation corridors for wildlife.

The subalpine fens and meadows also provide excellent-quality forage. The fens in the forest areas and along streams have significant amounts of water sedge (*Carex aquatilis*), bluejoint reedgrass (*Calomagrostis canadensis*), tufted hairgrass (*Deschampsia caespitosa*), and pullup muhly (*Muhlenbergia filiformis*) that provide 3,000 to 7,000 pounds of forage per acre per year. These areas receive light to moderate use by Rocky Mountain elk. In summer there is evidence of grazing in the fens at the head of National Creek and in the Sphagnum Bog area. The current number of grazing animals does not seem to have an adverse effect on plant community composition or structure, but the animals do play a role in removing vegetation, which affects the frequency of fires and the availability of nutrients.

The fens and riparian areas provide important and diverse habitat for wildlife. Perennial riparian areas either support shrubs or have the potential to support shrubs. Healthy riparian areas have vigorous, complex plant communities consisting of shrubs, forbs, grasses, and grasslike plants. They provide a buffer during periods of high water flow, provide a connection to the flood plain, and contribute to good instream aquatic habitat. The potential to improve riparian habitat is excellent if proper management is used. The period of time needed for riparian plants to recover is relatively short because of the perennial high water table or the shallow depth to the water table. In areas of severe channel alteration and degradation, longer periods of time and additional improvement practices are needed.

Forest Productivity and Management

The tables in this section can help forest owners or managers plan the use of soils for wood crops. They rate the soils that support trees according to the limitations that affect various aspects of forest management.

In tables 7 through 11, interpretive ratings are given for various aspects of forest management. The ratings are both verbal and numerical.

Some rating class terms indicate the degree to which the soils are suited to a specified forest management practice. *Well suited* indicates that the soil has features that are favorable for the specified practice and has no limitations. Good performance can be expected, and little or no maintenance is needed. *Moderately suited* indicates that the soil has features that are moderately favorable for the specified practice. One or more soil properties are less than desirable, and fair performance can be expected. Some maintenance is needed. *Poorly suited* indicates that the soil has one or more properties that are unfavorable for the specified practice. Overcoming the unfavorable properties requires special design, extra maintenance, and costly alteration. *Unsuited* indicates that the expected performance of the soil is unacceptable for the specified practice or that extreme measures are needed to overcome the undesirable soil properties.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified forest management practice (1.00) and the point at which the soil feature is not a limitation (0.00).

Rating class terms for fire damage and seedling mortality are expressed as *low, moderate,* and *high*. Where these terms are used, the numerical ratings indicate gradations between the point at which the potential for fire damage or seedling mortality is highest (1.00) and the point at which the potential is lowest (0.00).

The paragraphs that follow indicate the soil properties considered in rating the soils for forest management practices. More detailed information about the criteria used in the ratings is available in the “National Forestry Manual,” which is available in local offices of the Natural Resources Conservation Service or on the Internet. (http://nsscnt.nssc.nrcs.usda.gov/nfm/)

For *limitations affecting construction of haul roads and log landings*, the ratings are based on slope, flooding, permafrost, plasticity index, the hazard of soil slippage, content of sand, the Unified classification, rock fragments on or below the surface, depth to a restrictive layer that is indurated, depth to a water table, and ponding. The limitations are described as slight, moderate, or severe. A rating of *slight* indicates that no significant limitations affect construction activities, *moderate* indicates that one or more limitations can cause some difficulty in construction, and *severe* indicates that one or more limitations can make construction very difficult or very costly.

The ratings of *suitability for log landings* are based on slope, rock fragments on the surface, plasticity index, content of sand, the Unified classification, depth

to a water table, ponding, flooding, and the hazard of soil slippage. The soils are described as well suited, moderately suited, or poorly suited to use as log landings.

Ratings in the column *soil rutting hazard* are based on depth to a water table, rock fragments on or below the surface, the Unified classification, depth to a restrictive layer, and slope. Ruts form as a result of the operation of forest equipment. The hazard is described as slight, moderate, or severe. A rating of *slight* indicates that the soil is subject to little or no rutting, *moderate* indicates that rutting is likely, and *severe* indicates that ruts form readily.

Ratings in the column *hazard of off-road or off-trail erosion* are based on slope and on soil erodibility factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance. The hazard is described as slight, moderate, severe, or very severe. A rating of *slight* indicates that erosion is unlikely under ordinary climatic conditions; *moderate* indicates that some erosion is likely and that erosion-control measures may be needed; *severe* indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and *very severe* indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Ratings in the column *hazard of erosion on roads and trails* are based on the soil erodibility factor K, slope, and content of rock fragments. The ratings apply to unsurfaced roads and trails. The hazard is described as slight, moderate, or severe. A rating of *slight* indicates that little or no erosion is likely; *moderate* indicates that some erosion is likely, that the roads or trails may require occasional maintenance; and that simple erosion-control measures are needed; and *severe* indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

Ratings in the column *suitability for roads (natural surface)* are based on slope, rock fragments on the surface, plasticity index, content of sand, the Unified classification, depth to a water table, ponding, flooding, and the hazard of soil slippage. The ratings indicate the suitability for using the natural surface of the soil for roads. The soils are described as well suited, moderately suited, or poorly suited to this use.

Ratings in the columns *suitability for hand planting* and *suitability for mechanical planting* are based on slope, depth to a restrictive layer, content of sand, plasticity index, rock fragments on or below the surface, depth to a water table, and ponding. The soils are described as well suited, moderately suited, poorly suited, or unsuited to these methods of planting. It is assumed that necessary site preparation is completed before seedlings are planted.

Ratings in the column *suitability for use of harvesting equipment* are based on slope, rock fragments on the surface, plasticity index, content of sand, the Unified classification, depth to a water table, and ponding. The soils are described as well suited, moderately suited, or poorly suited to this use.

Ratings in the column *suitability for mechanical site preparation (surface)* are based on slope, depth to a restrictive layer, plasticity index, rock fragments on or below the surface, depth to a water table, and ponding. The soils are described as well suited, poorly suited, or unsuited to this management activity. The part of the soil from the surface to a depth of about 1 foot is considered in the ratings.

Ratings in the column *suitability for mechanical site preparation (deep)* are based on slope, depth to a restrictive layer, rock fragments on or below the surface, depth to a water table, and ponding. The soils are described as well suited, poorly suited, or unsuited to this management activity. The part of the soil from the surface to a depth of about 3 feet is considered in the ratings.

Ratings in the column *potential for damage to soil by fire* are based on texture of the surface layer, content of rock fragments and organic matter in the surface layer, thickness of the surface layer, and slope. The soils are described as having a low, moderate, or high potential for this kind of damage. The ratings indicate an evaluation of the potential impact of prescribed fires or wildfires that are intense enough to remove the duff layer and consume organic matter in the surface layer.

Ratings in the column *potential for seedling mortality* are based on flooding, ponding, depth to a water table, content of lime, reaction, salinity, available water capacity, soil moisture regime, soil temperature regime, aspect, and slope. The soils are described as having a low, moderate, or high potential for seedling mortality.

Recreation

The soils of the park are rated in table 12 according to limitations that affect their suitability for recreation. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the recreational uses. *Not limited* indicates that the soil

has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The ratings in the table 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, and access to water. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils that are subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

The information in the table can be supplemented by other information in this survey, for example, interpretations for building site development and sanitary facilities.

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 ratings are based on the soil properties that affect the ease of developing camp areas and the performance of the areas after development. Slope, stoniness, and depth to bedrock or a cemented pan are the main concerns affecting the development of camp areas.

The soil properties that affect the performance of the areas after development are those that influence trafficability and promote the growth of vegetation, especially in heavily used areas. For good trafficability, the surface of camp areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The ratings are based on the soil properties that affect the ease of developing picnic areas and that influence trafficability and the growth of vegetation after development. Slope and stoniness are the main concerns affecting the development of picnic areas. For good trafficability, the surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Paths and trails for hiking and horseback riding should require little or no slope modification through cutting and filling. The ratings are based on the soil properties that affect trafficability and erodibility. These properties are stoniness, depth to a water table, ponding, flooding, slope, and texture of the surface layer.

Engineering

This section provides information for planning land uses related to development. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development and sanitary facilities. 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 between the surface and a depth of 5 to 7 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 should 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 particle-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 7 feet of the surface, soil wetness, depth to a water table, ponding, 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 kinds 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 evaluate the potential of areas for residential and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; and 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

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. Tables 13 and 14 show the degree and kind of soil limitations that affect dwellings with and without basements, small commercial buildings, local roads and streets, shallow excavations, and lawns and landscaping.

The ratings in the tables are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet. The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. The ratings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation

and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility (which is inferred from the Unified classification). The properties that affect the ease and amount of excavation include flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

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 soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings, but it may be needed for the establishment and maintenance of vegetation. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

Sanitary Facilities

Tables 15 and 16 show the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, sanitary landfills, and daily cover for landfill. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Permeability, depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Considered in the ratings are slope, permeability, depth to a water table, ponding, depth to bedrock or a cemented pan, flooding, large stones, and content of organic matter.

Soil permeability is a critical property affecting the suitability for sewage lagoons. Most porous soils eventually become sealed when they are used as sites for sewage lagoons. Until sealing occurs, however, the hazard of pollution is severe. Soils that have a permeability rate of more than 2 inches per hour are too porous for the proper functioning of sewage lagoons. In these soils, seepage of the effluent can result in contamination of the ground water. Ground-water contamination is also a hazard if fractured bedrock is within a depth of 40 inches, if the water table is high enough to raise the level of sewage in the lagoon, or if floodwater overtops the lagoon.

A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor. If the lagoon is to be uniformly deep throughout, the slope must be gentle enough and the soil material must be thick enough over bedrock or a cemented pan to make land smoothing practical.

A *trench sanitary landfill* is an area where solid waste is placed in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil excavated at the site. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. The ratings in the table are based on the soil properties that affect the risk of pollution, the ease of excavation, trafficability, and revegetation. These properties include permeability, depth to bedrock or a cemented pan, depth to a water table, ponding, slope, flooding, texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, onsite investigation may be needed.

Hard, nonrippable bedrock, creviced bedrock, or highly permeable strata in or directly below the proposed trench bottom can affect the ease of excavation and the hazard of ground-water pollution. Slope affects construction of the trenches and the movement of surface water around the landfill. It also affects the construction and performance of roads in areas of the landfill.

Soil texture and consistence affect the ease with which the trench is dug and the ease with which the soil can be used as daily or final cover. They determine the workability of the soil when dry and when wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and are difficult to place as a uniformly thick cover over a layer of refuse.

The soil material used as the final cover for a trench landfill should be suitable for plants. It should not have excess sodium or salts and should not be too acid. The surface layer generally has the best workability, the highest content of organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

In an *area sanitary landfill*, solid 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. A final cover of soil material at least 2 feet thick is placed over the completed landfill. The ratings in the table are based on the soil properties that affect trafficability and the risk of pollution. These properties include flooding, permeability, depth to a water table, ponding, slope, and depth to bedrock or a cemented pan.

Flooding is a serious problem because it can result in pollution in areas downstream from the landfill. If permeability is too rapid or if fractured bedrock, a fractured cemented pan, or the water table is close to the surface, the leachate can contaminate the water supply. Slope is a consideration because of the extra grading required to maintain roads in the steeper areas of the landfill. Also, leachate may flow along the surface of the soils in the steeper areas and cause difficult seepage problems.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The ratings in the table also apply to the final cover for a landfill. They are based on the soil properties that affect workability, the ease of digging, and the ease of moving and spreading the material over the refuse daily during wet and dry periods. These properties include soil texture, depth to a water table, ponding, rock fragments, slope, depth to bedrock or a cemented pan, reaction, and content of salts, sodium, or lime.

Loamy or silty soils that are free of large stones and excess gravel are the best cover for a landfill. Clayey

soils may be sticky and difficult to spread; sandy soils are subject to wind erosion.

Slope affects the ease of excavation and of moving the cover material. Also, it can influence runoff, erosion, and reclamation of the borrow area.

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 the final cover for a landfill should be suitable for plants. It should not have excess sodium, salts, or lime and should not be too acid.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey.

Soil properties are ascertained 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.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the park, 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 to characterize key soils.

The estimates of soil properties are shown in tables. They include engineering index properties, physical and chemical properties, and pertinent soil and water features.

Engineering Index Properties

Table 17 gives the engineering classifications and the range of index properties for the layers of each soil in the park.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, 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 (ASTM, 1998) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1998).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-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, CL-ML.

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 particle-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.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the park 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 park or from nearby areas and on field examination.

The estimates of particle-size distribution, liquid limit, and plasticity index are generally 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 generally omitted in the table.

Physical Properties

Table 18 shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the park. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In table 18, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In table 18, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In table 18, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$- or $^1/_{10}$-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability (K_{sat}) refers to the ability of a soil to transmit water or air. The term “permeability,” as used in soil surveys, indicates saturated hydraulic conductivity (K_{sat}). The estimates in the table indicate the rate of water movement, in inches per hour, 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 and septic tank absorption fields.

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 soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants 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.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. Volume change is influenced by the amount and type of clay minerals in the soil.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for plants and soil organisms.

Erosion factors are shown in table 18 as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of several factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) 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 and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Chemical Properties

Table 19 shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the park. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Cation-exchange capacity is the total amount of extractable bases 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. Soils having a low cation-exchange capacity hold fewer cations and have lower soil fertility than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

Soil reaction is a measure of acidity or alkalinity. The pH of each soil 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.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil.

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. Salinity affects the growth and vigor of plants and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated

soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Water Features

Table 20 gives estimates of various water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, 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 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.

The *months* in the table indicate the portion of the year in which the feature is most likely to be a concern.

Water table refers to a saturated zone in the soil. Table 20 indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. Table 20 indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

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

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

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 little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on

the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Soil Features

Table 21 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for 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 the 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 to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes 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 results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete 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 also is 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 (Soil Survey Staff, 1998 and 1999). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 22 shows the classification of the soils in the park. The categories are defined in the following paragraphs.

ORDER. Twelve 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 Andisol.

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 Cryand (*Cry*, meaning icy cold, plus *and*, from Andisol).

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; type of saturation; 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 Vitricryands (*Vitri*, meaning presence of glass, plus *cryand*, the suborder of the Andisols that has cold temperatures).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup 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 taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Vitricryands.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is ashy, amorphic Typic Vitricryands.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the park is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the park is described. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” (Soil Survey Division Staff, 1993). Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” (Soil Survey Staff, 1999) and in “Keys to Soil Taxonomy” (Soil Survey Staff, 1998). Unless otherwise indicated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

Anniecreek Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Rapid
Position on landscape: Stream terraces
Parent material: Pumice and ash
Slope range: 0 to 2 percent
Elevation: 4,100 to 5,500 feet
Average annual precipitation: 25 to 40 inches

Average annual air temperature: 40 to 42 degrees F
Frequency of flooding: Occasional
Frost-free period: 10 to 50 days

Taxonomic class: Ashy, glassy Aquic Vitricryands

Typical Pedon

Oi—0 to 4 inches; mat of slightly decomposed needles; abrupt wavy boundary.
A1—4 to 12 inches; very dark grayish brown (10YR 3/2) ashy fine sandy loam, dark grayish brown (2.5Y 4/2) dry; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine irregular pores; about 5 percent pumice paragravel; slightly acid (pH 6.4); clear smooth boundary.
2A2—12 to 24 inches; very dark gray (10YR 3/1) very gravelly ashy sand, dark gray (10YR 4/1) dry; single grain; loose, nonsticky and nonplastic; many very fine irregular pores; about 10 percent pumice paragravel and 40 percent gravel; neutral (pH 7.0); abrupt smooth boundary.
3Ab—24 to 32 inches; dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1) stratified ashy fine sand and ashy sand, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; many fine prominent strong brown (7.5YR 4/6) soft iron masses and many fine prominent black (10YR 2/1) soft manganese masses; massive; soft, very friable, nonsticky and slightly plastic; few very fine roots; few very fine tubular pores; about 1 percent gravel; neutral (pH 6.6); clear smooth boundary.
4Bg1—32 to 55 inches; black (N 2.5/0) ashy sand, dark gray (2.5Y 4/1) dry; massive; soft, very friable, nonsticky and nonplastic; many very fine irregular pores; about 5 percent gravel; moderately acid (pH 5.6); clear smooth boundary.
5Bg2—55 to 71 inches; black (N 2.5/0) very gravelly ashy coarse sand, variegated dry; common coarse distinct strong brown (7.5YR 4/6) soft iron accumulations; single grain; loose, nonsticky and nonplastic; many very fine irregular pores; about 40 percent gravel; neutral (pH 6.8).

Typical Pedon Location

Map unit in which located: Anniecreek-Stirfry-Riverwash complex, 0 to 2 percent slopes
Location in park: Anne Creek stream terraces in the “panhandle” in Klamath County; in the SE1/4NW1/4 of sec. 32, T. 31 S., R. 7 E.; 588852 meters easting and 4743947 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Time of year water table is at a depth of less than 60 inches—March through June
Depth to redoximorphic features—20 to 35 inches
Thickness of umbric epipedon—15 to 25 inches
Content of clay—0 to 15 percent
Content of rock fragments in upper 40 inches of mineral soil—10 to 35 percent

A and 2A horizons:
Hue—10YR to 2.5Y
Value—2 or 3 moist, 3 to 5 dry
Chroma—1 or 2 moist, 1 to 3 dry

3Ab horizon:
Hue—10YR or 7.5YR
Value—2 to 4 moist, 4 or 5 dry
Chroma—1 to 3 moist or dry
Texture—variable, including medial very fine sandy loam, loamy coarse sand, ashy sand, and ashy fine sand

AC horizon (where present):
Hue—10YR to 2.5Y
Value—2 to 4 moist, 4 to 6 dry
Texture—ashy fine sandy loam, loamy sand, or sand

4B and 5B horizons:
Hue—neutral
Value—2.5 to 4 moist, 4 or 5 dry
Chroma—0 to 3 moist, 2 to 4 dry
Content of pumice paragravel—0 to 20 percent
Content of rock fragments—0 to 70 percent
Texture—ashy or medial and variable, including sand, loamy sand, and coarse sand

Castlecrest Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Mountain flanks and mountainsides
Parent material: Pumice and ash
Slope range: 0 to 80 percent
Elevation: 5,000 to 8,000 feet
Average annual precipitation: 40 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy, amorphic Typic Vitricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needle litter; abrupt wavy boundary.
A—1 inch to 3 inches; very dark grayish brown (10YR 3/2) paragravelly ashy loamy sand, dark grayish brown (10YR 4/2) dry; single grain; loose,

nonsticky and nonplastic; common fine and medium roots; many fine interstitial pores; 15 percent pumice paragravel; slightly acid (pH 6.2); clear smooth boundary.

Bw—3 to 19 inches; brown (10YR 4/3) paragravelly ashy loamy sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; common fine and medium roots; many fine interstitial pores; 15 percent pumice paragravel; slightly acid (pH 6.2); clear smooth boundary.

C1—19 to 26 inches; very dark grayish brown and dark grayish brown (10YR 3/2 and 10YR 4/2) ashy sand, brown (10YR 4/3 and 10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 7 percent pumice paragravel; slightly acid (pH 6.4); clear wavy boundary.

C2—26 to 38 inches; gray and very dark gray (10YR 6/1 and 10YR 3/1) ashy coarse sand, light gray and dark grayish brown (10YR 7/2 and 10YR 4/2) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 5 percent pumice paragravel; slightly acid (pH 6.4); gradual wavy boundary.

C3—38 to 64 inches; light yellowish brown and very dark gray (10YR 6/4 and 10YR 3/1) ashy coarse sand, very pale brown and dark grayish brown (10YR 7/4 and 10YR 4/2) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 5 percent pumice paragravel; slightly acid (pH 6.4).

Typical Pedon Location

Map unit in which located: Unionpeak-Castlecrest-Sunnotch complex, 0 to 15 percent slopes

Location in park: About 2.3 miles east-northeast of the Pumice Desert viewpoint; 568327 meters easting and 4765143 meters northing, UTM Zone 10T, NAD 27; lat. 43°2’15.65" N., long. 122°9’44.53" W.

Range in Characteristics

Profile:

Depth to bedrock—more than 60 inches

Thickness of solum—14 to 30 inches

Average content of rock fragments and pararock fragments—less than 35 percent

Hue—7.5YR or 10YR

An albic (E) horizon as much as 3 inches thick is in some pedons (fig. 8).

A horizon:

Value—2 to 5 moist, 3 to 6 dry

Chroma—2 to 4 moist or dry

Texture—ashy sandy loam, ashy loamy sand, gravelly

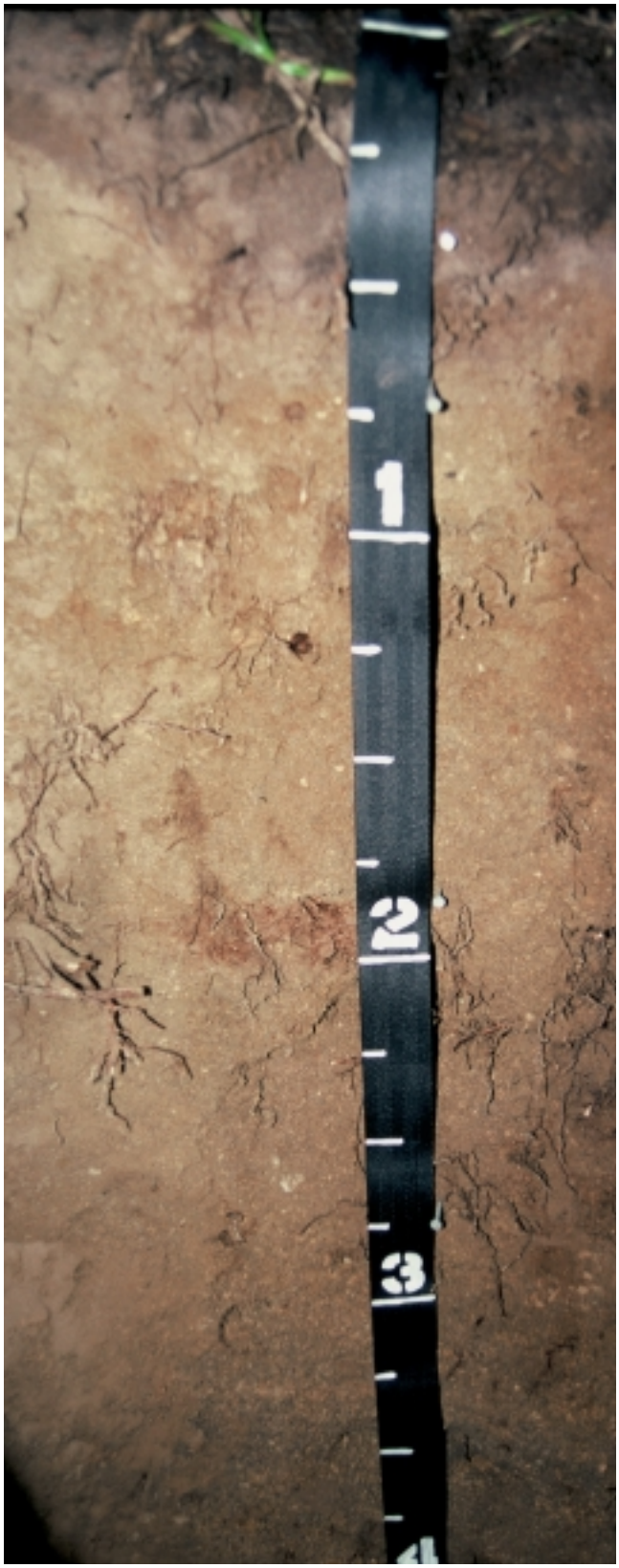

Figure 8.—Typical profile of a Castlecrest soil. Note the white, discontinuous E horizon at a depth of about 4 inches. Measurements on tape are in feet.

ashy sandy loam, gravelly ashy loamy sand, and paragravelly ashy loamy sand
Content of pumice paragravel—0 to 15 percent
Content of cinder gravel—0 to 8 percent
Content of andesite gravel—0 to 15 percent
Content of andesite cobbles—0 to 3 percent

Bw horizon:
Value—3 or 4 moist, 4 to 6 dry
Chroma—2 to 4 moist or dry
Texture—ashy loamy sand, ashy sandy loam, or ashy sand
Content of pumice paragravel—0 to 15 percent
Content of cinder gravel—0 to 5 percent
Content of andesite gravel—0 to 20 percent
Content of andesite cobbles—0 to 3 percent

C horizon:
Value—3 to 6 moist, 4 to 7 dry
Chroma—1 to 6 moist, 2 to 6 dry
Texture—ashy sand, ashy coarse sand, or ashy loamy sand
Content of pumice paragravel (upper part)—0 to 15 percent
Content of pumice paragravel (lower part)—0 to 60 percent
Content of cinder gravel—0 to 20 percent
Content of andesite gravel—0 to 15 percent
Content of andesite or cinder cobbles—0 to 2 percent

Cleetwood Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Position on landscape: Mountainsides, benches, and valleys
Parent material: Ash, and andesite and pumice fragments
Slope range: 0 to 30 percent
Elevation: 5,500 to 8,000 feet
Average annual precipitation: 40 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 30 days

Taxonomic class: Ashy, glassy, nonacid Vitrandic Cryopsamments

Typical Pedon

A1—0 to 2 inches; very dark brown (10YR 2/2) very gravelly ashy loamy coarse sand, light brownish gray (10YR 6/2) dry; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine interstitial pores; 45 percent andesite and cinder gravel, 5 percent andesite and cinder cobbles, and 1 percent andesite stones; moderately acid (pH 6.0); clear wavy boundary.
A2—2 to 10 inches; very dark brown (10YR 2/2) ashy loamy sand, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and few medium roots; many very fine interstitial pores; 10 percent andesite gravel; slightly acid (pH 6.2); clear wavy boundary.
C1—10 to 36 inches; dark brown (7.5YR 3/2) ashy sand, pinkish gray (7.5YR 6/2) dry; massive; slightly hard, firm, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores; 5 percent andesite gravel; slightly acid (pH 6.2); abrupt wavy boundary.
C2—36 to 50 inches; dark reddish brown (5YR 3/3) ashy coarse sand, light reddish brown (5YR 6/4) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 5 percent andesite gravel; slightly acid (pH 6.4); abrupt wavy boundary.
C3—50 to 60 inches; very dark grayish brown (10YR 3/2) gravelly ashy sand, light brownish gray (10YR 6/2) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 15 percent andesite gravel; slightly acid (pH 6.4).

Typical Pedon Location

Map unit in which located: Cleetwood, thin surface-Cleetwood-Dyarock complex, 2 to 20 percent slopes
Location in park: Meadow about one-half mile north of Watchman Lookout and west of the caldera rim; 567553 meters easting and 4755091 meters northing, UTM Zone 10T, NAD 27; lat. 42°56’50.02" N., long. 122°10’23.07" W.

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Thickness of solum—4 to 14 inches
Content of pumice—0 to 15 percent
Content of clay—0 to 5 percent

A1 horizon:
Hue—10YR or 7.5YR
Value—2 or 3 moist, 3 to 6 dry
Chroma—2 or 3 moist or dry
Texture—ashy loamy coarse sand, gravelly ashy loamy sand, gravelly ashy sandy loam, very gravelly ashy loamy sand, or very gravelly ashy loamy coarse sand
Content of rock fragments—0 to 55 percent

A2 horizon:
Hue—10YR or 7.5YR

Value—2 or 3 moist, 3 to 6 dry
Chroma—2 or 3 moist or dry
Texture—ashy loamy sand, ashy loamy coarse sand, or ashy sandy loam
Content of rock fragments—0 to 25 percent

C horizon:
Hue—10YR, 7.5YR, 5YR, or 2.5YR
Value—3 or 4 moist, 4 to 6 dry
Chroma—2 to 4 moist or dry
Texture—ashy sand, ashy loamy sand, ashy coarse sand, or ashy loamy coarse sand
Content of rock fragments—0 to 25 percent
Consistence when dry—loose to very firm

Collier Series

Depth class: Very deep (fig. 9)
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Ashflows
Parent material: Ash and cinders
Slope range: 0 to 80 percent
Elevation: 4,000 to 6,000 feet
Average annual precipitation: 20 to 60 inches
Average annual air temperature: 41 to 44 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy, glassy Xeric Vitricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needle litter.
A—1 inch to 5 inches; very dark brown (10YR 2/2) ashy sandy loam, dark yellowish brown (10YR 4/4) dry; weak fine granular structure; loose, very friable, nonsticky and nonplastic; many very fine and fine roots and common medium roots; many very fine interstitial pores; 5 percent pumice paragravel and 3 percent hard gravel; slightly acid (pH 6.1); clear wavy boundary.
BA—5 to 12 inches; dark brown (7.5YR 3/2) ashy loamy sand, brown (7.5YR 5/2) dry; weak fine subangular blocky structure; loose, nonsticky and nonplastic; many very fine and fine roots; many fine interstitial pores; 5 percent pumice paragravel and 3 percent hard gravel; slightly acid (pH 6.1); clear wavy boundary.
Bw—12 to 23 inches; brown (7.5YR 4/2) paragravelly ashy loamy sand, light brown (7.5YR 6/3) dry; weak fine subangular blocky structure; loose, nonsticky and nonplastic; few very fine roots; many fine interstitial pores; 15 percent pumice paragravel and 8 percent hard gravel; slightly acid (pH 6.1); clear wavy boundary.

Figure 9.—Typical profile of a Collier soil. Measurements on tape are in centimeters.

C—23 to 62 inches; brown (7.5YR 4/4) paragravelly ashy sand, light brown (7.5YR 6/4) dry; single grain; slightly hard, very friable, nonsticky and nonplastic; few fine roots; many fine interstitial pores; 15 percent pumice paragravel and 8 percent cinder gravel; neutral (pH 6.6).

Typical Pedon Location

Map unit in which located: Collier ashy loamy sand, 0 to 7 percent slopes
Location in park: About 2 miles west of Sharps Peak; 579858 meters easting and 4760342 meters northing, UTM Zone 10T, NAD 27; lat. 42°59'36.00" N., long. 122°01'17.48" W.

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Thickness of solum—14 to 30 inches
Average content of rock fragments—less than 35 percent
Hue—5YR, 7.5YR, or 10YR

A horizon:
Value—2 or 3 moist, 3 to 5 dry
Chroma—2 or 3 moist or dry
Texture—ashy sandy loam, ashy loamy sand, and very gravelly ashy loamy sand
Content of cinder gravel—0 to 15 percent
Content of pumice paragravel—0 to 15 percent
Content of andesite gravel—0 to 15 percent
Content of clay—0 to 3 percent

Bw horizon:
Value—3 or 4 moist, 4 or 5 dry
Chroma—3 or 4 moist or dry
Texture—ashy loamy sand or ashy sandy loam
Content of cinder gravel—0 to 15 percent
Content of pumice paragravel—0 to 20 percent
Content of andesite gravel—0 to 10 percent
Content of clay—0 to 5 percent

C horizon:
Value—3 or 4 moist, 4 or 5 dry
Chroma—2 to 4 moist or dry
Texture—ashy loamy sand or ashy sand
Content of cinder gravel—0 to 20 percent
Content of pumice paragravel—0 to 25 percent
Content of andesite gravel—0 to 10 percent
Content of cinder cobbles—0 to 5 percent
Content of cinder stones—0 to 5 percent
Content of clay—0 to 2 percent

Donegan Series

Depth class: Moderately deep to bedrock
Drainage class: Well drained
Permeability: Moderately slow
Position on landscape: Mountainsides
Parent material: Ash mixed with colluvium derived from andesite
Slope range: 30 to 65 percent
Elevation: 4,000 to 5,100 feet
Average annual precipitation: 40 to 50 inches
Average annual air temperature: 41 to 45 degrees F
Frost-free period: 30 to 70 days

Taxonomic class: Loamy-skeletal, mixed, superactive, frigid Humic Dystroxerepts

Typical Pedon

Oi—0 to 1 inch; partially decomposed leaves, needles, and twigs.
A—1 inch to 5 inches; dark brown (7.5YR 3/3) very gravelly ashy sandy loam, brown (7.5YR 4/3) dry; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many fine interstitial pores; 40 percent gravel and 10 percent cobbles; slightly acid (pH 6.2); clear wavy boundary.
Bw1—5 to 14 inches; dark brown (7.5YR 3/3) very gravelly loam, brown (7.5YR 4/3) dry; weak very fine and fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and common medium roots; many fine interstitial pores; 40 percent gravel and 15 percent cobbles; moderately acid (pH 6.0); clear wavy boundary.
Bw2—14 to 30 inches; dark brown (7.5YR 3/3) extremely gravelly loam, brown (7.5YR 4/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine, medium, and coarse roots; many fine interstitial pores; 60 percent gravel and 10 percent cobbles; moderately acid (pH 6.0); clear wavy boundary.
Bw3—30 to 39 inches; dark brown (7.5YR 3/3) extremely gravelly loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many medium and common coarse roots; many fine and medium interstitial pores; 60 percent gravel and 10 percent cobbles; moderately acid (pH 6.0); clear smooth boundary.
Cr—39 inches; weathered andesite.

Typical Pedon Location

Map unit in which located: Donegan very gravelly ashy sandy loam, 30 to 65 percent south slopes
Location in park: Red Blanket Creek Valley, in the southwestern corner of the park; 560375 meters easting and 4739013 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—20 to 40 inches
Thickness of umbric epipedon—20 to 40 inches
Content of clay—18 to 35 percent

A horizon:
Hue—5YR or 7.5YR
Value—2 or 3 moist, 3 to 5 dry
Chroma—2 or 3 moist or dry
Texture—very gravelly ashy sandy loam or gravelly ashy loam
Content of gravel—10 to 40 percent
Content of cobbles—5 to 10 percent

B horizon:
Hue—5YR or 7.5YR
Value—3 or 4 moist, 4 or 5 dry
Chroma—2 or 3 moist, 3 or 4 dry
Texture—loam or clay loam
Content of gravel—20 to 60 percent
Content of cobbles—10 to 40 percent

Dyarock Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Position on landscape: Swales and drainageways on mountains
Parent material: Ash, pumice, cinders, and andesite fragments
Slope range: 2 to 20 percent
Elevation: 6,000 to 7,500 feet
Average annual precipitation: 60 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 30 days

Taxonomic class: Ashy, amorphic Oxyaquic Vitricryands

Typical Pedon

A1—0 to 1 inch; very dark brown (10YR 2/2) very gravelly ashy loamy sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; 25 percent andesite gravel, 5 percent andesite cobbles, 5 percent andesite stones, and 15 percent pumice paragravel; moderately acid (pH 6.0); clear wavy boundary.
A2—1 inch to 7 inches; very dark brown (10YR 2/2) ashy sandy loam, brown (10YR 5/3) dry; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and common fine interstitial pores; 5 percent andesite gravel and 5 percent andesite cobbles; slightly acid (pH 6.2); clear wavy boundary.
AB—7 to 17 inches; very dark brown (10YR 2/2) ashy sandy loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and common fine interstitial pores; 2 percent andesite gravel; slightly acid (pH 6.2); clear wavy boundary.
Bw—17 to 30 inches; very dark grayish brown (10YR 3/2) ashy loamy sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; 2 percent andesite gravel; slightly acid (pH 6.2); clear wavy boundary.
C1—30 to 44 inches; dark brown (7.5YR 3/3) gravelly ashy loamy coarse sand, brown (7.5YR 5/2) dry; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine and common fine interstitial pores; 15 percent andesite gravel; slightly acid (pH 6.2); clear wavy boundary.
C2—44 to 62 inches; dark grayish brown (10YR 4/2) ashy coarse sand, light brownish gray (10YR 6/2) dry; single grain; loose, nonsticky and nonplastic; many fine and medium interstitial pores; 3 percent andesite gravel and 7 percent pumice paragravel; slightly acid (pH 6.2).

Typical Pedon Location

Map unit in which located: Cleetwood-Sunnotch-Castlecrest complex, high elevation, 15 to 30 percent slopes
Location in park: About 1 mile north of Watchman Lookout and just west of the caldera rim; 567758 meters easting and 4755351 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches

Thickness of solum—14 to 30 inches
Content of pumice—0 to 15 percent
Content of clay—0 to 5 percent
Depth to perched water table (from spring runoff)—within 36 inches of the surface for 20 consecutive days or more

A1 horizon:
Value—2 or 3 moist, 3 to 5 dry
Chroma—2 or 3 moist or dry
Texture—very gravelly ashy loamy sand or very gravelly ashy sandy loam
Content of rock fragments—35 to 55 percent
Content of organic matter—1 to 2 percent

A2 horizon:
Value—2 or 3 moist, 4 or 5 dry
Chroma—2 or 3 moist or dry
Texture—ashy sandy loam or ashy loamy sand
Content of rock fragments—0 to 30 percent
Content of organic matter—less than 1 percent

AB and Bw horizons:
Hue—10YR or 7.5YR
Value—2 to 4 moist, 3 to 5 dry
Chroma—2 to 4 moist or dry
Texture—ashy loamy sand or ashy sandy loam
Content of rock fragments—0 to 25 percent
Content of organic matter—less than 1 percent

C horizon:
Hue—10YR, 7.5YR, or 5YR
Value—3 or 4 moist, 4 to 6 dry
Chroma—2 to 4 moist or dry
Texture—ashy loamy sand, ashy coarse sand, or ashy loamy coarse sand
Content of rock fragments—0 to 25 percent

Grousehill Series

Depth class: Moderately deep to a duripan (fig. 10)
Drainage class: Moderately well drained
Permeability: Moderate
Position on landscape: Ridges and benches
Parent material: Ash over glacial till
Slope range: 0 to 35 percent
Elevation: 4,500 to 7,000 feet
Average annual precipitation: 45 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 35 days

Taxonomic class: Medial-skeletal, amorphic Typic Duricryands

Typical Pedon

Oi—0 to 3 inches; slightly decomposed needle litter; abrupt wavy boundary.

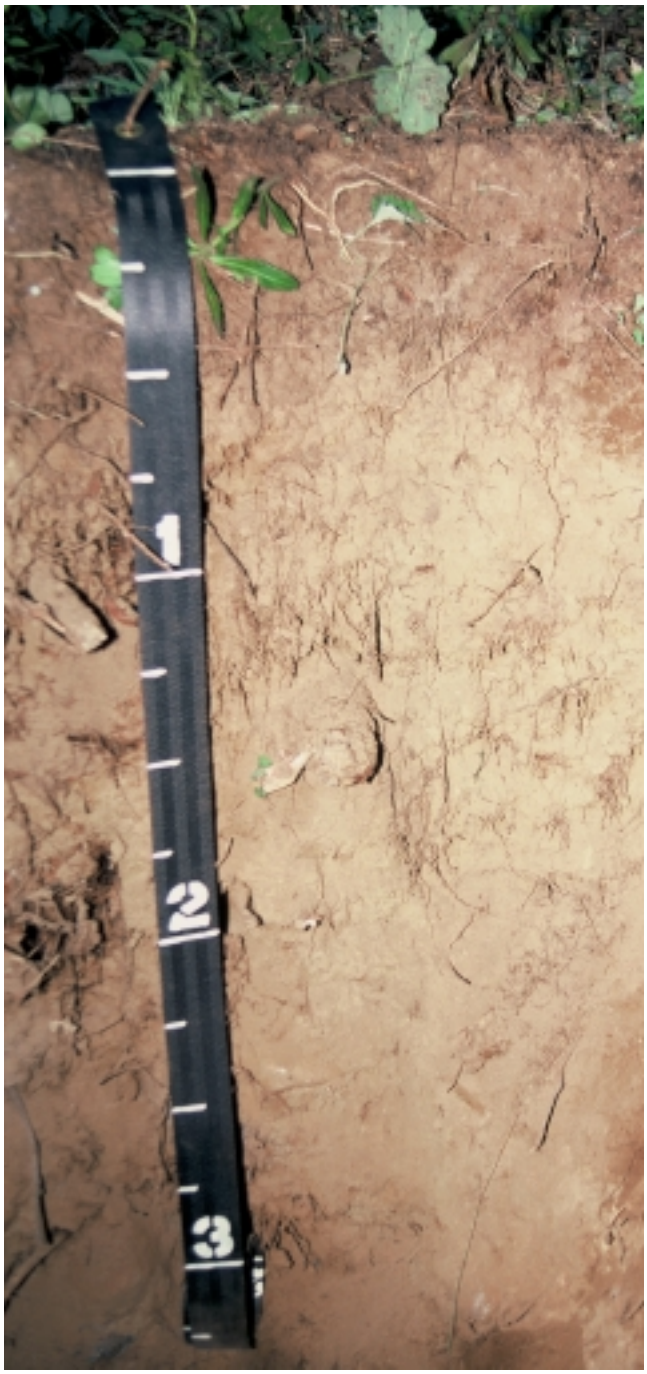

Figure 10.—Typical profile of a Grousehill soil. Measurements on tape are in feet.

A—3 to 10 inches; dark brown (7.5YR 3/3) gravelly medial loam, yellowish brown (10YR 5/4) dry; weak fine granular structure; soft, very friable, nonsticky and slightly plastic; many very fine, fine, and medium roots and common coarse roots; many very fine interstitial pores; 10 percent rounded andesite gravel, 5 percent rounded

andesite cobbles, and 5 percent pumice paragravel; slightly acid (pH 6.4); clear wavy boundary.
Bw1—10 to 31 inches; dark brown (7.5YR 3/4) very cobbly medial loam, brown (7.5YR 5/4) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and slightly plastic; many fine and medium roots and common coarse roots; many very fine interstitial pores; 10 percent andesite gravel, 30 percent rounded andesite cobbles, 15 percent rounded andesite stones, and 15 percent pumice paragravel; slightly acid (pH 6.4); clear wavy boundary.
Bw2—31 to 39 inches; very dark grayish brown (10YR 3/2) very cobbly medial loam, yellowish brown (10YR 5/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium roots and few fine and coarse roots; many very fine interstitial pores; 10 percent andesite gravel and 30 percent rounded andesite cobbles; slightly acid (pH 6.2); abrupt wavy boundary.
Bqm—39 to 56 inches; dark gray (10YR 4/1) moderately cemented duripan, light gray (10YR 7/1) dry; massive; extremely hard, slightly rigid.

Typical Pedon Location

Map unit in which located: Grousehill gravelly medial loam, 0 to 25 percent slopes
Location in park: About 2.5 miles north of State Highway 62 and 1/4 mile east of park boundary; 558994 meters easting and 4753267 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to moderately cemented duripan—20 to 40 inches
Shape of rock fragments—round
Content of clay—15 to 25 percent
Depth to perched water table—28 to 38 inches in November through July

A horizon:
Hue—10YR or 7.5YR
Value—2 to 4 moist, 4 to 6 dry
Chroma—2 to 4 moist or dry
Content of rock fragments—10 to 35 percent
Content of pumice paragravel—0 to 15 percent

Bw horizon:
Hue—10YR or 7.5YR
Value—3 or 4 moist, 4 to 6 dry
Chroma—3 or 4 moist or dry
Texture—medial loam or medial sandy loam
Content of rock fragments—35 to 70 percent
Content of pumice paragravel—0 to 20 percent

Bqm horizon:
Hue—10YR or 7.5YR
Value—3 or 4 moist, 4 to 7 dry
Chroma—1 to 4 moist or dry
Content of rock fragments—35 to 60 percent

Grousehill Taxadjunct

Depth class: Deep to a duripan
Drainage class: Moderately well drained
Permeability: Moderate
Position on landscape: Drainageways on mountains
Parent material: Ash over glacial till
Slope range: 0 to 5 percent
Elevation: 4,000 to 5,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 40 to 42 degrees F
Frost-free period: 10 to 50 days

Taxonomic class: Medial-skeletal, amorphic Aquic Haplocryands

Typical Pedon

A1—0 to 2 inches; very dark brown (10YR 2/2) ashy loamy sand, dark brown (10YR 3/3) dry; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; moderately acid (pH 6.0); clear smooth boundary.
A2—2 to 12 inches; very dark brown (10YR 2/2) ashy sandy loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and common medium roots; many very fine interstitial pores; 5 percent andesite gravel; moderately acid (pH 6.0); clear smooth boundary.
2Bw1—12 to 30 inches; dark grayish brown (10YR 4/2) very gravelly medial loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine dendritic tubular pores; 20 percent andesite gravel and 15 percent rounded andesite cobbles; moderately acid (pH 6.0); clear smooth boundary.
2Bw2—30 to 36 inches; brown (10YR 4/3) very gravelly medial clay loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine roots; few fine dendritic tubular pores; 20 percent andesite gravel, 15 percent

rounded andesite cobbles, and 5 percent rounded andesite stones; few faint medium brown (10YR 5/3) iron depletions and common very fine distinct strong brown (7.5YR 4/6) iron concentrations; moderately acid (pH 6.0); clear irregular boundary.

2BC—36 to 45 inches; brown (10YR 4/3) very gravelly medial sandy clay loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine roots; few fine dendritic tubular pores; 30 percent andesite gravel, 10 percent rounded andesite cobbles, and 5 percent rounded andesite stones; few faint medium brown (10YR 5/3) iron depletions and common very fine distinct strong brown (7.5YR 4/6) iron concentrations; moderately acid (pH 6.0); clear irregular boundary.

2Bqm—45 to 60 inches; brown (10YR 4/3) moderately cemented duripan, light brownish gray (10YR 6/2) dry; massive; very hard, slightly rigid; 35 percent andesite gravel, 15 percent rounded andesite cobbles, and 10 percent rounded andesite stones.

Typical Pedon Location

Map unit in which located: Grousehill-Racing complex, 0 to 5 percent slopes

Location in park: About 1/4 mile east and 2 1/2 miles north of State Highway 62, along the western boundary in “Poison Meadows”; 558656 meters easting and 4752907 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:

Depth to moderately cemented duripan—40 to 60 inches

Depth to bedrock—more than 60 inches

Depth to redoximorphic features—20 to 30 inches

Content of clay—10 to 28 percent

Average content of rock fragments in control section—more than 35 percent

A horizon:

Hue—10YR or 7.5YR

Value—2 to 4 moist, 3 to 6 dry

Chroma—2 or 3 moist or dry

Content of gravel—0 to 15 percent

Content of cobbles—0 to 10 percent

2Bw and 2BC horizons:

Hue—10YR or 7.5YR

Value—3 or 4 moist, 6 or 7 dry

Chroma—2 to 4 moist or dry

Content of rock fragments—35 to 70 percent

Content of gravel—15 to 50 percent

Content of cobbles—0 to 25 percent

Content of stones—0 to 15 percent

2Bqm horizon:

Hue—10YR or 7.5YR

Value—3 or 4 moist, 4 to 7 dry

Chroma—1 to 4 moist or dry

Content of gravel—15 to 50 percent

Content of cobbles—0 to 25 percent

Content of stones—0 to 15 percent

Taxadjunct Features

The Grousehill soil in areas of Grousehill-Racing complex, 0 to 5 percent slopes, is a taxadjunct to the Grousehill series because the duripan is at a depth of 40 to 60 inches and redoximorphic features are in the upper 1 meter.

Lapine Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Very rapid

Position on landscape: Pumice- and ash-mantled lava plains, hills, and cinder cones

Parent material: Pumice and ash

Slope range: 2 to 70 percent

Elevation: 4,200 to 6,500 feet

Average annual precipitation: 25 to 50 inches

Average annual air temperature: 38 to 42 degrees F

Frost-free period: 10 to 50 days

Taxonomic class: Ashy-pumiceous, glassy Xeric Vitricryands

Typical Pedon

Oi—0 to 2 inches; very dark brown (10YR 2/2) partially decomposed needle litter; abrupt smooth boundary.

A—2 to 8 inches; dark brown (10YR 3/3) paragravelly ashy loamy sand, brown (10YR 5/3) dry; weak very fine subangular blocky structure; loose, nonsticky and nonplastic; many very fine and fine roots and few coarse roots; many fine interstitial pores; 15 percent pumice paragravel and 3 percent hard gravel; slightly acid (pH 6.3); clear smooth boundary.

Bw1—8 to 15 inches; brown (10YR 4/3) paragravelly ashy loamy sand, brown (10YR 5/3) dry; weak very fine subangular blocky structure; loose, nonsticky and nonplastic; many fine and common coarse roots; many fine interstitial pores;

20 percent pumice paragravel; neutral (pH 6.7); clear smooth boundary.
Bw2—15 to 24 inches; dark brown (10YR 3/3) very paragravelly ashy sand, light yellowish brown (10YR 6/4) dry; single grain; loose, nonsticky and nonplastic; common coarse and few fine roots; many fine interstitial pores; 35 percent yellow (10YR 7/6) pumice paragravel; neutral (pH 6.7); clear smooth boundary.
C—24 to 60 inches; dark brown (10YR 3/3) extremely paragravelly ashy sand, light yellowish brown (10YR 6/4) dry; single grain; loose, nonsticky and nonplastic; few fine roots; many fine interstitial pores; 65 percent yellow (10YR 7/6) pumice paragravel; neutral (pH 6.8).

Typical Pedon Location

Map unit in which located: Lapine-Rock outcrop-Wuksi complex, 30 to 70 percent south slopes
Location in park: Sharp Peak; 581262 meters easting and 4761076 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Thickness of solum—14 to 35 inches
Hue—10YR or 7.5YR
Content of clay—0 to 5 percent
Average content of pumice paragravel in the 0- to 40-inch control section—35 to 85 percent

A horizon:
Value—2 to 4 moist, 4 to 6 dry
Chroma—1 to 3 moist or dry
Content of pumice paragravel—15 to 35 percent
Content of hard gravel—0 to 5 percent

Bw horizon:
Value—3 to 5 moist, 5 to 7 dry
Chroma—3 to 5 moist or dry
Content of pumice paragravel—20 to 50 percent

C horizon:
Value—3 to 5 moist, 6 to 7 dry
Chroma—2 to 4 moist or dry
Content of pumice paragravel—40 to 85 percent

Llaorock Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Ridges and backslopes of mountains
Parent material: Residuum and colluvium derived from andesite mixed with ash
Slope range: 0 to 80 percent
Elevation: 4,500 to 8,900 feet
Average annual precipitation: 40 to 80 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Medial-skeletal, amorphic Vitric Haplocryands (fig. 11)

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needle litter; abrupt smooth boundary.
A—1 inch to 7 inches; brown (7.5YR 4/4) gravelly ashy sandy loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and common medium and coarse roots; many very fine interstitial pores; 20 percent andesite gravel and 5 percent andesite cobbles; slightly acid (pH 6.2); clear wavy boundary.
AB—7 to 14 inches; brown (7.5YR 4/4) very stony ashy sandy loam, brown (7.5YR 5/4) dry; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots and common coarse roots; many very fine interstitial pores and common medium dendritic tubular pores; 15 percent andesite gravel, 15 percent andesite cobbles, and 20 percent andesite stones; slightly acid (pH 6.2); clear wavy boundary.
Bw1—14 to 24 inches; brown (7.5YR 4/4) extremely stony medial sandy loam, light brown (7.5YR 6/4) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; many fine interstitial pores; 10 percent andesite gravel, 10 percent andesite cobbles, 40 percent andesite stones, and 10 percent andesite boulders; neutral (pH 6.6); clear wavy boundary.
Bw2—24 to 61 inches; dark brown (7.5YR 3/4) extremely stony medial sandy loam, light brown (7.5YR 6/4) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; common fine interstitial pores; 10 percent andesite gravel, 10 percent andesite cobbles, 50 percent andesite stones, and 10 percent andesite boulders; accumulations of organic matter

Figure 11.—Typical profile of a Llaorock soil. Measurements on tape are in feet.

consisting of decomposing roots on surface of boulders; neutral (pH 6.6).

Typical Pedon Location

Map unit in which located: Llaorock-Castlecrest complex, 0 to 15 percent slopes

Location in park: About 1/2 mile east of the end of Forest Service Road 800 (from Forest Service Road 60 take Forest Service Road 900 to Forest Service Road 800); 560224 meters easting and 4743157 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Average content of rock fragments—more than 50 percent andesite cobbles, stones, and boulders
Percentage of surface covered with stones and boulders—as much as 30 percent

A and AB horizons:
Hue—7.5YR or 10YR
Value—3 or 4 moist, 4 or 5 dry
Chroma—2 to 4 moist or dry
Texture—gravelly ashy sandy loam or gravelly ashy loamy sand
Content of gravel—10 to 20 percent
Content of pumice gravel—0 to 5 percent
Content of cobbles—0 to 10 percent
Content of stones—0 to 5 percent
Content of boulders—0 to 2 percent

Bw horizon:
Value—3 or 4 moist, 5 or 6 dry
Texture—medial loamy sand or medial sandy loam
Content of gravel—0 to 20 percent
Content of cobbles—10 to 30 percent
Content of stones—20 to 50 percent
Content of boulders—0 to 10 percent

Maklak Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Position on landscape: Pumice flows
Parent material: Pumice and ash (fig. 12)
Slope range: 0 to 10 percent
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 30 to 60 inches
Average annual precipitation: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Taxonomic class: Ashy-pumiceous, glassy Xeric Vitricryands

Typical Pedon

Oi—0 to 1 inch; black (10YR 2/1) slightly decomposed needle litter; abrupt smooth boundary.
A—1 inch to 4 inches; very dark grayish brown (10YR 3/2) paragravelly ashy loamy sand, brown

Figure 12.—Typical profile of a Maklak soil. Fragments are paracobble-sized pumice. Measurements on tape are in centimeters.

(10YR 5/3) dry; weak fine subangular blocky structure; loose, nonsticky and nonplastic; common very fine and fine roots and few medium roots; many very fine interstitial pores; 30 percent fine pumice paragravel; moderately acid (pH 6.0); clear smooth boundary.

Bw—4 to 15 inches; dark brown (10YR 3/3) very paragravelly ashy loamy sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; many very fine, fine, and medium roots and common coarse roots; many fine interstitial pores; 30 percent fine pumice paragravel and 25 percent pumice paracobbles; moderately acid (pH 6.0); clear wavy boundary.

C1—15 to 25 inches; brown (10YR 4/3) extremely paracobbly ashy loamy sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; common medium and few fine roots; many fine interstitial pores; 30 percent pumice paragravel and 40 percent pumice paracobbles; slightly acid (pH 6.2); clear smooth boundary.

C2—25 to 60 inches; dark reddish brown (5YR 3/4) extremely paragravelly ashy loamy sand, reddish brown (5YR 5/4) dry; single grain; loose, nonsticky and nonplastic; common fine and medium roots; many fine interstitial pores; 70 percent pinkish gray (5YR 7/2) pumice paragravel and 15 percent pinkish gray (5YR 7/2) pumice paracobbles; moderately acid (pH 6.0).

Typical Pedon Location

Map unit in which located: Maklak paragravelly ashy loamy sand, 0 to 10 percent slopes

Location in park: About 1/2 mile west and 1/2 mile south of the northeastern corner; 580676 meters easting and 4770013 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Thickness of solum—14 to 35 inches
Hue—10YR, 7.5YR, or 5YR
Content of clay—0 to 7 percent

A horizon:
Value—2 or 3 moist, 4 or 5 dry
Chroma—2 or 3 moist or dry
Content of pumice paragravel—15 to 30 percent
Content of pumice paracobbles—0 to 10 percent

Bw horizon:
Value—3 to 5 moist, 5 to 7 dry
Chroma—2 to 6 moist or dry
Texture—ashy loamy sand or ashy loamy coarse sand

Average content of pumice paragravel—25 to 50 percent
Content of pumice paracobbles—15 to 25 percent

C horizon:
Value—3 to 7 moist, 5 to 8 dry
Chroma—2 to 6 moist or dry
Texture—ashy loamy sand or ashy loamy coarse sand
Average content of pumice paragravel—25 to 70 percent
Average content of pumice paracobbles—15 to 45 percent

Mariel Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Position on landscape: Bogs in mountain basins
Parent material: Organic material
Slope range: 0 to 3 percent
Elevation: 5,000 to 6,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days
Frequency of ponding: Frequent

Taxonomic class: Euic Typic Cryohemists

Typical Pedon

Oe1—0 to 5 inches; black (10YR 2/1) mucky peat; about 100 percent unrubbed fibers, 40 percent rubbed; many very fine, fine, and medium roots; strongly acid (pH 5.5); gradual smooth boundary.
Oe2—5 to 15 inches; very dark brown (10YR 2/2) mucky peat; about 85 percent unrubbed fibers, 35 percent rubbed; many very fine and fine roots; strongly acid (pH 5.5); clear wavy boundary.
Oa—15 to 61 inches; dark brown (7.5YR 3/2) muck; about 50 percent unrubbed fibers, 15 percent rubbed; many very fine roots; very strongly acid (pH 5.0).

Typical Pedon Location

Map unit in which located: Mariel-Stirfry complex, 0 to 3 percent slopes
Location in park: Mainly in Sphagnum Bog and Annie Creek bottom; 569016 meters easting and 4745702 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Hue—10YR or 7.5YR
Depth to sapric material—7 to 15 inches
Depth of ponding—6 to 8 inches above the surface in January through June
Depth to water table—3 to 6 inches below the surface in July through December and at the surface in January through June

Oe horizon:
Value—2 or 3 moist
Chroma—1 or 2 moist
Texture—hemic material that is 80 to 100 percent unrubbed fibric material, 25 to 40 percent rubbed

Oa horizon:
Value—2 to 4 moist
Chroma—1 or 2 moist
Texture—sapric material that is 30 to 50 percent unrubbed material, 5 to 15 percent rubbed

Oatman Series

Depth class: Deep to a duripan (fig. 13)
Drainage class: Well drained
Permeability: Moderate
Position on landscape: Glaciated volcanic uplands
Parent material: Glacial deposits derived from andesite mixed with ash
Slope range: 5 to 60 percent
Elevation: 4,300 to 6,000 feet
Average annual precipitation: 30 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Taxonomic class: Medial-skeletal, amorphic Xeric Haplocryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needles and twigs.
Oe—1 inch to 2 inches; moderately decomposed needles and twigs.
A—2 to 3 inches; very dark brown (7.5YR 2.5/3) gravelly medial sandy loam, brown (10YR 4/3) dry; weak very fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots and few fine and medium roots; many very fine irregular pores; 20 percent andesite gravel, 5 percent subrounded andesite cobbles, and 1 percent subrounded andesite stones; moderately acid (pH 5.6); clear wavy boundary.
AB—3 to 12 inches; dark brown (7.5YR 3/3) very cobbly medial sandy loam, brown (7.5YR 5/4) dry; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky and slightly plastic; many very fine and fine roots, common medium roots, and few coarse roots;

Figure 13.—Typical profile of an Oatman soil. A duripan is at a depth of about 140 centimeters. Measurements on tape are in centimeters.

many very fine irregular pores; 20 percent andesite gravel, 20 percent subrounded andesite cobbles, and 5 percent subrounded andesite stones; moderately acid (pH 5.8); gradual wavy boundary.

Bw1—12 to 31 inches; dark brown (10YR 3/3) very gravelly medial fine sandy loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine, fine, and medium roots and few coarse roots; many very fine tubular pores; 30 percent andesite gravel, 20 percent subrounded andesite cobbles, and 5 percent subrounded andesite stones; neutral (pH 6.6); gradual wavy boundary.

Bw2—31 to 45 inches; brown (10YR 4/3) very gravelly medial sandy loam, yellowish brown (10YR 5/4) dry; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; common very fine tubular pores; 25 percent andesite gravel, 10 percent subrounded andesite cobbles, and 1 percent subrounded andesite stones; moderately acid (pH 5.8); clear smooth boundary.

Bw3—45 to 51 inches; brown (7.5YR 4/4) extremely gravelly medial fine sandy loam, light brown (7.5YR 6/4) dry; massive; hard, friable, nonsticky and nonplastic; common very fine and fine roots; common very fine tubular pores; 50 percent andesite gravel, 10 percent andesite subrounded cobbles, and 1 percent subrounded andesite stones; moderately acid (pH 5.6); abrupt smooth boundary.

Bqm—51 to 61 inches; brown (10YR 4/3) indurated duripan, yellowish brown (10YR 5/4) dry; 10 percent andesite cobbles and 1 percent andesite stones; many very fine and few fine irregular pores.

Typical Pedon Location

Outside Crater Lake National Park, about 2 miles south of the boundary, in Winema National Forest, Klamath County, Oregon; 574064 meters easting and 4733737 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:

Depth to indurated duripan—40 to 60 inches
Depth to bedrock—more than 60 inches
Hue—10YR, 7.5YR, or 5YR
Content of clay—15 to 27 percent
Average content of rock fragments in particle-size control section—35 to 65 percent
Reaction—slightly acid or neutral
Bulk density—0.90 to 1.00 gram per cubic centimeter

A and AB horizons:

Value—3 or 4 moist, 3 to 5 dry
Chroma—2 to 4 moist, 3 or 4 dry
Texture—gravelly medial loam, gravelly medial sandy loam, very cobbly medial loam, or very cobbly medial sandy loam

Content of rock fragments—20 to 65 percent
Content of gravel—20 to 50 percent
Content of cobbles—0 to 20 percent
Content of stones—0 to 10 percent

B horizon:
Value—3 or 4 moist, 4 to 6 dry
Chroma—3 or 4 moist or dry
Texture—loam or sandy loam
Content of gravel—25 to 50 percent
Content of cobbles—10 to 20 percent
Content of stones—0 to 10 percent

Racing Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate over slow
Position on landscape: Mountain basins
Parent material: Ash over glacial till
Slope range: 0 to 3 percent
Elevation: 4,000 to 5,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 40 degrees F
Frost-free period: 10 to 30 days
Frequency of ponding: Frequent

Taxonomic class: Fine-loamy, mixed, superactive, nonacid Aquandic Cryaquepts

Typical Pedon

Oa—0 to 4 inches; very dark brown (10YR 2/2) muck, very dark grayish brown (10YR 3/2) dry; fibrous; soft, friable, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine irregular and dendritic tubular pores; moderately acid (pH 6.0); abrupt smooth boundary.

A—4 to 6 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many medium dendritic tubular pores; few fine distinct strong brown (7.5YR 5/6) iron concentrations; strongly acid (pH 5.5); abrupt wavy boundary.

Bw—6 to 18 inches; light brownish gray (10YR 6/2) ashy very fine sandy loam, light gray (10YR 7/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many medium dendritic tubular pores; many coarse prominent light brownish gray (10YR 6/2) iron depletions and common medium prominent strong brown (7.5YR 5/8) iron concentrations; strongly acid (pH 5.5); clear wavy boundary.

Bg1—18 to 28 inches; gray (10YR 5/1) ashy sandy clay loam, light gray (10YR 7/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common medium dendritic tubular pores; many coarse prominent gray (10YR 5/1) iron depletions and common fine distinct strong brown (7.5YR 5/6) iron concentrations; strongly acid (pH 5.5); clear wavy boundary.

Bg2—28 to 34 inches; greenish gray (10Y 5/1) ashy sandy clay loam; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium roots; few medium dendritic tubular pores; many coarse prominent gray (10YR 5/1) iron depletions and common fine distinct strong brown (7.5YR 5/6) iron concentrations; 3 percent fine gravel; strongly acid (pH 5.5); clear wavy boundary.

2Bg3—34 to 50 inches; greenish gray (5G 5/1) very gravelly ashy sandy loam; weak medium subangular blocky structure; soft, friable, nonsticky and nonplastic; many fine interstitial pores; many coarse prominent greenish gray (10Y 5/1) iron depletions and common medium distinct strong brown (7.5YR 5/6) iron concentrations; 35 percent gravel; strongly acid (pH 5.5); clear wavy boundary.

3Bq—50 to 60 inches; grayish brown (10YR 5/2) extremely gravelly loamy sand, light gray (10YR 7/2) dry; massive; hard, firm, nonsticky and nonplastic; discontinuous weak cementation; few very fine interstitial pores; 70 percent gravel and 5 percent cobbles; strongly acid (pH 5.5).

Typical Pedon Location

Map unit in which located: Grousehill-Racing complex, 0 to 5 percent slopes
Location in park: About 1/4 mile east and 2 1/2 miles north of State Highway 62, along the western boundary of “Poison Meadows”; 558778 meters easting and 4752920 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to discontinuous weakly cemented substratum—40 to 60 inches
Content of clay—20 to 30 percent

Depth to bedrock—more than 60 inches
Average content of rock fragments in control section—less than 35 percent
Reaction—very strongly acid to moderately acid

Redoximorphic features are throughout the profile.

Oa horizon (where present):
Value—2 or 3 moist or dry
Chroma—0 to 2 moist or dry

A horizon:
Value—2 to 5 moist, 3 to 6 dry
Chroma—2 or 3 moist, 2 to 4 dry
Content of gravel—0 to 5 percent

Bw horizon (where present):
Value—3 to 6 moist, 3 to 7 dry
Chroma—2 or 3 moist, 2 to 4 dry
Texture—ashy very fine sandy loam, ashy sandy loam, or ashy loam
Content of gravel—0 to 5 percent

Bg horizon:
Hue—10YR, 10Y, or 5G
Value—4 to 6 moist, 6 to 8 dry
Chroma—1 or 2 moist or dry
Texture—silt loam, ashy clay loam, or ashy sandy clay loam
Content of gravel—0 to 5 percent

2Bg horizon:
Hue—10YR, 10Y, or 5G
Value—5 or 6 moist, 7 or 8 dry
Chroma—1 or 2 moist or dry
Texture—loam, ashy loam, ashy sandy loam, clay loam, or ashy clay loam
Content of rock fragments—35 to 80 percent
Content of cobbles—0 to 5 percent

3Bq horizon:
Hue—10YR, 10Y, or 5G
Value—5 or 6 moist, 7 or 8 dry
Chroma—1 or 2 moist, 2 or 3 dry
Content of rock fragments—60 to 85 percent
Content of cobbles—0 to 10 percent
Content of clay—5 to 20 percent
Texture—sand, sandy loam, or ashy sandy loam
Cementation—discontinuous and weak

Redcone Series

Depth class: Moderately deep to a duripan
Drainage class: Somewhat excessively drained
Permeability: Rapid to the cemented duripan and moderate through it
Position on landscape: Cinder cones
Parent material: Colluvium derived from ash and cinders
Slope range: 30 to 60 percent
Elevation: 5,500 to 7,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy-skeletal, amorphic Typic Duricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needle litter; 15 percent cinder gravel, 5 percent cinder cobbles, and 3 percent cinder stones; abrupt smooth boundary.
A—1 inch to 7 inches; dark brown (7.5YR 3/2) very gravelly ashy sandy loam, brown (7.5YR 5/2) dry; weak very fine granular structure; loose, very friable, nonsticky and nonplastic; many fine and medium roots and common very fine and coarse roots; many fine interstitial pores; 30 percent cinder gravel and 5 percent andesitic gravel; moderately acid (pH 5.8); clear wavy boundary.
Bw1—7 to 24 inches; dark brown (7.5YR 3/4) very gravelly ashy coarse sandy loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure parting to single grain; soft, very friable, nonsticky and nonplastic; common very fine, fine, medium, and coarse roots and few very coarse roots; many fine interstitial pores; 30 percent cinder gravel and 5 percent andesitic gravel; moderately acid (pH 5.8); clear wavy boundary.
Bw2—24 to 27 inches; dark brown (7.5YR 3/4) very gravelly ashy loamy sand, brown (7.5YR 5/4) dry; weak very fine and fine subangular blocky structure parting to single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 55 percent cinder gravel; moderately acid (pH 6.0); abrupt wavy boundary.
2Bqsm—27 to 38 inches; dark red (2.5YR 3/6) weakly cemented gravelly ashy loamy sand, strong brown (7.5YR 5/8) dry; massive; hard, firm, nonsticky and nonplastic; few fine and medium interstitial pores; 20 percent black (7.5YR 2/1) cinder gravel; moderately acid (pH 6.0) clear wavy boundary.
2BC—38 to 61 inches; red (2.5YR 4/8), dark red (2.5YR 3/6), and dark reddish brown (2.5YR 3/4) extremely gravelly ashy loamy sand; massive; slightly hard, friable, nonsticky and nonplastic; few fine and medium interstitial pores; 80 percent

black (7.5YR 2/1) cinder gravel; slightly acid (pH 6.2).

Typical Pedon Location

Map unit in which located: Redcone-Rock outcrop complex, 30 to 60 percent north slopes
Location in park: About 1.5 miles west and 500 feet north of Red Cone Springs Trailhead in Crater Lake National Park; 568360 meters easting and 4761328 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Depth to weakly cemented duripan—20 to 40 inches

A horizon:
Hue—7.5YR or 10YR
Value—2 or 3 moist, 4 or 5 dry
Chroma—2 to 4 moist or dry
Content of andesite gravel—0 to 10 percent
Content of cinder gravel—10 to 30 percent
Content of cinder cobbles—0 to 5 percent

Bw horizon:
Hue—7.5YR or 10YR
Texture—ashy loamy sand, ashy sandy loam, or ashy sand
Content of andesite gravel—0 to 5 percent
Content of cinder gravel—25 to 55 percent
Content of cinder cobbles—0 to 5 percent

2Bqsm horizon:
Hue—2.5YR, 5YR, or 7.5YR
Value—2.5 to 5 moist or dry
Chroma—0, 1, 4, 6, or 8 moist or dry
Texture—ashy loamy sand or ashy sand
Content of cinder gravel—15 to 35 percent
Cementation—weakly cemented or moderately cemented

2BC horizon:
Hue—2.5YR, 5YR, or 7.5YR
Value—2.5 to 5 moist or dry
Chroma—0, 1, 4, 6, or 8 moist or dry
Texture—ashy loamy sand or ashy sand
Content of cinders—65 to 90 percent

Steiger Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Pumice- and ash-mantled lava plains and ridges
Parent material: Ash and pumice
Slope range: 2 to 25 percent
Elevation: 4,500 to 6,000 feet
Average annual precipitation: 20 to 50 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Taxonomic class: Ashy, glassy Xeric Vitricryands

Typical Pedon

A—0 to 4 inches; very dark brown (10YR 2/2) ashy loamy coarse sand, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine pores; about 10 percent paragravel pumice fragments; moderately acid (pH 5.6); abrupt wavy boundary.
Bw1—4 to 10 inches; dark brown (10YR 3/3) paragravelly ashy loamy coarse sand, pale brown (10YR 6/3) dry; single grain; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine pores; very slightly compacted; about 20 percent yellowish brown paragravel pumice fragments; slightly acid (pH 6.2); clear wavy boundary.
Bw2—10 to 19 inches; dark yellowish brown (10YR 4/4) paragravelly ashy loamy coarse sand, pale brown (10YR 6/3) dry; single grain; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine pores; very slightly compacted; about 20 percent yellowish brown paragravel pumice fragments; neutral (pH 6.7); gradual wavy boundary.
BC—19 to 29 inches; yellowish brown (10YR 5/4) paragravelly ashy coarse sand, light yellowish brown (10YR 6/4) dry; single grain; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine pores; about 30 percent yellowish brown paragravel pumice fragments; pocket of dark yellowish brown Bw material extends from the upper boundary through the lower boundary; slightly acid (pH 6.4); clear wavy boundary.
C1—29 to 35 inches; yellowish red (5YR 5/6) paragravelly ashy coarse sand, light reddish brown (5YR 6/4) dry; single grain; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine pores; about 20 percent paragravel pumice fragments; slightly acid (pH 6.5); gradual wavy boundary.
C2—35 to 60 inches; yellowish red (5YR 4/6) paragravelly ashy coarse sand, light reddish brown (5YR 6/3) dry; single grain; soft, very friable, nonsticky and nonplastic; common very

fine and fine roots; many very fine pores; about 20 percent paragravel pumice fragments; neutral (pH 6.8).

Typical Pedon Location

Map unit in which located: Lapine-Steiger-Wuksi complex, high elevation, 2 to 25 percent slopes
Location: Outside park about 1 1/2 miles west and 3 miles south of the northwest corner of the park, in Klamath County, Oregon; 2,400 feet north and 2,600 feet east of the southwest corner of sec. 14, T. 33 S., R. 7 1/2 E.

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Content of pumice paragravel—5 to 35 percent
Field estimated content of clay—0 to 5 percent

Some pedons have an O horizon that is as much as 3 inches thick.

A horizon:
Value—2 or 3 moist, 4 or 5 dry
Chroma—2 moist, 1 or 2 dry
Content of paragravel—0 to 15 percent

Bw horizon:
Hue—10YR to 5YR
Value—3 to 5 moist, 4 to 6 dry
Chroma—2 to 4 moist or dry
Chroma of pumice fragments—4 to 8
Texture—ashy loamy coarse sand or ashy coarse sand
Content of pumice paragravel—5 to 35 percent

BC and C horizons:
Value—3 to 6 moist, 6 or 7 dry
Chroma—4 to 8 moist, 2 to 6 dry
Texture—ashy loamy coarse sand or ashy coarse sand
Content of pumice paragravel—15 to 60 percent

Pumice fragments commonly have the higher chroma and value.

Stirfry Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid
Position on landscape: Drainageways, stream terraces, and seeps on mountains
Parent material: Mossy organic material over ash and pumice
Slope range: 0 to 15 percent
Elevation: 4,100 to 6,500 feet
Average annual precipitation: 25 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Euic Typic Cryosaprists

Typical Pedon

Oi—0 to 2 inches; dark brown (7.5YR 3/2) peat; fibrous; soft, very friable, nonsticky and nonplastic; 100 percent nonrubbed sphagnum fiber, 85 percent rubbed fiber; many very fine and fine roots; strongly acid (pH 5.5); clear wavy boundary.
Oe—2 to 8 inches; dark brown (7.5YR 3/2) mucky peat; fibrous; soft, very friable, nonsticky and nonplastic; 90 percent nonrubbed sphagnum fiber, 45 percent rubbed fiber; many very fine and fine roots; strongly acid (pH 5.5); clear wavy boundary.
Oa1—8 to 18 inches; very dark gray (10YR 3/1) muck; fibrous; soft, very friable, nonsticky and nonplastic; 90 percent nonrubbed fiber, 25 percent rubbed fiber; many very fine roots; very strongly acid (pH 5.0); clear wavy boundary.
Oa2—18 to 51 inches; dark brown (7.5YR 3/2) muck; fibrous; soft, very friable, nonsticky and nonplastic; 85 percent nonrubbed fiber, 15 percent rubbed fiber; many very fine, fine, and medium roots; very strongly acid (pH 5.0); abrupt wavy boundary.
2A—51 to 60 inches; black (7.5YR 2.5/1) gravelly ashy very coarse sand, gray (7.5YR 5/1) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 20 percent andesite gravel; strongly acid (pH 5.5).

Typical Pedon Location

Map unit in which located: Mariel-Stirfry complex, 0 to 3 percent slopes
Location in park: Sphagnum Bog; 560930 meters easting and 4760856 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to aquic conditions—0 to 20 inches
Depth to bedrock—more than 60 inches
Depth to water table—less than 6 inches in November through June and 6 to 12 inches in July through October
Depth to mineral soil—40 to 60 inches

Oi horizon:
Thickness—0 to 20 inches
Percentage of nonrubbed fiber—95 to 100 percent
Percentage of rubbed fiber—75 to 95 percent

Reaction—very strongly acid to moderately acid (pH 4.5 to 6.0)

The Oi horizon is present in areas on microhighs and hummocks, but it is absent in areas on microlows and in depressions.

Oe horizon:
Depth to horizon—0 to 20 inches
Thickness—4 to 20 inches
Hue (nonrubbed)—5YR, 7.5YR, or 10YR dry or moist
Value (nonrubbed)—2 to 4 dry, 2 or 3 moist
Chroma (nonrubbed)—1 or 2 dry, 1 to 3 moist
Percentage of nonrubbed fiber—60 to 90 percent
Percentage of rubbed fiber—20 to 50 percent
Reaction—very strongly acid to moderately acid (pH 4.5 to 6.0)

Oa horizon:
Depth to horizon—4 to 24 inches
Thickness—30 to 60 inches or more
Hue (nonrubbed)—5YR, 7.5YR, or 10YR
Value (nonrubbed)—2 to 4 dry, 2 or 3 moist
Chroma (nonrubbed)—1 or 2 dry, 1 to 3 moist
Percentage of nonrubbed fiber—20 to 50 percent
Percentage of rubbed fiber—0 to 15 percent
Reaction—very strongly acid to moderately acid (pH 4.5 to 6.0)

2A horizon:
Depth to horizon—51 to 60 inches or more
Texture—ashy loamy coarse sand or ashy coarse sand
Content of paragravel—0 to 25 percent
Content of gravel—0 to 45 percent

Stirfry Taxadjunct

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid
Position on landscape: Drainageways on mountains
Parent material: Mossy organic material over ash, pumice, and andesite fragments
Slope range: 0 to 10 percent
Elevation: 4,500 to 5,500 feet
Average annual precipitation: 50 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy-skeletal, glassy, euic Terric Cryosaprists

Typical Pedon

Oe—0 to 2 inches; dark brown (7.5YR 3/3) peat; fibrous; soft, very friable, nonsticky and nonplastic; 100 percent nonrubbed sphagnum fiber, 85 percent rubbed fiber; many very fine and fine roots; very strongly acid (pH 5.4); clear wavy boundary.
Oa1—2 to 12 inches; very dark brown (10YR 2/2) mucky peat; fibrous; soft, very friable, nonsticky and nonplastic; 90 percent nonrubbed sphagnum fiber, 75 percent rubbed fiber; many very fine and fine roots; very strongly acid (pH 5.4); clear wavy boundary.
Oa2—12 to 26 inches; black (10YR 2/1) mucky peat; fibrous; soft, very friable, nonsticky and nonplastic; 90 percent nonrubbed fiber, 55 percent rubbed fiber; many very fine roots; very strongly acid (pH 5.4); clear wavy boundary.
2C1—26 to 30 inches; dark brown (7.5YR 3/3) mucky ashy sandy loam; single grain; fibrous; soft, very friable, nonsticky and nonplastic; 10 percent nonrubbed fiber, 15 percent rubbed fiber; many very fine, fine, and medium roots; very strongly acid (pH 5.4); clear wavy boundary.
2C2—30 to 60 inches; dark brown (7.5YR 3/3) very gravelly mucky ashy loamy coarse sand; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 40 percent andesite gravel and 10 percent andesite cobbles; very strongly acid (pH 4.8).

Typical Pedon Location

Map unit in which located: Stirfry-Grousehill complex, 0 to 10 percent slopes
Location in park: Thousand Springs; 558357 meters easting and 4747464 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:
Depth to aquic conditions—0 to 20 inches
Depth to bedrock—more than 60 inches
Depth to 2C horizon—20 to 40 inches
Depth to water table—less than 6 inches in November through June and 6 to 12 inches in July through October
Depth to mineral soil—20 to 40 inches

Oi horizon (where present):
Thickness—0 to 20 inches
Percentage of nonrubbed fiber—95 to 100 percent
Percentage of rubbed fiber—75 to 95 percent
Reaction—very strongly acid to moderately acid (pH 4.5 to 6.0)

The Oi horizon is present in areas on microhighs and hummocks, but it is absent in areas on microlows and in depressions.

Oe horizon:
Depth to horizon—0 to 20 inches
Thickness—4 to 20 inches
Hue (nonrubbed)—5YR, 7.5YR, or 10YR dry or moist
Value (nonrubbed)—2 to 4 dry, 2 or 3 moist
Chroma (nonrubbed)—1 or 2 dry, 1 to 3 moist
Percentage of nonrubbed fiber—60 to 90 percent
Percentage of rubbed fiber—20 to 50 percent
Reaction—very strongly acid to moderately acid (pH 4.5 to 6.0)

Oa horizon:
Depth to horizon—4 to 24 inches
Thickness—30 to 60 inches or more
Hue (nonrubbed)—5YR, 7.5YR, or 10YR
Value (nonrubbed)—2 to 4 dry, 2 or 3 moist
Chroma (nonrubbed)—1 or 2 dry, 1 to 3 moist
Percentage of nonrubbed fiber—20 to 50 percent
Percentage of rubbed fiber—0 to 15 percent
Reaction—very strongly acid to moderately acid (pH 4.5 to 6.0)

2C horizon:
Texture—mucky ashy loamy coarse sand or mucky ashy coarse sand
Content of paragravel—0 to 25 percent
Content of gravel—0 to 60 percent
Content of cobbles—0 to 15 percent

Taxadjunct Features

The Stirfry soil in Stirfry-Grousehill complex, 0 to 10 percent slopes, is a taxadjunct to the Stirfry series because mineral soil material is at a depth of 26 inches.

Sunnotch Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Debris flows on mountains
Parent material: Ash and cinders
Slope range: 0 to 45 percent
Elevation: 5,000 to 8,000 feet
Average annual precipitation: 40 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy-skeletal, amorphic Typic Vitricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needle litter; abrupt smooth boundary.
A1—1 inch to 3 inches; very dark brown (10YR 2/2) gravelly ashy sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; many very fine interstitial pores; 10 percent black cinder gravel, 10 percent andesite gravel, and 10 percent pumice paragravel; moderately acid (pH 5.9); abrupt smooth boundary.
A2—3 to 11 inches; very dark grayish brown (10YR 3/2) ashy loamy sand, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium roots and few coarse roots; many very fine interstitial pores; 5 percent black cinder gravel, 5 percent andesite gravel, and 5 percent pumice paragravel; slightly acid (pH 6.3); clear wavy boundary.
Bw—11 to 25 inches; dark brown (10YR 3/3) very gravelly ashy loamy sand, brown (10YR 5/3) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and common medium roots; many very fine interstitial pores; 20 percent black cinder gravel, 10 percent red cinder gravel, 10 percent andesite gravel, and 10 percent pumice paragravel; slightly acid (pH 6.4); clear smooth boundary.
2C—25 to 61 inches; dark brown (7.5YR 3/4) very gravelly ashy sand, brown (7.5YR 5/4) dry; single grain; soft, very friable, nonsticky and nonplastic; few fine roots; many very fine interstitial pores; 20 percent black cinder gravel, 10 percent black cinder cobbles, 15 percent andesite gravel, 15 percent pumice paragravel, and 3 percent pumice paracobbles; slightly acid (pH 6.4)

Typical Pedon Location

Map unit in which located: Castlecrest gravelly ashy sandy loam, 2 to 10 percent slopes
Location in park: About 1 mile north of Red Cone Spring and about 350 feet west of Boundary Springs Trail; 565967 meters easting and 4762797 meters northing, UTM Zone 10T, NAD 27; lat. 43°1’0.37", long. 122°11’29.83"

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Content of rock fragments—averages 35 to 50 percent
Content of pararock fragments—averages 5 to 20 percent

Some pedons may have stone- or boulder-sized cinders on the surface.

Cinders commonly are rounded or subrounded.

A horizon:
Hue—10YR or 7.5YR
Value—2 to 5 moist, 3 to 6 dry
Chroma—2 to 4 moist or dry
Texture—gravelly ashy sandy loam, gravelly ashy loamy sand, ashy sandy loam, and ashy loamy sand
Content of cinder gravel—5 to 20 percent
Content of andesite gravel—5 to 25 percent
Content of pumice paragravel—0 to 20 percent

Bw horizon:
Hue—10YR or 7.5YR
Value—3 or 4 moist, 4 to 6 dry
Chroma—2 to 6 moist or dry
Texture—ashy sandy loam, ashy loamy sand, ashy loamy coarse sand, ashy coarse sand, or ashy sand
Content of cinder gravel—5 to 35 percent
Content of andesite gravel—5 to 20 percent
Content of pumice paragravel—0 to 10 percent
Content of clay—0 to 7 percent

2C horizon:
Hue—10YR, 7.5YR, or 5YR
Value—3 or 4 moist, 5 or 6 dry
Chroma—3 to 6 moist or dry
Texture—ashy loamy sand, ashy loamy coarse sand, ashy coarse sand, or ashy sand
Content of cinder gravel—15 to 40 percent
Content of cinder cobbles—0 to 15 percent
Content of cinders more than 10 inches in diameter—0 to 15 percent
Content of andesite gravel—15 to 60 percent
Content of pumice paragravel—0 to 10 percent
Content of pumice paracobbles—0 to 5 percent
Content of clay—0 to 5 percent

Timbercrater Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Position on landscape: Mountain flanks and mountainsides
Parent material: Pumice and ash (fig. 14)
Slope range: 0 to 80 percent
Elevation: 5,000 to 8,900 feet
Average annual precipitation: 40 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy-pumiceous, amorphic Typic Vitricryands

Figure 14.—Typical profile of a Timbercrater soil. Fragments are paragravel-sized pumice. Measurements on tape are in centimeters.

Typical Pedon

Oi—0 to 2 inches; slightly decomposed needle litter; abrupt smooth boundary.

A—2 to 5 inches; dark brown (10YR 3/3) paragravelly ashy loamy sand, brown (10YR 4/3) dry; weak fine granular structure; loose, nonsticky and nonplastic; many very fine, fine, and medium roots; many fine interstitial pores; 25 percent pumice gravel and 5 percent andesite gravel; moderately acid (pH 5.9); clear smooth boundary.
Bw—5 to 16 inches; brown (10YR 4/3) very paragravelly ashy loamy sand, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure parting to single grain; loose, nonsticky and nonplastic; common very fine, fine, and medium roots; many fine interstitial pores; 50 percent pumice gravel; slightly acid (pH 6.3); clear wavy boundary.
C1—16 to 20 inches; yellowish brown (10YR 5/6) extremely paragravelly ashy sand, brownish yellow (10YR 6/6) dry; single grain; loose, nonsticky and nonplastic; many very fine and fine roots and common medium roots; many fine and medium interstitial pores; 90 percent pumice gravel with yellow (10YR 7/6) interior; moderately acid (pH 6.0); clear wavy boundary.
C2—20 to 62 inches; brownish yellow (10YR 6/6) extremely paragravelly ashy sand, yellow (10YR 7/8) dry; few medium roots; 85 percent pumice gravel with very pale brown (10YR 8/4) interior; moderately acid (pH 6.0).

Typical Pedon Location

Map unit in which located: Timbercrater-Castlecrest-Llaorock complex, 10 to 30 percent south slopes
Location in park: About 3.1 miles south and 3.7 miles west of the northeast corner of Crater Lake National Park; 575586 meters easting and 4765875 meters northing, UTM Zone 10T, NAD 27; lat. 43°2’36.93" N., long. 122°4’23.42" W.

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Thickness of solum—14 to 25 inches
Average content of pararock fragments—35 to 80 percent

A horizon:
Value—2 or 3 moist, 3 to 5 dry
Chroma—2 or 3 moist or dry
Texture—paragravelly ashy sandy loam and paragravelly ashy loamy sand
Content of pumice gravel—15 to 35 percent
Content of andesite gravel—0 to 10 percent

Bw horizon:
Value—3 or 4 moist, 4 or 5 dry
Chroma—3 or 4 moist or dry
Content of pumice gravel—20 to 60 percent

C horizon:
Value—3 to 6 moist, 4 to 8 dry
Chroma—4 to 8 moist or dry
Texture—ashy sand or ashy loamy sand
Content of pumice gravel—70 to 95 percent

Umak Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Position on landscape: Pumice flows
Parent material: Pumice and ash
Slope range: 0 to 10 percent
Elevation: 4,500 to 7,000 feet
Average annual precipitation: 40 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy-pumiceous, amorphic Typic Vitricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed organic material; 20 percent pumice paragravel and 10 percent pumice paracobbles; abrupt wavy boundary.
A—1 inch to 5 inches; very dark grayish brown (10YR 3/2) paragravelly ashy fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; many very fine interstitial pores; 20 percent pumice paragravel and 5 percent pumice paracobbles; moderately acid (pH 6.0); clear wavy boundary.
Bw1—5 to 21 inches; brown (10YR 4/3) very paracobbly ashy coarse sandy loam, very pale brown (10YR 7/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; common very fine interstitial pores; 20 percent pumice paragravel and 30 percent pumice paracobbles; slightly acid (pH 6.2); clear wavy boundary.
Bw2—21 to 43 inches; brown (7.5YR 4/4) extremely paracobbly ashy loamy sand, light brown (7.5YR 6/4) dry; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; few very fine interstitial pores; 30 percent pumice

paragravel, 30 percent pumice paracobbles, and 10 percent pumice parastones; slightly acid (pH 6.4); clear wavy boundary.
Bw3—43 to 62 inches; brown (7.5YR 4/4) extremely paracobbly ashy loamy sand, pinkish gray (7.5YR 6/2) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; 40 percent pumice paragravel, 20 percent pumice paracobbles, 10 percent cinder cobbles, and 10 percent pumice parastones; neutral (pH 6.6).

Typical Pedon Location

Map unit in which located: Umak paragravelly ashy fine sandy loam, 0 to 7 percent slopes
Location in park: About 2.5 miles east of the western boundary of Crater Lake National Park, on State Highway 62 and about 100 feet north of the road; 562044 meters easting and 4748433 meters northing, UTM Zone 10T, NAD 27; lat. 42°53'15.94" N., long. 122°14'28.85" W.

Range in Characteristics

Profile:
Depth to bedrock—more than 60 inches
Average content of pumice (more than 2-millimeter fraction)—more than 35 percent

A horizon:
Value—2 or 3 moist, 4 or 5 dry
Chroma—2 or 3 moist or dry
Content of pumice paragravel—10 to 30 percent
Content of cinder gravel—0 to 10 percent
Content of andesite gravel—0 to 5 percent
Content of pumice paracobbles—0 to 10 percent

Bw horizon:
Value—3 or 4 moist, 5 to 7 dry
Chroma—3 or 4 moist or dry
Texture—ashy loamy sand or ashy sandy loam
Content of pumice paragravel—10 to 45 percent
Content of cinder gravel—0 to 10 percent
Content of andesite gravel—0 to 5 percent
Content of pumice paracobbles—5 to 30 percent
Content of pumice parastones—0 to 10 percent

C horizon (where present):
Hue—7.5YR or 10YR
Value—3 or 4 moist, 4 or 5 dry
Chroma—2 to 4 moist or dry
Content of pumice paragravel—10 to 50 percent
Content of cinder gravel—0 to 15 percent
Content of andesite gravel—0 to 10 percent
Content of pumice paracobbles—15 to 50 percent
Content of pumice parastones—0 to 10 percent

Unionpeak Series

Depth class: Moderately deep to a duripan
Drainage class: Somewhat excessively drained
Permeability: Rapid throughout the solum and moderately rapid in the Bqm horizon
Position on landscape: Ashflows
Parent material: Pumice, ash, and andesite and dacite fragments
Slope range: 0 to 35 percent
Elevation: 4,500 to 7,000 feet
Average annual precipitation: 40 to 70 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 0 to 50 days

Taxonomic class: Ashy, amorphic Typic Duricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needle litter; abrupt wavy boundary.
A1—1 inch to 4 inches; very dark grayish brown (10YR 3/2) ashy sandy loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots and few fine and medium roots; many very fine interstitial pores; 2 percent andesite gravel, 3 percent cinder gravel, and 5 percent pumice paragravel; moderately acid (pH 6.0); clear wavy boundary.
A2—4 to 8 inches; brown (10YR 4/3) ashy loamy sand, dark yellowish brown (10YR 4/4) dry; weak very fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots and few medium roots; common very fine interstitial pores and common fine dendritic tubular pores; 2 percent andesite gravel, 3 percent cinder gravel, and 5 percent pumice paragravel; moderately acid (pH 6.0); clear wavy boundary.
Bw—8 to 30 inches; brown (10YR 4/3) gravelly ashy loamy sand, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots and few fine, medium, and coarse roots; common very fine interstitial pores; 15 percent andesite gravel, 10 percent cinder gravel, and 7 percent pumice paragravel; neutral (pH 6.6); gradual wavy boundary.
Bqm—30 to 45 inches; dark grayish brown (10YR 4/2) weakly cemented ashy loamy sand, light brownish gray (10YR 6/2) dry; massive parting to thick platy rocklike structure; hard, very friable, nonsticky and nonplastic; few very fine and fine roots; many very

fine interstitial pores; common distinct relict redoximorphic concentrations on surface of plates; 5 percent andesite gravel and 5 percent cinder gravel; slightly acid (pH 6.4); clear wavy boundary.

C—45 to 65 inches; dark reddish brown (5YR 3/3) gravelly ashy loamy sand, reddish brown (5YR 5/3) dry; single grain; loose, nonsticky and nonplastic; many fine interstitial pores; 25 percent cinder gravel and 1 percent cinder cobbles; moderately acid (pH 6.4).

Typical Pedon Location

Map unit in which located: Unionpeak-Castlecrest-Sunnotch complex 0 to 15 percent slopes

Location in park: About 1.5 miles southeast of Rim Drive junction, on the old east entrance road, and 700 feet north of road; 577216 meters easting and 4750353 meters northing, UTM Zone 10T, NAD 27; lat. 42°54'13.21" N., long. 122°03'19.10" W.

Range in Characteristics

Profile:
Depth to weakly cemented duripan—20 to 40 inches
Depth to bedrock—more than 60 inches

A horizon:
Value—2 or 3 moist, 3 to 5 dry
Chroma—2 or 3 moist or dry
Texture—ashy sandy loam or ashy loamy sand
Content of pumice paragravel—0 to 15 percent
Content of cinder gravel—0 to 10 percent
Content of andesite gravel—0 to 5 percent

Bw horizon:
Value—3 or 4 moist, 4 to 6 dry
Chroma—2 or 3 moist or dry
Texture—ashy loamy sand or ashy sandy loam
Content of pumice paragravel—0 to 10 percent
Content of cinder gravel—0 to 10 percent
Content of andesite gravel—0 to 5 percent

Bqm horizon:
Hue—5YR, 7.5YR, or 10YR
Value—3 or 4 moist, 4 or 5 dry
Chroma—2 or 3 moist or dry
Texture—ashy loamy sand or ashy sand
Dry consistence—hard in the upper part and slightly hard or soft in the lower part
Content of pumice paragravel—0 to 30 percent
Content of cinder gravel—0 to 25 percent
Content of andesite gravel—0 to 15 percent
Content of cinder cobbles—0 to 5 percent
Cementation—very weakly cemented or weakly cemented

C horizon:
Hue—5YR, 7.5YR, or 10YR
Value—3 or 4 moist, 4 or 5 dry
Chroma—2 or 3 moist or dry
Texture—ashy loamy sand or ashy sand
Content of pumice paragravel—0 to 30 percent
Content of cinder gravel—0 to 25 percent
Content of andesite gravel—0 to 15 percent
Content of cinder cobbles—0 to 5 percent

Wuksi Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Position on landscape: Lava flows and volcanic buttes
Parent material: Ash mixed with colluvium derived from andesite
Slope range: 2 to 70 percent
Elevation: 4,500 to 6,500 feet
Average annual precipitation: 25 to 40 inches
Average annual air temperature: 38 to 42 degrees F
Frost-free period: 10 to 50 days

Taxonomic class: Ashy-skeletal, glassy Xeric Vitricryands

Typical Pedon

Oi—0 to 1 inch; slightly decomposed needles; abrupt smooth boundary.

A—1 inch to 5 inches; dark yellowish brown (10YR 3/4) cobbly ashy loamy sand, dark yellowish brown (10YR 4/4) dry; weak fine granular structure; loose, nonsticky and nonplastic; many very fine, fine, and medium roots; many very fine irregular pores; 15 percent andesite gravel and 15 percent andesite cobbles; strongly acid (pH 5.4); clear wavy boundary.

AB—5 to 14 inches; brown (7.5YR 4/4) very cobbly ashy loamy coarse sand, strong brown (7.5YR 4/6) dry; weak very fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots and common medium and coarse roots; many fine irregular pores; 15 percent andesite gravel, 30 percent andesite cobbles, and 5 percent andesite stones; moderately acid (pH 6.0); clear wavy boundary.

Bw1—14 to 29 inches; dark brown (7.5YR 3/4) very cobbly ashy loamy sand, strong brown (10YR 4/6) dry; weak very fine subangular blocky structure; soft, very friable , nonsticky and nonplastic; many very fine and fine roots and common medium roots; many fine and medium irregular pores; 15 percent andesite gravel, 35 percent andesite

cobbles, and 5 percent stones; moderately acid (pH 6.0); clear wavy boundary.

Bw2—29 to 37 inches; brown (7.5YR 4/3) very cobbly ashy sandy loam, yellowish brown (10YR 5/6) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; many fine and medium irregular pores; 15 percent andesite gravel, 35 percent andesite cobbles, and 5 percent andesite stones; moderately acid (pH 6.0); clear irregular boundary.

Bw3—37 to 60 inches; brown (7.5YR 4/3) extremely cobbly ashy sandy loam, yellowish brown (7.5YR 5/6) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine irregular pores; 15 percent andesite gravel, 55 percent andesite cobbles, and 5 percent andesite stones; moderately acid (pH 6.0).

Typical Pedon Location

Map unit in which located: Lapine-Steiger-Wuksi complex, high elevation, 2 to 25 percent slopes

Location in park: Northeastern side of Crater Lake National Park, in the Sharp Peak area and on the eastern flank of Timber Crater; 580696 meters easting and 4766251 meters northing, UTM Zone 10T, NAD 27

Range in Characteristics

Profile:

Depth to bedrock—more than 60 inches

Content of clay—0 to 5 percent

A and AB horizons (where present):

Hue—10YR or 7.5YR

Value—3 or 4 moist, 4 to 6 dry

Chroma—2 to 4 moist or dry

Texture—cobbly ashy loamy sand, cobbly ashy loamy coarse sand, very cobbly ashy loamy sand, and very cobbly ashy loamy coarse sand

Content of gravel—10 to 30 percent

Content of cobbles—15 to 45 percent

Content of stones—0 to 5 percent

Bw horizon and C horizon (where present):

Hue—10YR or 7.5YR

Value—3 to 5 moist, 4 to 6 dry

Chroma—3 to 6 moist or dry

Content of gravel—15 to 25 percent

Content of cobbles—25 to 60 percent

Content of stones—0 to 5 percent

Formation of the Soils

Time

Soils develop over a long period of time. The time needed to fully develop the features that represent a mature soil is measured in tens of thousands of years. Volcanic areas are unique because of the deposition of pumice and ash on the surface. Soils in these areas rarely have sufficient time to develop before being buried during the next eruption.

The last major volcanic eruption in the park was only 7,700 years ago (Bacon and others, 1997). Material from the eruption of Mount Mazama covered about 90 percent of the surface of the park. The oldest soils, those of the Grousehill and Oatman series, are in the remaining 10 percent, mainly along the western and southwestern edges of the park. These soils formed on glacial ground moraines that are about 15,000 to 25,000 years old (Harris, 1988). Soils of the Llaorock series are an example of those that began forming in andesite and dacite bedrock when the last glaciers receded from the park, but thin layers of ash have been added to the profile over time.

The soils in the remainder of the park exhibit only early stages of soil development. The basic nature of these soils is dependent on the parent material in which they are forming. The relative thinness of the solum (A and B horizons) indicates that not much weathering and soil development have taken place below a depth of about 20 inches. Examples of soils in this early stage of development include those of the Maklak, Lapine, Castlecrest, Sunnotch, Timbercrater, and Cleetwood series.

Climate

Climatic factors that influence the soils in the park are precipitation, temperature, and wind patterns. The park is located at high elevations in the Cascade Mountains; therefore, snowfall is a major factor in soil development. The average annual snowfall is about 500 inches, and the snowpack routinely remains through July or August. Precipitation in summer is light, and it generally is limited to a few scattered thunderstorms. The average annual precipitation averages about 60 to 70 inches on the western side and at the crest of the Cascade Range, but it decreases to an average of about 30 inches on the eastern side. The soil moisture regime along the eastern and northeastern edges, where elevation is relatively low, in the southern “panhandle” area, and in the southwestern corner of the park is the drier xeric regime. The remainder of the survey is in the moist udic regime.

The winters in the park are cold, and the summers are cool. The soil temperature regime throughout the park is cryic except on the glacial valley sidewall at the extreme southwestern corner, where it is frigid. The cryic soil temperatures inhibit soil development. Soil development occurs at a faster rate when temperatures are warm and moisture is present in the soil; however, this favorable environment for soil development exists for only a short period of time each year in the park.

The wind patterns affect the soils by causing drifting of snow and rapid drying of soils in areas unprotected by forest cover and the associated layer of duff (O horizon). This is most noticeable in the treeless open areas throughout the park, where there are sites that support desert vegetation because of early melting of the snowpack and subsequent drying of the soils as a result of wind blowing across the open areas. This rapid drying of the soil surface, the lack of layers of duff on the surface, and the prevalent winds that move soil particles create a poor environment for the survival and growth of tree seedlings, thus resulting in open meadow areas such as the “Pumice Desert.” Smaller areas have snowdrifts that are so deep and remain so long into the year that vegetation does not have enough time to grow and reproduce before the next winter.

Parent Material

The geologic history of the park is one of fire and ice. Volcanic eruption material and glaciation combined over time to form the soils in the park. Because of the complexity of the geologic history, only the part that relates to soil development is discussed in this section. The weathered remnants of Union Peak and Timber Crater represent volcanoes that

were active approximately 0.5 to 1.5 million years ago. These peaks have undergone extensive erosion by water and ice, leaving a central spire that formed from the resistant rock of the core plug and the surrounding andesite lava flows. The less resistant ashflow deposits of the upper portions of the volcanoes have been eroded away.

The next volcanic generation in the park is that of Mount Mazama, which is about 400,000 years old. The mountain is a composite cone that formed from five closely spaced volcanic vents. Regular eruptions of pumice and ash and lava flows of andesite and dacite built a peak reaching an elevation of 10,000 to 12,000 feet (Bacon and others, 1997). About 7,700 years ago, a major eruption began that covered much of Oregon and the rest of the Northwest with a layer of pumice and ash. Near the mountain, pyroclastic ash and cinder avalanches covered much of the flanks and nearby lowlands. The massive eruption emptied the magma chamber under Mount Mazama; thus, the mountain collapsed and formed a caldera about 4,000 feet deep (Williams, 1942). The caldera has partially filled with water, creating the spectacular Crater Lake. Approximately 7,400 years ago, eruptions within the caldera formed several cones, one of which extends above the surface of the lake and is known as Wizard Island.

The soils that formed from the eruption deposits can be divided into groups according to the characteristics of the parent material. Parent material from the cataclysmic eruptions consists of ash, cinders, and pumice. The weathering of this material produced soils with characteristics that directly correspond to the percentage of pumice, ash, hard rock fragments, and cinders in each of the stages of the eruptions. The initial eruption produced a plume of fine sand-sized ash that covered a large portion of Oregon and the rest of the Northwest. This ash produced the parent material for the Steiger soils, which are mainly on the drier xeric part of the eastern flank of Timber Crater. Castlecrest soils formed in similar material in the wetter udic zone.

The initial pumice and ash pyroclastic flows produced thick accumulations of cobble-sized pumice within and extending far beyond the boundary of the park and settling mainly in the valleys and the low-lying lava plains. The soils that formed in these accumulations are those of the Umak and Maklak series. Portions of this early airfall material produced thick accumulations of gravel-sized pumice to the north and east of the mountain and extending far beyond the park. Timbercrater soils are mainly in the wetter areas on mountainsides and buttes, where the gravel-sized pumice deposits were at a high enough elevation to avoid being buried by subsequent ashflows. In similar positions along the eastern boundary of the park are the drier Lapine soils.

In later eruptions, the ashflows were of smaller extent and were dominantly crystalline-rich ash and cinders with a smaller percentage of pumice. Soils on these ashflows are those of the Castlecrest, Cleetwood, and Collier series. There are localized areas within these flows that are dominantly andesite rock and cinder fragments ranging in size from gravel to boulders. The Sunnotch soils formed in these areas. Some ashflows on the uppermost slopes of the caldera were deposited while sufficiently hot to weld the particles of ash together. Soils of the Unionpeak series, which generally have a weakly cemented, root-restricting layer in the subsoil, formed in this material.

The soils of the Llaorock series formed in areas on the older volcanoes of Union Peak and Timber Crater, where the slightly weathered andesitic or dacitic bedrock is near the surface and in uncovered areas of the younger andesite lava flows of Mount Mazama. The Llaorock soils are characterized by large angular rock fragments mixed with airfall ash.

Somewhat overshadowed by the effects of recent volcanic eruptions is the long history of glaciation in the park. Valley glaciers have been present on Mount Mazama throughout its history. During the height of the Ice Age, large icecaps covered most of the Cascade Range. Mount Mazama commonly had many valley glaciers, which over several ice advances slowly carved large valleys. Some of the valleys were totally or partially filled in during eruptions, especially those on the northern side of Mount Mazama. The cataclysmic eruption occurred during a period that was warmer than the present climate, and the valley glaciers had retreated beyond the present caldera rim. The collapse of the mountain truncated the glacial valleys. Most of the valley glacial deposits were incorporated into or covered by eruption debris; however, there are remnants of deposits from the icecaps, mainly upwind of the airfall deposits and at elevations high enough to escape burial by the ashflows. These remnants lie to the west and south, near the border of the park. The Grousehill and Oatman soils formed in these deposits, which represent some of the oldest parent material in the park. The ice receded about 15,000 to 25,000 years ago; therefore, these soils are the most developed of any in the park.

Relief

The stability of the parent material in which a soil is forming is significantly influenced by the steepness of the slope. The stability or instability of sloping landscapes effects the rate at which a soil forms. Ridgetops, benches, and nearly level valley floors have stable slopes, and the soils exhibit stronger soil development. As the landscapes become steeper, soil development is more weakly expressed. This lack of development can be attributed to the colluvial action produced by gravity and water erosion, which mixes the soil layers. Because of the instability of the very steep inner caldera wall, very little soil has formed or accumulated on the wall. Consequently, soil and vegetation are noticeably absent except in concave areas and in areas of landslide material.

Old valley glacier sidewalls are throughout the park. Well-preserved classic *U*-shaped valley sidewalls are on the southern side of Mount Mazama. Scattered cliffs and buttes that are remnants of glacial valleys are primarily on the northern side of the mountain. All of the glacial valleys were filled with volcanic ejecta during later eruptions of Mount Mazama. These steep, unstable sidewalls are similar to the inner caldera walls, and soil development is weakly expressed.

The lava flows on the flanks of the older volcanoes, such as Union Peak and Timber Crater, have slopes that average about 10 percent. Icecap glaciation has eroded the slopes into a pattern of small rock hummocks that average 10 to 30 feet high and ash-filled depressions. The rock hummocks and depressions are elongated downslope. The ash was deposited in the low areas during the many eruptions of Mount Mazama and nearby volcanoes since the icecaps melted. This landscape is relatively stable. Castlecrest soils formed in the depressions, and Llaorock soils formed on the colluvial sides of the hummocks.

Glacial remnants that escaped burial by ashfall and ashflow deposits are on a few ridges near the western and southern boundaries of the park. Some of the oldest soils in the park, including the Grousehill and Oatman soils, are on these broad, very gently rolling ridges. These landscapes and soils have had about 15,000 to 25,000 years to form since the icecaps melted.

The slopes of Mount Mazama are a combination of glacial valley sidewalls, rock outcroppings, and ashflows. The pyroclastic flow deposits tend to be in stable positions on gently sloping side slopes, benches, and nearly level valley bottoms. During the eruptions, the steeper slopes were repeatedly blasted clean of pumice and ash. Unionpeak soils formed in gently sloping ashy material that was deposited while it was hot, resulting in a weakly cemented layer in the profile. Castlecrest soils, the most common soils in the park, formed in gently sloping to nearly level ashflows. Pyroclastic flows that are dominantly cobble-sized pumice fragments commonly are on nearly level to gently undulating flows. Umak and Maklak soils formed on these flows.

Cleetwood soils formed in sparsely vegetated deserts and meadows. These soils are gently sloping, but the unprotected ashy sand surface is subject to wind and water erosion.

Figures 15, 16, 17, and 18 show some of the major landscapes in the park, and they show the location of the major soils on those landscapes.

Living Organisms

The forests in the park make up the dominant ecosystem that affects soil development. Because the parent material is stable in areas covered by forests, organic matter accumulates and begins to decompose, which releases nutrients for use by micro-organisms. The major types of forest communities in the park are dominantly mountain hemlock, Shasta red fir, lodgepole pine, ponderosa pine-fir, whitebark pine, and Douglas fir (See General Vegetation Map).

The mountain hemlock communities cover most of the park. These communities typically occur in areas where precipitation is about 60 to 70 inches and at elevations of more than 5,000 feet on the western side and 6,000 feet on the drier eastern side. These communities are in the cryic soil temperature regime and the udic soil moisture regime. Most of the udic soils in the park, including Llaorock, Castlecrest, Timbercrater, Sunnotch, Unionpeak, Grousehill, and Umak soils, are associated with these communities.

The Shasta red fir communities are at lower elevations and receive slightly less precipitation that do the mountain hemlock communities. The Shasta red fir communities are mainly on south-facing exposures in the eastern part of the park. The soils associated with these communities are similar to those associated with the western hemlock communities; however, unique map units are included in the survey to identify these ecologically different communities. If a map unit or map unit component is identified as “dry”, it is associated with the Shasta red fir communities.

Lodgepole pine forests are throughout the park, and in many areas these forests occur as the early

stage of forest succession after a fire. Over time these areas will return to the historic climax forest type. Where cold air frost pockets inhibit the survival of other tree species, lodgepole pine is the historic climax forest type. Examples of forests that are dominantly lodgepole pine are on the bench surrounding the depression at “Pumice Desert”, the bottom of Desert Creek, and the southeastern portion of Pinnacle Valley. The soils in these areas commonly are low of Castlecrest and Collier soils.

Ponderosa pine-fir communities are in the drier areas of the park, where the average annual precipitation generally is less than 50 inches. These areas are in the cryic soil temperature regime and the xeric soil moisture regime and are along the eastern and southeastern borders of the park. Maklak, Collier, Lapine, and Oatman soils support these communities.

Whitebark pine communities are dominant in higher lying, windswept positions in the park, near rock outcroppings and on the edges of alpine meadows. They occur at elevations of more than 6,000 feet and commonly are associated with mountain hemlock communities.

Douglas fir communities occur only on the steep, south-facing slopes along Red Blanket Creek, in the southwestern corner of the park. The soil temperature regime is frigid, and the soil moisture regime is xeric. Soils of the Donegan series support these communities.

Because most of the park is covered by forests, areas where forests are absent stand out in stark contrast. These areas consist of meadows and deserts, areas of Rock outcrop, and areas of Rubble land. The only vegetation in the areas of Rock outcrop and Rubble land is in the associated areas of minor soil components. The vegetation in the meadows is mainly sedges, grasses, and forbs with a few trees, and the vegetation in the deserts is mainly a sparse cover of sedges and forbs. Cleetwood soils are in the meadows and deserts. Because the root systems of the sparse vegetation are insufficient to stabilize the ash and sand, these soils are subject to wind and water erosion. The lack of plant cover allows winds to dry the soil surface rapidly after the snow cover has melted; thus, encroachment by forests is limited by high seedling mortality. Moisture remains in the subsoil well into the dry season because of a unique “summer fallow” effect, which allows a few seedlings to become established. Cleetwood soils exhibit only a few weakly expressed soil characteristics because the lack of stabilizing vegetation and disturbance by erosion has greatly limited soil development.

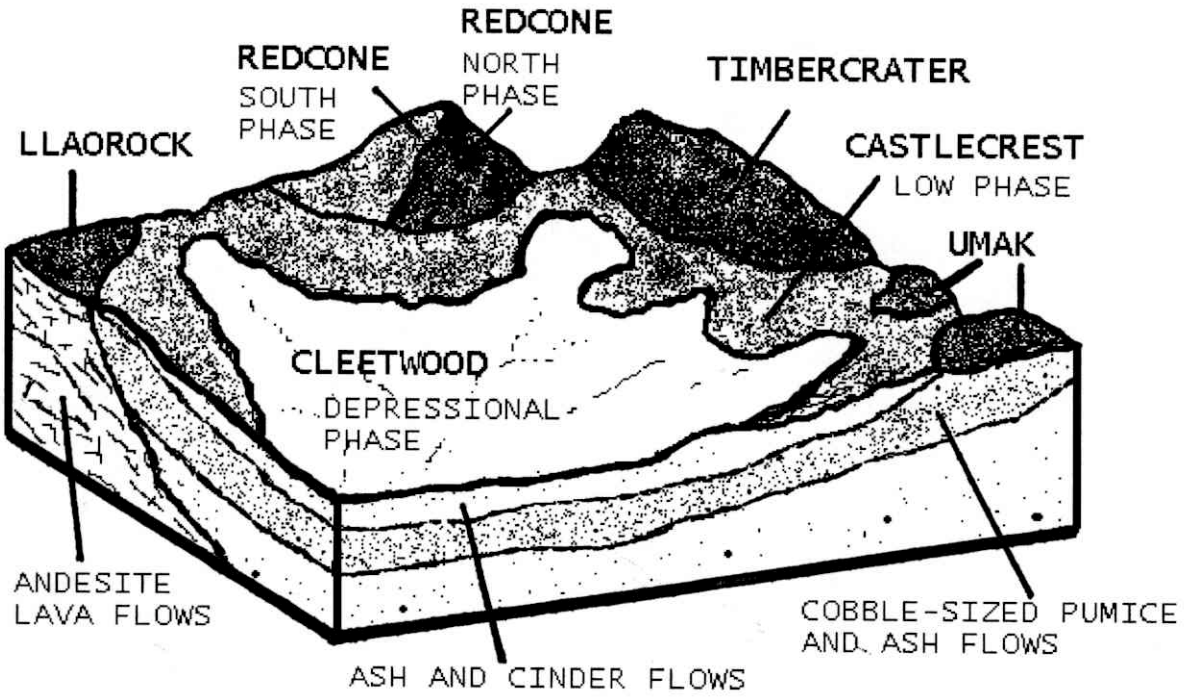

Figure 15.—Typical pattern of soils on pumice- and ash-covered uplands in the Pumice Desert area.

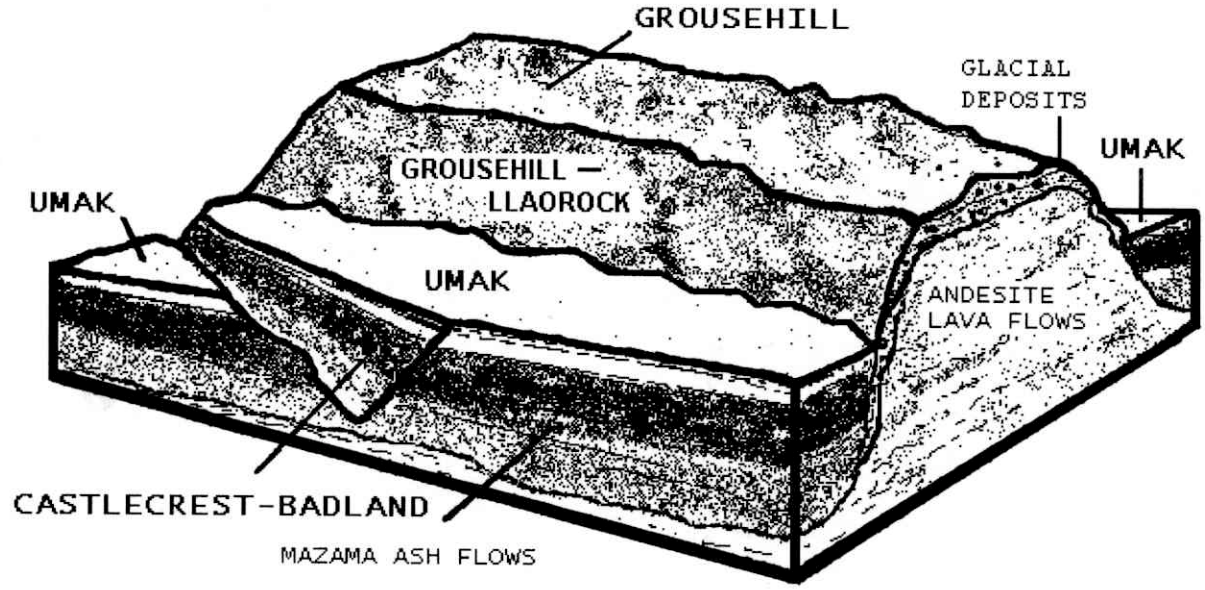

Figure 16.—Typical pattern of soils on pumice- and ash-mantled glaciated uplands along the western edge of the park.

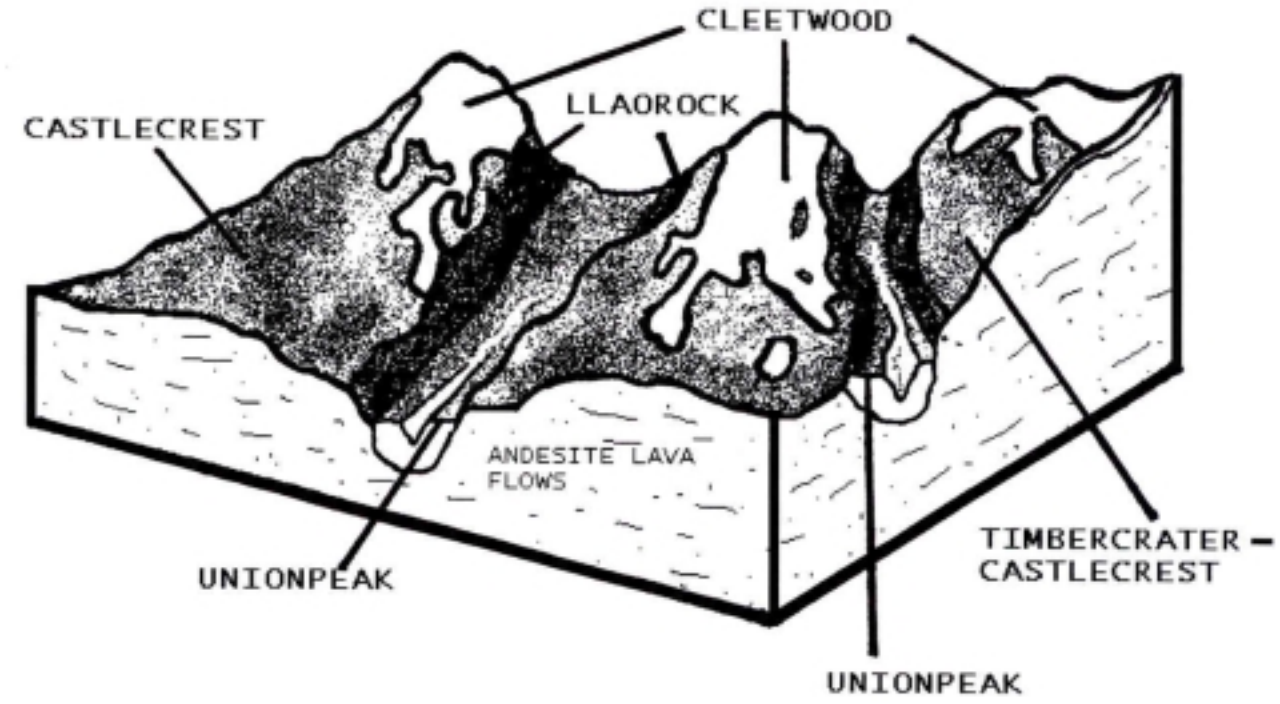

Figure 17.—Typical pattern of soils on ashflows in sedge- and grass-covered prairies and in valleys on the south slope of Mount Mazama.

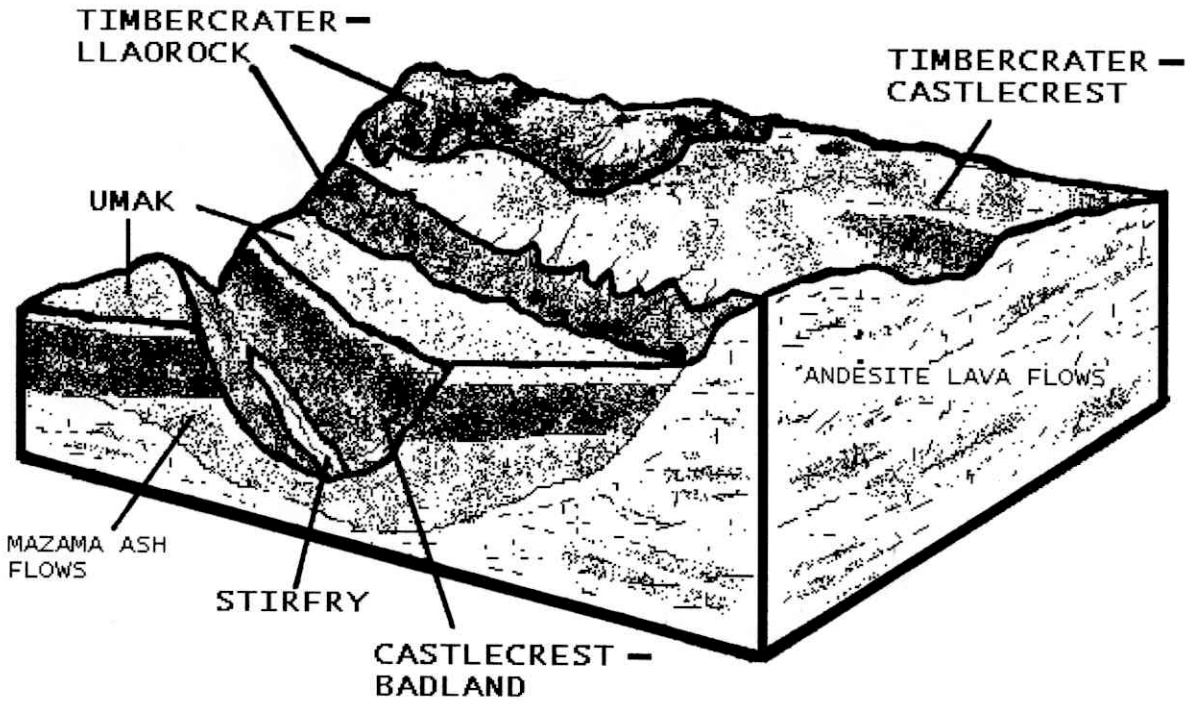

Figure 18.—Typical pattern of soils on pumice flows and pumice- and ash-covered uplands along Annie Creek, in the southeastern part of the park.

References

Aerts, R. 1999. Plant-mediated controls on nutrient cycling in temperate fens and bogs. Ecology: 79.

American Association of State Highway and Transportation Officials (AASHTO). 2000. Standard specifications for transportation materials and methods of sampling and testing. 20th edition, 2 volumes.

American Society for Testing and Materials (ASTM). 2001. Standard classification of soils for engineering purposes. ASTM Standard D 2487-00.

Anonymous. 2000. Geologic history of Crater Lake. U.S. Geological Survey, Crater Lake Data Clearinghouse. (http://craterlake.wr.usgs.gov)

Arno, Stephen F. 1980. Forest fire history in the northern Rockies. Journal of Forestry 78(8): 460-465.

Arno, Stephen F. 1986. Whitebark pine cone crops—a diminishing source of wildlife food. Western Journal of Applied Forestry 3: 92-94.

Arno, Stephen F., and Ramona P. Hammerly. 1977. Northwest trees, Seattle, WA. *In* The Mountaineers.

Atzet, Thomas, and David L. Wheeler. 1982. Historical and ecological perspectives on fire activity in the Klamath Geological Province of the Rogue River and Siskiyou National Forests. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region.

Atzet, Thomas, and Lisa A. McCrimmon. 1990. Preliminary plant associations of the Southern Oregon Cascade Mountain Province. U.S. Department of Agriculture, Forest Service, Siskiyou National Forest.

Bacon, Charles R., Larry G. Mastin, Kevin M. Scott, and Manuel Nathenson. 1997. Volcano and earthquake hazards in the Crater Lake Region, Oregon. U.S. Geological Survey open file report 97-487.

Booth, Douglas E. 1991. Estimating prelogging old-growth in the Pacific Northwest. Journal of Forestry 89(10): 25-29.

Dickman, Alan, and Stanton Cook. 1989. Fire and fungus in a mountain hemlock forest. Canadian Journal of Botany 67(7): 2005-2016.

Dorr, J., and others. 2000. Ecological unit inventory of the Winema National Forest Area. Klamath County, Oregon, Interim Report 2. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Winema National Forest.

Fischer, William C., and Bruce D. Clayton. 1983. Fire ecology of Montana forest habitat types east of the Continental Divide. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station General Technical Report INT-141.

Franklin, J.F., and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. Oregon State University Press.

Habeck, James R. 1985. Impact of fire suppression on forest succession and fuel accumulations in long-fire-interval wilderness habitat types. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station General Technical Bulletin INT-182.

Harris, Stephen L. 1988. Fire mountains of the West, the Cascade and Mono Lake Volcanoes. Mountain Press Publishing Company, Missoula, Montana.

Hemstrom, Miles A., and Jerry F. Franklin. 1982. Fire and other disturbance of the forests in Mount Rainer National Park. Quaternary Research 18: 32-51.

Johnson, D., and others. 1995. Plants of the Western Boreal Forest and Aspen Parkland. Lone Pine Publishing and Canadian Forest Service.

Kovalchik, Bernard L. 1987. Riparian zones associations, Deschutes, Ochoco, Fremont, and Winema National Forests. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region TP-279-87.

Laacke, Robert J. 1990. Abies concolor (Gord. and Glend.) Lindl. ex Hildebr. white fir. *In* Silvics of North America, volume 1. U.S. Department of Agriculture, Forest Service, Conifers Agriculture Handbook 654, pp. 36-46.

Lotan, James E., Martin E. Alexander, Stephen F. Arno, and others. 1981. Effects of fire on flora: A state-of-knowledge review. National Fire Effects Workshop. U.S. Department of Agriculture, Forest Service General Technical Report WO-16.

Lynch, E.A. 1998. Origin of a park-forest vegetation mosaic in the Wind River Range, Wyoming. Ecology: 78.

Mastrogiuseppee, R.J., and J.D. Mastrogiuseppee. n.d. Fire history of the northeastern portion of Crater Lake National Park, Oregon. (www.nps.gov.crla)

McNeil, Robert C., and Donald B. Zobel. 1980. Vegetation and fire history of a ponderosa pine-white fir forest in Crater Lake National Park. Northwest Science 54: 30-45.

Raab, T.K. 1999. Soil amino acid utilization among species of the Cyperaceae: Plant and soil processes. Ecology: 79.

Radforth, N.W., and C.O. Brawner. 1977. Muskeg and the northern environment in Canada. University of Toronto Press.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1998. Keys to soil taxonomy. 8th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. (http://nsscnt.nssc.nrcs.usda.gov/nfm/)

United States Department of Agriculture, Soil Conservation Service. 1981. Land resource regions and major land resource areas of the United States. U.S. Department of Agriculture Handbook 296.

Williams, Howel. 1942. The geology of Crater Lake National Park, Oregon. Carnegie Institution of Washington Publication 540, Washington, D.C.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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

Andesite. Dark-colored, fine-grained extrusive rock.

Andic soil properties. A collection of physical and chemical properties given in “Soil Taxonomy” that are the taxonomic criteria for the Andisol order.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Ash. Volcanic ejecta material less than 2 millimeters in diameter.

Aspect. The direction in which a slope faces.

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 given in the detailed map unit descriptions. An average single number is given for each soil component in a map unit.

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal till. Compact glacial till deposited beneath the ice.

Base slope. A geomorphic component of hills consisting of the concave to linear (perpendicular to the contour) slope that, regardless of the lateral shape, forms an apron or wedge at the bottom of a hillside dominated by colluvium and slope-wash sediments (for example, slope alluvium).

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

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

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.

Cinders. Volcanic ejecta material that is more than 2 millimeters in diameter and has specific gravity of 1.0 to 2.0.

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 depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese

and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Coarse textured soil. Sand or loamy sand.

Cobbly soil material. Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility). See Linear extensibility.

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

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

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 from the surface of the mineral soil to a depth of 40 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Dacite. A fine-grained extrusive rock that has composition similar to that of andesite but has less calcic plagioclase and more quartz.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Desert pavement. On a desert surface, a layer of gravel or larger fragments that was emplaced by upward movement of the underlying sediments or that remains after finer particles have been removed by running water or the wind.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

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

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Ecological site. An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological 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 ecological sites in kind and/or proportion of species or in total production.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

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.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of 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 human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

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, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Footslope. The position that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

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. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till. 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.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hard to reclaim (in tables). Reclamation is difficult after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Head slope. A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Historic climax plant community. 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.

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 uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Hydrophobic. Refers to resistance to wetting by water.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on

the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

K_{sat}. Saturated hydraulic conductivity. (See Permeability.)

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 (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Linear extensibility. Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

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.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Medial. A textural modifier and a family particle-size class name (see Soil Survey Staff, 1999 and USDA, NRCS, National Soil Survey Handbook in the “References” section).

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single,

isolated mass or in a group forming a chain or range.

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

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nose slope. A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Pararock fragments. Unattached pieces of cemented material 2 millimeters in diameter or more. The fragments are extremely weakly cemented to moderately cemented.

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 movement of water through the soil.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Impermeable	less than 0.0015 inch
Very slow	0.0015 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

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.

Pitting (in tables). Pits caused by melting around ice. They form on the soil after plant cover is removed.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

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

Pumice. Volcanic ejecta material that is more than 2 millimeters in diameter and has specific gravity of less than 1.0.

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.

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 degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

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.

Rock fragments. Unattached pieces of cemented material 2 millimeters in diameter or more. The fragments are strongly cemented or more resistant to rupture.

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.

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.

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.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shoulder. The position that forms the uppermost inclined surface near the top of a hillslope. It is a transition from backslope to summit. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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 refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

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

Substratum. The part of the soil below the solum.

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

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

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is 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 that is 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.

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

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.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

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 a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.