SOIL SURVEY OF

Modoc County, California, Alturas Area

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

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

Major fieldwork for this soil survey was completed in the period 1969 to 1973. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1974. This survey was made cooperatively by the Soil Conservation Service and the University of California, Agricultural Experiment Station. It is part of the technical assistance furnished to the Goose Lake and Central Modoc Resource Conservation Districts.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, woodlands, and wildlife areas; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of the Alturas area of Modoc County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

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

Finding and Using Information

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

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

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

Wildlife managers and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Recreation."

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

Scientists and others can read about the soils in the sections "Formation and Morphology of the Soils" and "Classification."

Newcomers in the area may be especially interested in the section "General Soil Map for Broad Land Use Planning" where broad patterns of soils are described. They may also be interested in the information in the section "General Nature of the Area."

Cover: Willows and cattails growing in Pit soils on the banks of the Pit River provide habitat for wetland wildlife.

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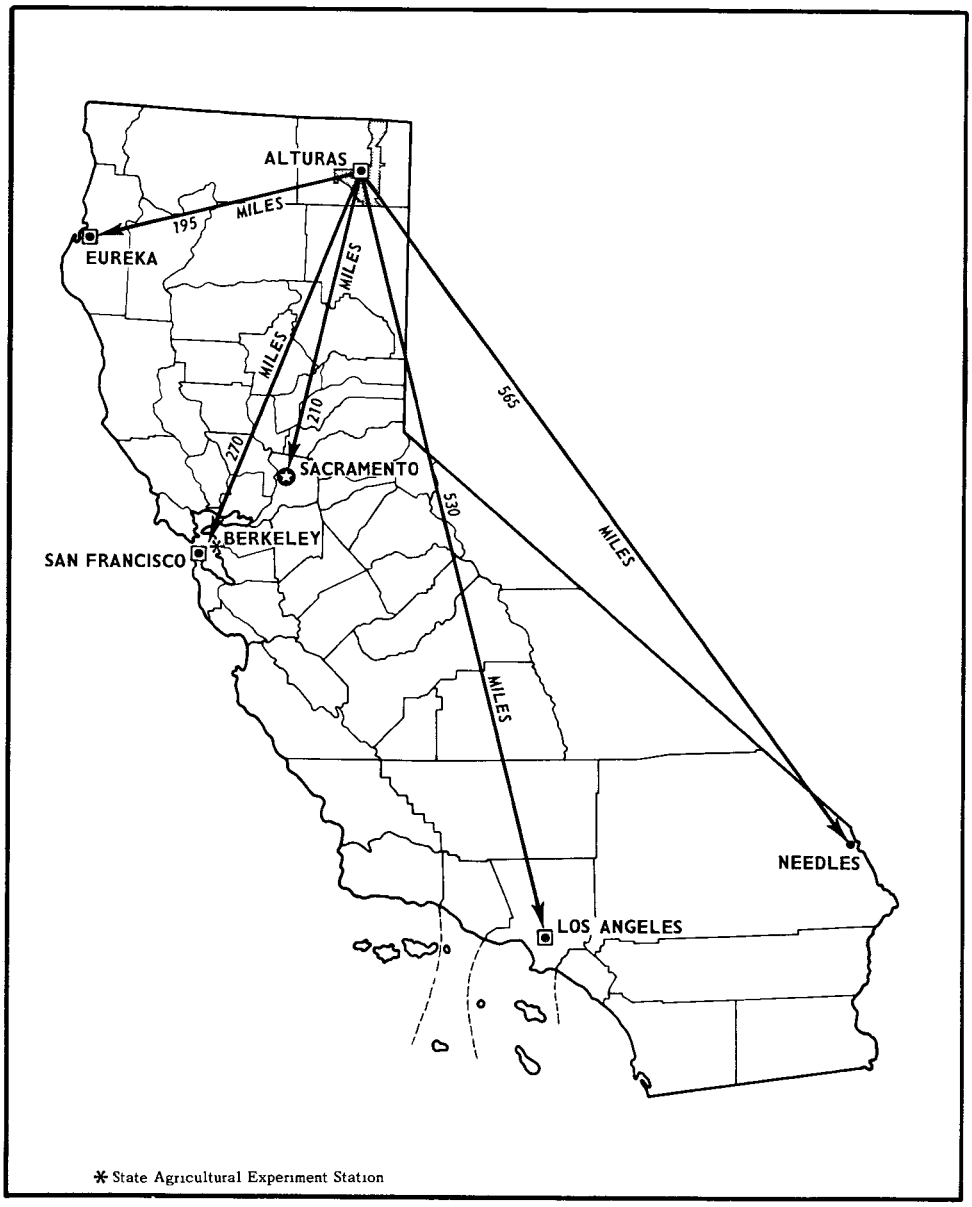

Location of Alturas Area in Modoc County, California.

SOIL SURVEY OF MODOC COUNTY, CALIFORNIA, ALTURAS AREA

By Wayne B. Sheldon, Soil Conservation Service

Fieldwork by Wayne B. Sheldon and John O. Borgen, Soil Conservation Service

United States Department of Agriculture and the University of California Agricultural Experiment Station

MODOC COUNTY, ALTURAS AREA, is in the extreme northeastern corner of California. Alturas, the largest city in the Alturas Area, is in a valley at the confluence of the North Fork and South Fork of the Pit River. The entire Alturas Area is in the Modoc Plateau natural province.

The Alturas Area is in the eastern part of Modoc County, but on the west side of the Warner Mountains. Its total area, excluding the extent of Goose Lake, is 656 square miles, or 419,781 acres. It is bounded on the north by the Oregon State line, on the east and west by Modoc National Forest, and on the south by Lassen County.

The Area includes the closed basin of Goose Lake Valley, Alturas Valley—consisting of the basin north of Likely and the valley surrounding the town of Alturas —and Warm Springs Valley to the west. Lava plateaus and mountains surround these valleys. Elevation ranges from about 4,300 feet at the Canby bridge to more than 5,700 feet along Graven Ridge and at the lower edge of the Warner Mountains. The Pit River, including its North and South Forks, drains the area to the west.

The valleys are used for irrigated forage crops, which are put up as hay for winter feed. Some areas are used for grazing in spring and fall, and grain is grown in some small areas. The valley margins and uplands are used either for dryland forage crops or for dryland range. Raising livestock is the main farm enterprise and nearly all the livestock are cattle.

How This Survey Was Made

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

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General Soil Map for Broad Land Use Planning" and "Descriptions of the Soils."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General Soil Map for Broad Land Use Planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor

soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The soils in the survey area vary widely in their potential for major land uses. The descriptions in this section indicate the extent of the map units shown on the general soil map and give general ratings of the potential of each for major land uses.

Nearly Level to Moderately Sloping, Very Deep and Shallow, Moderately Well Drained to Poorly Drained Soils in Basins and on Flood Plains and Low Terraces

The four map units in this group make up about 19 percent of the survey area. The soils are in basins and on flood plains and low terraces in Goose Lake Valley and in areas along the Pit River and its tributaries. All the soils are very deep, except Pineal soils which are shallow over a hardpan. The parent material is alluvium that was derived from basic igneous rocks. Diatomaceous earth is present in the soils in the basin north of Likely.

The elevation ranges from 4,100 to 4,900 feet. The average annual precipitation is 8 to 15 inches. The map units in this group receive the lowest rainfall in the survey area. Most areas are irrigated. The mean annual temperature is 46° to 52° F. The frost-free period is 70 to 130 days. Vegetation is grass and shrubs.

The soils are used mostly for crops and pasture. Some areas are used for range.

1. Tulana-Pasquetti

Nearly level, very deep, poorly drained mucky loams and silty clay loams in basins

This map unit is mainly in the basin north of Likely. It consists of soils that formed in very deep deposits of lake sediment and alluvium that have a high content of diatomaceous earth and volcanic ash. The slope is 0 to 2 percent. Vegetation is mostly perennial grasses and meadow and pasture plants. The elevation ranges from 4,350 to 4,400 feet. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 47° to 50° F, and the frost-free period is 80 to 100 days.

This unit makes up 3 percent of the survey area. The Tulana soils make up about 45 percent of the unit, and the Pasquetti soils make up about 40 percent. Pit, Goose Lake, and Buntingville soils make up the rest.

The Tulana soils are more than 60 inches deep to bedrock, and the water table is at a depth of 24 to 60 inches or more. These soils have a surface layer of dark gray mucky loam. The underlying material is light gray loam and very dark grayish brown silty clay loam. These soils overlie diatomaceous lake sediment. The Pasquetti soils are more than 60 inches deep to bedrock, and the water table is at a depth of 36 to 60 inches or more. These soils have a surface layer of very dark gray silty clay loam. The underlying material is gray sandy loam and silty clay loam. Discontinuous layers of ash are throughout the profile.

The soils in this unit are very productive if properly managed. In most areas, they are irrigated. The soils are used for alfalfa, grasses and legumes, hay and pasture crops, and small grain. In some areas they are subject to flooding or have a high water table, or both.

2. Pit-Buntingville-Goose Lake

Nearly level to moderately sloping, very deep, somewhat poorly drained and poorly drained silt loams, clay loams, silty clay loams, and clays in basins and on flood plains

This map unit is on low flood plains surrounding Goose Lake and in basins and on flood plains bordering the Pit River and its major tributaries. It consists of soils that formed in very deep alluvium derived from basic igneous rocks. The slope is 0 to 9 percent. Vegetation is mostly perennial grasses. The elevation ranges from 4,300 to 4,800 feet. The average annual precipitation is 10 to 14 inches, the average annual temperature is 46° to 52° F, and the frost-free period is 80 to 90 days.

This unit makes up 10 percent of the survey area. The Pit soils make up about 45 percent of the unit, the Buntingville soils make up about 30 percent, and the Goose Lake soils make up about 10 percent. Lakeview, Alturas, and Rumbo soils make up the rest.

The Pit soils are more than 60 inches deep and are somewhat poorly drained. They have a water table at a depth of 36 to 48 inches. The surface layer is mostly gray silty clay loam, but in some areas it is clay. The underlying material is grayish brown silty clay loam. The soil is calcareous in the lower part of the profile. The Buntingville soils are over 60 inches deep and are somewhat poorly drained. They have a water table at a depth of 36 to 60 inches or more. The surface layer is dark gray clay loam. The subsoil is very dark gray, dark gray, and grayish brown mottled clay loam. The substratum is light brownish gray clay loam. The Goose Lake soils are over 60 inches deep and are poorly drained. They have a water table at a depth of 12 to 36 inches. The surface layer is dark gray silt loam, and the subsurface layer is light gray silt loam. The subsoil is dark gray, grayish brown mottled silty clay in the upper part and pale brown mottled clay loam and sandy clay loam in the lower part. The substratum is light yellowish brown mottled loam.

These soils are used for grass, grass and legume hay, and pasture. In most areas they are irrigated. Alfalfa is grown on the better drained soils.

3. Fluvaquents-Lolak-Tandy

Nearly level, very deep, very poorly drained, stratified

sandy, clayey, and gravelly soils and somewhat poorly drained and poorly drained loamy fine sands and silty clay loams in basins

This map unit is in the nearly level lake basin adjacent to Goose Lake. It consists of soils that formed in very deep lacustrine deposits derived from tuff, basalt, and volcanic ash. Some areas are covered by windblown or water-deposited sandy material. The slope is 0 to 2 percent. The Tandy soils in this map unit are covered by sandy deposits, and they are slightly higher on the landscape than the other soils in the unit. Vegetation is mostly saltgrass, sedges, and rushes. Some areas are almost bare because the water level of the lake fluctuates. The elevation ranges from 4,650 to 4,725 feet. The average annual precipitation is 12 to 15 inches, the average annual temperature is 46° to 48° F, and the frost-free period is 70 to 90 days.

This unit makes up 4 percent of the survey area. Fluvaquents make up about 50 percent of the unit, Lolak soils make up about 25 percent, and Tandy soils make up 15 percent. Rumbo soils, Typic Xerorthents, and small areas of windblown sand deposits make up the rest.

Fluvaquents are highly stratified soils of variable texture. They are very poorly drained. The water table fluctuates with the lake level, but it often is at a depth of 4 to 12 inches. These soils are strongly affected by salt. The Lolak soils are more than 60 inches deep and are poorly drained. They have a water table at a depth of 20 to 36 inches. The surface layer is light brownish gray silty clay loam and clay loam. The underlying material is light gray and light olive gray silty clay that overlies light brownish gray sand. The Tandy soils are more than 60 inches deep and are somewhat poorly drained. The water table fluctuates between a depth of 18 to 48 inches. The surface layer is light brownish gray, calcareous, loamy fine sand. The underlying material is grayish brown and light brownish gray, calcareous, stratified sandy loam, loamy fine sand, clay loam, and loamy sand.

These soils are used mainly for range and as wildlife habitat.

4. Rumbo-Alturas-Pineal

Nearly level and gently sloping, very deep and shallow, moderately well drained loams and silt loams in basins and on low terraces

This map unit is on basin edges, low terraces, and lower alluvial fans in Warm Springs Valley. It consists of soils that formed in very deep alluvium derived from basic igneous rocks. The slope is 0 to 5 percent. Vegetation is mostly grass and brush that are tolerant of salts or alkali, or both. The elevation ranges from 4,100 to 4,900 feet. The average annual precipitation is 8 to 15 inches, the average annual air temperature is 46° to 52° F, and the frost-free period is 80 to 130 days.

This unit makes up 2 percent of the survey area. The Rumbo soils make up 35 percent of the unit, the Alturas soils make up 30 percent, and the Pineal soils make up 20 percent. Lovejoy, Barnard, Salisbury, and Bieber soils on low terraces and Buntingville, Pit, and Pasquetti soils in basins make up the rest.

The Rumbo soils are more than 60 inches deep. At times they have a perched water table at a depth of 40 to 60 inches for short periods. The surface layer is light brownish gray loam. The subsoil is dark grayish brown, brown, and dark yellowish brown heavy clay loam. The substratum is pale brown and light brownish gray loamy sand and very gravelly loamy sand. The Alturas soils are more than 60 inches deep and have a water table at a depth of 30 to 60 inches. The surface layer is gray silt loam, loam, and clay loam. The subsoil is dark gray, grayish brown, and dark brown heavy clay loam. The substratum is grayish brown gravelly loam and light brownish gray, weakly cemented gravelly sandy loam. The Pineal soils are 10 to 20 inches deep to a silica- and lime-cemented hardpan. They have a surface layer of light brownish gray silt loam. The subsoil is brown heavy clay loam and overlies the hardpan.

These soils are used for range, dryland pasture and hay and, in small areas, for dryland grain.

Nearly Level to Steep, Shallow to Very Deep, Somewhat Excessively Drained to Well Drained Soils on Alluvial Fans, Terraces, and Escarpments

The five map units in this group make up 35 percent of the survey area. The soils are on alluvial fans, terraces, and escarpments throughout the survey area. They are above the basins, flood plains, and low lake terraces and below the lava plateaus of lower mountain slopes. They are somewhat excessively drained to well drained. They have a surface layer that ranges in texture from loam to clay and that is gravelly, cobbly, or stony. The soils are more than 60 inches deep or are underlain by a hardpan, sedimentary tuff, or lake sediment at a depth of 8 to more than 40 inches. The parent material derived from basic igneous and pyroclastic rocks and some diatomaceous earth.

The elevation ranges from 4,300 to 5,300 feet. The average annual precipitation is 10 to 20 inches, and the average annual temperature is 46° to 49° F. The frost-free period ranges from 70 to 110 days.

The soils are used mostly for range, for irrigated grass and legume or alfalfa hay, and for dryland pasture. In some areas they are used for dryland grain.

5. Bieber-Barnard-Modoc

Nearly level to strongly sloping, shallow and moderately deep, well drained gravelly loams, cobbly loams, clay loams, and sandy loams on alluvial fans and terraces

This map unit is on alluvial fans and lake terraces. It consists of soils that formed in alluvium derived from basic igneous rocks. The soils are 8 to 40 inches deep to a hardpan. The slope is 0 to 15 percent. Vegetation is mostly shrubs and grass. Low sagebrush grows on the Bieber soils, and big sagebrush grows on the Barnard and Modoc soils. The elevation ranges from 4,300 to 5,000 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is 70 to 90 days.

This unit makes up 11 percent of the survey area. The Bieber soils make up 40 percent of the unit, the Barnard soils make up 25 percent, and the Modoc soils

make up 15 percent. Daphnedale, Delma, Lovejoy, Casuse, and Ladd soils make up the rest.

The Bieber soils are 8 to 20 inches deep to a silica-cemented hardpan. These soils have a surface layer of grayish brown gravelly loam or cobbly loam. The subsoil is dark grayish brown clay loam and dark brown clay and overlies the hardpan. The Barnard soils are 26 to 40 inches deep to a silica-cemented hardpan. These soils have a surface layer of grayish brown gravelly loam, cobbly loam, or clay loam. The subsoil is dark brown clay loam and dark reddish gray clay. The substratum above the hardpan is brown clay loam. The Modoc soils are 24 to 40 inches deep to a silica-cemented hardpan. These soils have a surface layer of brown gravelly loam or sandy loam. The subsoil is brown clay loam and overlies the hardpan.

The moderately deep Barnard and Modoc soils are used for irrigated grass and legume hay or for alfalfa. They are also used for irrigated pasture and dryland grain. In some small areas, these soils are used for range. The shallow Bieber soils are used mainly for range, but small areas of these soils are used for dryland and irrigated pasture.

6. *Bieber-Salisbury*

Nearly level to strongly sloping, shallow and moderately deep, well drained gravelly loams, cobbly loams, very fine sandy loams, clay loams, and very cobbly clay loams on alluvial fans and terraces

This map unit is on alluvial fans and terraces in Goose Lake Valley. It consists of soils that formed in alluvium derived from basic igneous rocks. The soils are 8 to 32 inches deep to a hardpan. The slope is 0 to 15 percent. The vegetation is mostly shrubs and grass. Low sagebrush grows on Bieber soils, and big sagebrush grows on Salisbury soils. The elevation ranges from 4,300 to 5,100 feet. The average annual precipitation is 10 to 20 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is 70 to 110 days.

This unit makes up 5 percent of the survey area. The Bieber soils make up 45 percent of the unit, and the Salisbury soils make up 40 percent. Modoc and Drews soils make up the rest.

The Bieber soils are 8 to 20 inches deep to a silica-cemented hardpan. They have a surface layer of grayish brown gravelly loam or cobbly loam. The subsoil is dark grayish brown clay loam and dark brown clay and overlies the hardpan. The Salisbury soils are 20 to 32 inches deep to a silica-cemented hardpan. These soils have a surface layer of dark gray gravelly loam, very fine sandy loam, very cobbly loam, or clay loam. The subsoil is yellowish brown and reddish brown clay loam and overlies the hardpan.

The Bieber soils are used mostly for range, but small areas of these soils are used for irrigated pasture or dryland grain. The Salisbury soils are used for dryland grass and legume hay, pasture, and grain. Where water is available, they are used for irrigated grass and legume hay, alfalfa hay, and pasture. Small areas of Salisbury soils are used for range.

7. *Drews-Donica-Calimus*

Nearly level and moderately sloping, very deep, somewhat excessively drained and well drained gravelly loams, gravelly clay loams, loams, and clay loams on alluvial fans

This map unit is on alluvial fans in Goose Lake Valley. It consists of soils that formed in alluvium derived from basalt, andesite, and obsidian. The soils are more than 60 inches deep. The slope is 0 to 9 percent. Vegetation is mostly grass and sagebrush. The elevation ranges from 4,500 to 5,000 feet. The average annual precipitation is 14 to 20 inches, the average annual air temperature is 47° to 49° F, and the frost-free period is 80 to 100 days.

This unit makes up 1 percent of the survey area. The Drews soils make up 50 percent of the unit, the Donica soils make up 20 percent, and the Calimus soils make up 15 percent. Lakeview and Salisbury soils make up the rest.

The Drews soils are more than 60 inches deep and are well drained. They have a surface layer of dark grayish brown loam, gravelly loam, and clay loam. The subsoil is dark grayish brown and brown clay loam. The substratum is dark grayish brown and brown sandy clay loam and clay loam. The Donica soils are more than 60 inches deep and are somewhat excessively drained. The surface layer is grayish brown and dark brown gravelly clay loam. The subsoil is brown gravelly coarse sandy loam and gravelly loam. The substratum is brown gravelly coarse sand. The Calimus soils are more than 60 inches deep and are well drained. They have a surface layer that is mainly grayish brown gravelly clay loam and dark grayish brown clay loam, but in some areas the surface layer is loam. The underlying material is dark brown loam and brown very gravelly loamy sand.

These soils are used for irrigated grass and legume hay, pasture, and alfalfa and for irrigated grain. Donica soils are also used for range.

8. *Thoms-Exel*

Nearly level to gently sloping, shallow to moderately deep, well drained very cobbly loams and gravelly loams on mounded terraces

This map unit is on old terraces in the southwestern part of Goose Lake Valley. It consists of soils that formed in alluvium derived from basic igneous and pyroclastic rocks. The soils are 12 to 35 inches deep to a hardpan. The slope is 0 to 5 percent. Vegetation is mostly sagebrush and grass. The elevation ranges from 4,750 to 5,300 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is about 80 days.

This unit makes up 2 percent of the survey area. The Thoms soils make up 50 percent of the unit, and the Exel soils make up 40 percent. Bieber and Barnard soils make up the rest. The land surface of this map unit is mounded; the Thoms soils are between the mounds, and the Exel soils are on the mounds.

The Thoms soils are 12 to 18 inches deep to a silica-cemented hardpan. They have a surface layer of brown very cobbly loam. The subsoil is dark brown clay loam and overlies the hardpan. The hardpan is reddish yellow. The Exel soils are 21 to 35 inches deep to a silica-cemented hardpan. They have a surface layer of light brownish gray and brown loam. The subsoil is

brown cobbly clay loam and reddish brown very cobbly clay loam and overlies the hardpan. The hardpan is reddish brown and pink.

These soils are used for range.

9. Daphnedale-Delma-Ager

Nearly level to steep, shallow to deep, well drained stony loams, cobbly loams, loams, cobbly clays, and clays on terraces and escarpments

This map unit is throughout Warm Springs Valley and in the area surrounding Parker Creek. It consists of soils that formed in old lake deposits derived from basic igneous rocks, diatomite, tuff, and pyroclastic rocks. The slope is 0 to 50 percent. Vegetation is mostly junipers, shrubs, and grass. The elevation ranges from 4,300 to 5,300 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is 70 to 100 days.

This unit makes up 16 percent of the survey area. The Daphnedale soils make up about 35 percent of the unit, the Delma soils make up about 35 percent, and the Ager soils make up about 15 percent. Barnard and Casuse soils and Tuff outcrop make up the rest.

The Daphnedale soils are 25 to 40 inches deep to sedimentary tuff. They have a surface layer of very dark grayish brown loam that is cobbly or stony in places. The subsoil is very dark grayish brown and dark brown clay loam and overlies soft sedimentary tuff. The Delma soils are 8 to 20 inches deep to soft lake sediment. They have a surface layer of grayish brown cobbly loam and brown loam. The subsoil is dark brown clay and overlies white, soft lake sediment. The Ager soils are 40 to 60 inches deep to siltstone and mudstone. They have a surface layer of grayish brown and dark grayish brown clay or cobbly clay. The next layer is brown clay. The substratum is pale brown and light gray, calcareous, clay loam and loam. It overlies calcareous siltstone and mudstone.

These soils are used for range, dryland pasture and hay, and grain. Small areas are used for irrigated grass and legume or alfalfa hay.

Nearly Level to Steep, Shallow to Moderately Deep, Well Drained Soils on Plateaus and Mountains

The five map units in this group make up about 46 percent of the survey area. The soils are on uplands throughout the survey area. They are well drained, varied in texture, and formed mainly in weathered basalt. These soils are 8 to 38 inches deep to bedrock.

The elevation ranges from 4,300 to 5,900 feet. The average annual precipitation is 8 to 20 inches, and the average annual temperature is 44° to 50° F. The frost-free period ranges from 70 to 100 days.

The soils in this group are used for range, wildlife habitat, and watershed. In some small areas they are used for dryland pasture.

10. McQuarrie-Lorella

Moderately sloping to steep, shallow, well drained sandy loams, stony loams, loams, and cobbly clay loams on mountainous uplands

This map unit is at the base of the Warner Mountains from Parker Creek to the Oregon State line. It consists of soils that formed in material weathered from hard basalt, andesite, rhyolite, and lapilla tuff. The slope is 5 to 50 percent. The vegetation is shrub and grass and scattered junipers. The elevation ranges from 4,400 to 5,900 feet. The average annual precipitation is 12 to 20 inches, the average annual air temperature is 45° to 49° F, and the frost-free period is 80 to 100 days.

This unit makes up 6 percent of the survey area. The McQuarrie soils make up 60 percent of the unit, and the Lorella soils make up 20 percent. Ninekar, Delma, and Daphnedale soils and the Daphnedale deep variant make up the rest.

The McQuarrie soils are 10 to 16 inches deep to hard andesite. They have a surface layer of grayish brown sandy loam and brown sandy clay loam. In some areas the surface is stony. The subsoil is dark brown clay loam and overlies the hard andesite. The Lorella soils are 10 to 20 inches deep to hard rhyolite. They have a surface layer of dark grayish brown cobbly clay loam or loam. The subsoil is very dark grayish brown cobbly clay loam and dark brown very cobbly clay. It overlies the hard rhyolite.

These soils are used for range, wildlife habitat, and watershed.

11. Tuff outcrop-Casuse

Gently sloping to steep, shallow, well drained sandy loams and Tuff outcrop on plateaus and mountains

This map unit is southeast of the town of Alturas. It consists of Tuff outcrop and of soils that formed in material that weathered from hard pumice lapilli tuff, ashy sandstone, and welded tuff. The slope is 2 to 50 percent. The vegetation is mostly junipers, shrubs, and grass. The elevation ranges from 4,300 to 4,700 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 46° to 50° F, and the frost-free period is 80 to 90 days.

This unit makes up 5 percent of the survey area. Tuff outcrop makes up about 65 percent of the unit, and the Casuse soils make up about 25 percent. Small areas of Bieber and Delma soils and soils that are similar to Casuse soils but that lack a subsoil or are more than 20 inches deep make up the rest.

Tuff outcrop consists of exposed hard bedrock that is made up of massive pumice lapilli tuff, ashy sandstone, and welded tuff. The Casuse soils are 8 to 20 inches deep to tuff. They have a surface layer of brown sandy loam and cobbly sandy loam. The subsoil is brown clay loam. It overlies weakly fractured tuff that contains a large amount of pumice.

The soils in this map unit are used for range, wildlife habitat, and watershed. Some small areas of less sloping soils are used for dryland pasture.

12. Karcal-Ninekar

Nearly level to moderately sloping, moderately deep, well drained very cobbly silt loams and cobbly clays on plateaus

This map unit is mostly in the southeastern part of the survey area on the Likely Tableland. It consists of soils that formed in material weathered from hard

fractured basalt. The slope is 0 to 9 percent. The vegetation is shrubs and grass. The elevation ranges from 4,300 to 5,800 feet. The average annual precipitation is 10 to 16 inches, the average annual air temperature is 45° to 47° F, and the frost-free period is 70 to 80 days.

This unit makes up 15 percent of the survey area. The Karcal soils make up about 50 percent of the unit, and the Ninekar soils make up about 40 percent. Deven and Ager soils and Rock outcrop make up the rest.

The Karcal soils are 20 to 30 inches deep to hard fractured basalt. The surface layer is brown cobbly clay and clay and overlies the basalt. The Ninekar soils are 20 to 38 inches deep to hard fractured basalt. The surface layer is gray very stony silt loam. The subsoil is brown silty clay loam and overlies the basalt.

These soils are used for range, wildlife habitat, and watershed.

13. Packwood-Rock outcrop-Ditchcamp

Nearly level to moderately sloping, shallow and moderately deep, well drained extremely stony loams and loams and Rock outcrop on plateaus

This map unit is mostly in a large area near Lauer Reservoir. It consists of outcrops of basalt and soils that formed in material weathered from hard fractured basalt. The slope is 0 to 9 percent. The vegetation is junipers, shrubs, and grass. The elevation ranges from 4,900 to 5,400 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 47° to 49° F, and the frost-free period is about 80 days.

This unit makes up 3 percent of the survey area. The Packwood soils make up 45 percent of the unit, the Rock outcrop makes up about 20 percent, and the Ditchcamp soils make up about 20 percent. Karcal and Jenny soils make up the rest.

The Packwood soils are 8 to 16 inches deep to a yellowish red, silica-cemented, indurated hardpan. The surface layer is grayish brown extremely stony loam. The subsoil is brown clay loam. It overlies the hardpan, and the hardpan overlies basic igneous rock. The Rock outcrop is mostly exposures of hard basalt. The Ditchcamp soils are 21 to 35 inches deep to a silica-cemented indurated hardpan. The surface layer is brown loam. The subsoil is brown and reddish brown clay loam and clay. It overlies the hardpan, and the hardpan overlies hard basic igneous rock.

The soils in this unit are used for range, wildlife habitat, and recreation. The Ditchcamp soils have potential for other uses, but because of the small size and the distribution of the areas, these soils have not been developed.

14. Deven-Rock outcrop-Puls

Nearly level to steep, shallow, well drained extremely stony clay loams, clay loams, and very stony clay loams and Rock outcrop on plateaus and mountains

This map unit is mostly at the base of the Warner Mountains on the eastern edge of the survey area, in the area known as "Devil's Garden" in the northwestern part, along Graven Ridge in the southwestern part, and on the plateau north of Graven Ridge. It consists of soils that formed in material weathered from hard fractured basalt. An indurated hardpan overlies the basalt in some places. The slope is 0 to 50 percent. The vegetation is junipers, shrubs, and grasses. The elevation ranges from 4,400 to 5,800 feet. The average annual precipitation is 10 to 18 inches, the average annual air temperature is 44° to 49° F, and the frost-free period is 70 to 100 days.

This unit makes up 17 percent of the survey area. The Deven soils make up 40 percent of the unit, Rock outcrop makes up 25 percent, and the Puls soils make up about 20 percent. Packwood and Barnard soils, Rubble land, and a soil that is 20 to 40 inches deep to hard bedrock make up the rest. The latter is on north-facing slopes. It has a surface layer of dark brown loam and a subsoil of brown loam.

The Deven soils are 13 to 20 inches deep to hard fractured basalt. The surface layer is brown clay loam and very stony clay loam. The subsoil is dark reddish brown clay and overlies the hard fractured basalt. The Rock outcrop is mostly exposures of basalt. The Puls soils are 14 to 20 inches deep to a silica-cemented, indurated hardpan. The surface layer is pinkish gray extremely stony clay loam. The subsoil is dark reddish brown clay and clay loam and overlies the hardpan. The hardpan overlies hard basalt bedrock.

These soils are used for range, wildlife habitat, watershed, and some recreational uses.

Descriptions of the Soils

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and Management of the Soils."

Preceding the name of each map unit is the number that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management coneerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series.* Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Alturas series, for example, was named for the town of Alturas in Modoc County.

Soils of one series can differ in texture of the surface

layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Ager clay, 2 to 15 percent slopes, is one of several phases within the Ager series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes, soil associations, and undifferentiated groups.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Karcal-Ninekar complex, 0 to 9 percent slopes, is an example.

A *soil association* is made up of soils that are geographically associated and are shown as one unit on the map because it is not practical to separate them. A soil association has considerable regularity in geographic pattern and in the kinds of soil that are a part of it. The extent of the soils can differ appreciably from one delineation to another; nevertheless, interpretations can be made for use and management of the soils. Lorella, deep variant-Rubble land association, steep, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because there is little value in separating them. The pattern and proportion of the soils are not uniform. There are no undifferentiated groups in this survey area.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas;* they are delineated on the soil map and given descriptive names. Rubble land is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 1, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of Tables.") Many of the terms used in describing soils are defined in the Glossary.

Ager Series

The Ager series consists of well drained soils on lake terraces and escarpments. These soils formed in old lake sediment. They are underlain by siltstone or mudstone. The slope ranges from 2 to 50 percent. The elevation ranges from 4,300 to 5,000 feet. Annual rainfall is 10 to 14 inches, average annual air temperature is 47° to 49° F, and the frost-free period is 70 to 90 days. The vegetation is scattered trees, shrubs, and grass. It consists mainly of Western Juniper, big sagebrush, grey horsebrush, rabbitbrush, squirreltail, Japanese brome, streambank wheatgrass, medusahead, and cheatgrass.

In a representative profile the surface layer is grayish brown and dark grayish brown, mildly alkaline and moderately alkaline clay about 33 inches thick. The next layer is brown calcareous clay 6 inches thick. The substratum is pale brown and light gray calcareous clay loam and loam. Soft siltstone is at a depth of 53 inches.

Permeability is slow.

Ager soils are used mostly for range, dryland pasture, and small grain. Small areas of these soils are used for irrigated alfalfa or mixed grass and legumes.

Representative profile of Ager clay, 2 to 15 percent slopes, on a high lake terrace about 2 miles northeast of Canby in SW¼NE¼ sec. 20, T. 42 N., R. 10 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) moist; strong very fine granular structure; soft, friable, very sticky and very plastic; few very fine roots; many very fine interstitial pores; 4-centimeter wide cracks; mildly alkaline (pH 7.5); abrupt smooth boundary.

A12—2 to 7 inches; grayish brown (10YR 5/2) dry and moist clay; strong very coarse prismatic structure; very hard, friable, sticky and very plastic; few very fine, fine, and medium roots, mostly exped; common very fine tubular pores; 4-centimeter wide cracks; mildly alkaline (pH 7.5); clear smooth boundary.

A13—7 to 25 inches; grayish brown (10YR 5/2) dry and moist clay; strong very coarse prismatic structure parting to strong very coarse and coarse angular blocky; extremely hard, friable, sticky and very plastic; few very fine, fine, and medium roots, mostly exped; few very fine tubular pores; 3-centimeter wide cracks; common intersecting slickensides; slightly effervescent; lime segregated in fine irregular soft bodies; mildly alkaline (pH 7.5); gradual wavy boundary.

A14—25 to 33 inches; dark grayish brown (10YR 4/2) clay, dark brown (10YR 4/3) moist; strong very coarse angular blocky structure; extremely hard, friable, sticky and very plastic; few very fine and fine tubular pores; many intersecting slickensides; 1-centimeter wide cracks; strongly effervescent; lime segregated in fine regular soft bodies; common fine white (10YR 8/1) lime mottles; moderately alkaline (pH 8.0); gradual wavy boundary.

AC—33 to 39 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate fine prismatic structure; extremely hard, friable, sticky and very plastic; few very

TABLE 1.—*Acreage and proportionate extent of soils*

Map symbol	Soil name	Acres	Percent
100	Ager clay, 2 to 15 percent slopes	3,495	0.8
101	Ager cobbly clay, 2 to 15 percent slopes	1,682	0.4
102	Ager cobbly clay, 30 to 50 percent slopes	1,149	0.3
103	Alturas loam	4,395	1.0
104	Balman loam	651	0.2
105	Balman loam, wet	182	(1)
106	Barnard gravelly loam, 0 to 9 percent slopes	12,058	2.9
107	Barnard cobbly loam, 0 to 9 percent slopes	1,728	0.4
108	Barnard clay loam, 9 to 15 percent slopes	541	0.1
109	Bieber gravelly loam, 0 to 9 percent slopes	28,138	6.7
110	Bieber gravelly loam, 9 to 15 percent slopes	1,127	0.3
111	Bieber cobbly loam, 2 to 15 percent slopes, eroded	1,376	0.3
112	Buntingville clay loam, 0 to 2 percent slopes	11,293	2.7
113	Buntingville clay loam, 2 to 9 percent slopes	559	0.1
114	Calimus loam, 0 to 2 percent slopes	114	(1)
115	Calimus loam, 2 to 9 percent slopes	195	(1)
116	Calimus gravelly loam, 2 to 5 percent slopes	582	0.1
117	Calimus clay loam, 0 to 2 percent slopes	301	0.1
118	Casuse sandy loam, 2 to 9 percent slopes	6,949	1.7
119	Daphnedale loam, 2 to 9 percent slopes	5,107	1.2
120	Daphnedale cobbly loam, 9 to 30 percent slopes	4,709	1.1
121	Daphnedale stony loam, 30 to 50 percent slopes	11,191	2.7
122	Daphnedale-Delma loams, 2 to 9 percent slopes	3,100	0.7
123	Daphnedale very cobbly loam, deep variant, 5 to 15 percent slopes	160	(1)
124	Daphnedale very cobbly loam, deep variant, 30 to 50 percent slopes	1,647	0.4
125	Daphnedale clay loam, deep variant, 5 to 15 percent slopes	692	0.2
126	Delma loam, 15 to 30 percent slopes, eroded	92	(1)
127	Delma loam, 30 to 50 percent slopes	5,403	1.3
128	Delma cobbly loam, 0 to 9 percent slopes	18,687	4.5
129	Delma cobbly loam, 9 to 30 percent slopes	6,976	1.7
130	Deven clay loam, 0 to 9 percent slopes	4,620	1.1
131	Deven very stony clay loam, 30 to 50 percent slopes	6,588	1.6
132	Deven-Rock outcrop complex, 2 to 9 percent slopes	40,387	9.6
133	Donica gravelly clay loam, 2 to 9 percent slopes	1,940	0.5
134	Drews loam, 0 to 5 percent slopes	1,013	0.2
135	Drews gravelly loam, 0 to 9 percent slopes	1,178	0.3
136	Drews gravelly loam, 15 to 30 percent slopes	190	(1)
137	Drews clay loam, 2 to 5 percent slopes	1,838	0.4
138	Drews clay loam, wet, 0 to 2 percent slopes	1,035	0.2
139	Fluvaquents	7,605	1.8
140	Gleason loam, 9 to 30 percent slopes	286	0.1
141	Gleason gravelly loam, 30 to 50 percent slopes	140	(1)
142	Goose Lake silt loam	2,747	0.7
143	Gravel pits	259	0.1
144	Jenny silty clay loam, overwash, 0 to 5 percent slopes	170	(1)
145	Jenny silty clay, 0 to 5 percent slopes	1,636	0.4
146	Karcal very cobbly clay, 0 to 9 percent slopes	5,742	1.4
147	Karcal-Ninekar complex, 0 to 9 percent slopes	53,014	12.7
148	Kinkel loam, 2 to 15 percent slopes	282	0.1
149	Kinkel loam, 30 to 50 percent slopes	378	0.1
150	Ladd sandy loam, 0 to 2 percent slopes	4,678	1.1
151	Ladd sandy loam, 2 to 9 percent slopes	7,029	1.7
152	Lakeview loam, 0 to 2 percent slopes	2,660	0.6
153	Lakeview clay loam, 2 to 5 percent slopes	362	0.1
154	Lolak silty clay loam	2,913	0.7
155	Lorella loam, 5 to 30 percent slopes	1,001	0.2
156	Lorella loam, 5 to 30 percent slopes, eroded	589	0.1
157	Lorella loam, 30 to 50 percent slopes	541	0.1
158	Lorella cobbly clay loam, 15 to 30 percent slopes	549	0.1
159	Lorella cobbly clay loam, 30 to 50 percent slopes	2,590	0.6
160	Lorella cobbly clay loam, 30 to 50 percent slopes, eroded	324	0.1
161	Lorella, deep variant-Rubble land association, steep	4,547	1.1
162	Lovejoy silt loam, 0 to 5 percent slopes	1,119	0.3
163	Lovejoy-Reba complex, 0 to 5 percent slopes	799	0.2
164	Lyonman loam, 15 to 30 percent slopes	190	(1)
165	Lyonman loam, 30 to 50 percent slopes	360	0.1
166	McQuarrie sandy loam, 5 to 30 percent slopes	7,408	1.8
167	McQuarrie stony loam, 30 to 50 percent slopes	10,097	2.4
168	Modoc sandy loam, 0 to 9 percent slopes	4,890	1.2
169	Modoc gravelly loam, 0 to 9 percent slopes	4,160	1.0
170	Ninekar very stony silt loam, 0 to 9 percent slopes	2,192	0.5
171	Packwood-Ditchcamp complex	630	0.2
172	Packwood-Rock outcrop complex	12,638	3.0
173	Pasquetti silty clay loam, partially drained	3,477	.8
174	Pasquetti silty clay loam, drained	1,606	.4
175	Pineal silt loam	2,606	0.6
176	Pit silty clay loam, 0 to 2 percent slopes	11,263	2.7
177	Pit clay, 2 to 5 percent slopes	1,053	0.3
178	Pit clay, seeped, 0 to 2 percent slopes	237	0.1

TABLE 1.—*Acreage and proportionate extent of soils*—Continued

Map symbol	Soil name	Acres	Percent	Map symbol	Soil name	Acres	Percent
179	Puls extremely stony clay loam, 0 to 9 percent slopes	3,874	0.9	191	Tandy loamy fine sand	1,988	0.5
180	Puls-Ninekar complex, sloping	1,185	0.3	192	Thoms-Exel complex	6,506	1.5
181	Puls-Rock outcrop complex, 0 to 9 percent slopes	4,330	1.0	193	Tuff outcrop-Casuse, eroded complex, 2 to 15 percent slopes	12,183	2.9
182	Reba loam, 0 to 5 percent slopes	324	0.1	194	Tuff outcrop-Casuse, eroded complex, 30 to 50 percent slopes	4,723	1.1
183	Rock outcrop-Lithic Xerorthents complex	4,300	1.0	195	Tulana mucky loam, partially drained	5,165	1.2
184	Rubble land	216	0.1	196	Tulana mucky loam, drained	1,462	0.3
185	Rumbo loam, 0 to 2 percent slopes	4,359	1.0	197	Typic Xerorthents	371	0.1
186	Rumbo loam, 2 to 5 percent slopes, eroded	885	0.2	198	Woodcock stony loam, 2 to 30 percent slopes	931	0.2
187	Salisbury very fine sandy loam, 0 to 9 percent slopes	219	0.1	199	Woodcock stony loam, 30 to 50 percent slopes	1,176	0.3
188	Salisbury gravelly loam, 0 to 9 percent slopes	3,724	0.9	200	Xerofluvents, occasionally flooded	81	[1]
189	Salisbury very cobbly loam, 0 to 9 percent slopes	485	0.1		Water	3,229	0.8
190	Salisbury clay loam, 9 to 15 percent slopes	293	0.1		Total	419,844	100.0

[1] Less than 0.1 percent.

fine, fine, and medium roots, mostly exped; common very fine tubular pores; common intersecting slickensides; strongly effervescent; lime segregated in fine irregular filaments and soft bodies; many fine white (10YR 8/1) lime mottles; moderately alkaline (pH 8.0); abrupt wavy boundary.

C1ca—39 to 47 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate coarse angular blocky; very hard, friable, sticky and plastic; few very fine and fine roots; common very fine tubular and interstitial pores; violently effervescent; lime segregated in fine irregular seams; many fine white (10YR 8/1) lime mottles; moderately alkaline (pH 8.0); abrupt smooth boundary.

C2ca—47 to 53 inches; light gray (10YR 7/1) dry and moist loam; common fine pale brown (10YR 6/3) mottles; massive; very hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and few fine tubular pores and few very fine interstitial pores; violently effervescent; disseminated lime; moderately alkaline (pH 8.0); gradual smooth boundary.

C3r—53 to 64 inches; light yellowish brown (10YR 6/4) soft calcareous siltstone that crushes to silt loam.

C4r—64 to 78 inches; light yellowish brown (10YR 6/4) soft calcareous mudstone that crushes to silty clay loam.

Depth to mudstone or siltstone is 40 to 60 inches. The soil has cracks that open and close once each year. The cracks remain open from July through October and are closed the rest of the year. Few to many intersecting slickensides are in the lower part of the A horizon. Rock fragments make up as much as 25 percent of the surface layer and are at the surface. They are mostly rounded basalt cobblestones.

The A horizon ranges from 27 to 39 inches in thickness. Both dry and moist colors are pale brown and brown to olive or dark grayish brown. The texture of the A horizon is clay or silty clay and has strong granular structure in the upper few inches and strong angular blocky or prismatic structure below that. The A horizon is mildly alkaline to moderately alkaline, and its content of carbonates increases with depth.

The Cca horizon is light gray, pale brown, or light brownish gray. It is loam, clay loam, or clay that has angular blocky or prismatic structure or is massive. The Cca horizon contains disseminated lime and lime that is segregated in seams. The Cr horizon is soft siltstone or mudstone that crushes to silt loam, loam, silty clay loam, or clay loam.

100—Ager clay, 2 to 15 percent slopes. This gently sloping to strongly sloping soil is on high terraces. One large area of this soil is west of Clover Swale. This soil has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Daphnedale loam, 2 to 9 percent slopes; making up 3 percent is a soil that is similar to Ager clay but is 20 to 40 inches deep to siltstone or mudstone; and 3 percent is Ager cobbly clay, 2 to 15 percent slopes. Also included, in the southern part of Warm Springs Valley, is a soil that is similar to Ager clay but is reddish in color.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 8 to 10 inches. The effective rooting depth is 40 to 60 inches. The fine texture of the soil limits the development of root systems.

The soil is used mostly for range. Small areas are used for small grain and irrigated grass and legume hay. Capability unit IIIe–5 (irrigated) and IVe–5 (dryland); Clayey Slopes range site; Storie Index 20.

101—Ager cobbly clay, 2 to 15 percent slopes. This gently sloping to strongly sloping soil is on high terraces in Warm Springs Valley and at the upper end of Parker Creek. It has a profile similar to the one described as representative of the series, but the surface layer contains 15 to 25 percent basalt cobbles. The cobbles are only at the soil surface.

Included with this soil in mapping and making up about 5 percent of the acreage is Delma cobbly loam, 9 to 30 percent slopes; 3 percent is Daphnedale cobbly loam, 9 to 30 percent slopes; 3 percent is Bieber gravelly loam, 0 to 9 percent slopes; and 1 percent is Ager cobbly clay, 30 to 50 percent slopes. Also included and making up 2 percent of the acreage is a soil similar to this Ager soil but reddish in color, that is in the southern part of Warm Springs Valley.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 8 to 9 inches. The effective rooting depth is 40 to 50 inches, and it is limited by the fine texture of the soil. Numerous springs are in areas of this soil.

This soil is used for range. Capability unit IVe–7 (dryland); Clayey Slopes range site; Storie Index 12.

102—Ager cobbly clay, 30 to 50 percent slopes. This steep soil is on upland side slopes between lava plateaus and old lake basins in Warm Springs Valley and near the upper part of Parker Creek. It has a profile similar to the one described as representative of the series, but 15 to 25 percent of the surface is covered with cobbles.

Included with this soil in mapping and making up about 5 percent of the acreage is Ager cobbly clay, 2 to 15 percent slopes; 3 percent is Daphnedale stony loam, 30 to 50 percent slopes; and 3 percent is a soil that is similar to Ager cobbly clay but is 20 to 40 inches deep to siltstone or mudstone.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 8 to 9 inches. The effective rooting depth is 40 to 50 inches, and it is limited by the fine texture of the soil. There are numerous springs in areas of this soil.

This soil is used for range and wildlife. Capability unit VIe–1 (dryland); Clayey Slopes range site; Storie Index 4.

Alturas Series

The Alturas series consists of moderately well drained soils on basin edges and low terraces. The soils formed in sediment derived from basic igneous rocks. They are underlain by stratified sediments. Salts have moved into these soils from lower-lying, wetter soils. The slope is 0 to 2 percent. These soils are slightly hummocky in places. The elevation ranges from 4,100 to 4,800 feet. Precipitation is 8 to 15 inches, average annual air temperature is 46° to 49° F, and the frost-free period is 80 to 130 days. Vegetation is grass and shrubs. It consists mainly of saltgrass, alkali meadowgrass, squirreltail, cheatgrass, and rabbitbrush.

In a representative profile the surface layer is gray, moderately alkaline silt loam, loam, and clay loam about 17 inches thick. It contains soluble salts. The subsoil is dark gray, grayish brown, and dark brown moderately alkaline heavy clay loam about 25 inches thick. The substratum, to a depth of 60 inches or more, is grayish brown and light brownish gray, very weakly cemented, mottled, moderately alkaline gravelly loam and gravelly sandy loam.

Permeability is slow, and the available water capacity is 9 to 10 inches. The effective rooting depth is more than 60 inches. This soil has a perched water table at a depth of 30 to 60 inches in spring. Runoff is ponded, and the erosion hazard is slight.

Alturas soils are used for irrigated and dryland pasture and range and, in small areas, for small grain.

Representative profile of Alturas loam, on a basin edge in a dryland pasture about 5 miles south of Davis Creek, or 1.4 miles west on County Road 209 from Highway 395 to railroad tracks, 0.2 mile west on a dirt road, and 102 feet south of east-west fence in SW¼ SE¼ sec. 12, T. 44 N., R. 13 E.

A11—0 to 2 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium and thick platy structure; hard, friable, sticky and slightly plastic; common very fine and very few fine roots; common very fine tubular pores; violently effervescent; disseminated lime; moderately alkaline (pH 8.0); clear smooth boundary.

A12—2 to 10 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and slightly plastic; common very fine and very few fine roots; few very fine tubular pores; bleached sand grains; violently effervescent; disseminated lime; moderately alkaline (pH 8.0); clear smooth boundary.

A13—10 to 17 inches; gray (10YR 6/1) clay loam, very dark gray (10YR 3/1) moist; weak medium and coarse angular blocky structure; hard, very friable, sticky and slightly plastic; common very fine and very few fine roots; common very fine tubular pores; bleached sand grains; violently effervescent; disseminated lime; moderately alkaline (pH 8.0); clear wavy boundary.

B21t—17 to 22 inches; dark gray (10YR 4/1) heavy clay loam, very dark gray (10YR 3/1) moist; moderate very fine and fine prismatic structure parting to fine and medium angular blocky; very hard, very friable, sticky and plastic; few very fine and very few fine roots; common very fine and fine tubular pores and very few very fine interstitial pores; many thin clay films lining pores; upper part of horizon is degrading; strongly effervescent; disseminated lime; moderately alkaline (pH 8.0); clear smooth boundary.

B22tca—22 to 30 inches; grayish brown (10YR 5/2) heavy clay loam, dark grayish

brown (10YR 4/2) moist; moderate fine and medium prismatic structure parting to fine and medium angular blocky; hard, very friable, sticky and plastic; few very fine and very few fine roots; very few very fine tubular pores; many thin clay films on peds and lining pores; violently effervescent; irregular soft bodies of segregated lime; moderately alkaline (pH 8.0); clear smooth boundary.

B3tca—30 to 42 inches; dark brown (10YR 4/3) heavy clay loam, dark brown (10YR 3/3) moist; massive; hard, very friable, sticky and plastic; very few very fine roots; few very fine tubular and interstitial pores; many moderately thick clay films lining pores; violently effervescent; fine rounded soft bodies of segregated lime; moderately alkaline (pH 8.0); clear irregular boundary.

IIC1—42 to 50 inches; grayish brown (10YR 5/2) gravelly heavy loam, dark brown (10YR 3/3) moist; common fine distinct mottles of yellowish brown (10YR 5/6); massive; slightly hard, very friable, slightly sticky and slightly plastic; very few very fine roots; common very fine interstitial and few very fine tubular pores; many thin colloidal stains on mineral grains; 15 percent, by volume, rounded gravel; very weakly cemented; slightly effervescent; fine rounded soft bodies of segregated lime; moderately alkaline (pH 8.0); clear smooth boundary.

IIIC2—50 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sandy loam, very dark grayish brown (2.5Y 3/2) moist; few fine distinct mottles of dark brown (10YR 3/3) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; many very fine interstitial pores and very few very fine tubular pores; common thin colloidal stains on mineral grains; 30 percent, by volume, rounded gravel; weakly cemented; slightly effervescent; fine rounded soft bodies of segregated lime; moderately alkaline (pH 8.0).

Durinodes or weakly cemented horizons, or both, are at a depth of about 40 to 50 inches.

The A horizon, when dry, is gray or grayish brown in the upper 10 inches and light gray, gray, light brownish gray, or grayish brown in the lower part, all in hue of 10YR. When moist it is very dark grayish brown, very dark gray, very dark brown, or black, all in hue of 10YR. It is loam, silt loam, clay loam, or silty clay loam. The A horizon has platy, subangular blocky structure, or it is massive. Salinity is highest in the A horizon, and the electrical conductivity is 2 to 8 millimhos per centimeter at 25° C.

The Bt horizon, when dry, is brown, grayish brown, dark grayish brown, gray, or dark gray, all in hue of 10YR. When moist, it is brown and dark gray and ranges to black. It is heavy clay loam, silty clay loam, or clay that has moderate or strong prismatic structure or is massive. The consistence is very hard or hard, very friable to very firm, sticky or very sticky, and plastic or very plastic. Reaction ranges from moderately alkaline to strongly alkaline. Exchangeable sodium is more than 15 percent in some places. Lime accumulates in the lower part of the B horizon.

The IIC horizon, when dry, is pale brown, light brownish gray, grayish brown, or brown, and when moist it is dark brown, very dark grayish brown, or very dark brown, all in hue of 10YR or 2.5YR. It is gravelly loamy coarse sand, loamy fine sand, sandy loam, or loam, and is stratified. The content of gravel is as much as 25 percent. The IIC horizon is weakly cemented in the lower part, or is less than 20 percent durinodes, by volume, or both. The water table or mottling is below a depth of 30 inches.

103—Alturas loam. This is a nearly level soil that commonly is on basin edges and low terraces. Salts have moved into the soil from lower lying, wetter soils.

Included with this soil in mapping and making up about 5 percent of the acreage is Rumbo loam, 0 to 2 percent slopes, and 5 percent is a soil that is similar to this Alturas soil but has a brittle horizon within 40 inches of the surface. This brittle horizon is at least 6 inches thick and is firm when moist, but it is not a hardpan. Also included and making up 3 percent of the acreage is Buntingville clay loam, 0 to 2 percent slopes; about 1 percent is Barnard gravelly loam, 0 to 9 percent slopes; and 1 percent is Salisbury gravelly loam, 0 to 9 percent slopes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated and dryland pasture, range, and small grain. Because it is moderately affected by alkali salts, this soil should be reclaimed before alkali-sensitive crops are planted. If reclaimed, this soil can be used for irrigated hay. Capability unit IIIw–6 (irrigated and dryland); Alkali Terrace range site; Storie Index 32.

Balman Series

The Balman series consists of somewhat poorly drained and poorly drained soils on basin edges and low lake terraces. The soils formed in alluvium derived from basic igneous rocks. The slope is 0 to 2 percent, and the surface is hummocky. The elevation ranges from 4,250 to 4,400 feet. Annual rainfall is 10 to 12 inches, average annual air temperature is 46° to 48° F, and the frost-free period is 80 to 90 days. The vegetation consists mainly of saltgrass, alkali meadowgrass, and greasewood.

In a representative profile the surface layer is light brownish gray, very strongly alkaline loam and light gray, strongly alkaline loam about 13 inches thick. The underlying material, to a depth of 24 inches, is light gray, moderately alkaline clay loam. Below this, to a depth of 60 inches or more, it is light gray, moderately alkaline fine sandy loam.

Permeability is moderately slow, and the available water capacity is 7.5 to 9.5 inches.

Balman soils are used for range and pasture, and for wildlife habitat.

Representative profile of Balman loam, on a nearly level, hummocky basin edge 315 feet north of east-

west fence and 600 feet east of north-south fence, 5 miles south of Alturas on the east side of old Highway 395 in SW¼NW¼ sec. 6, T. 41 N., R. 13 E.

A11ca—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark brown (10YR 4/3) moist; weak coarse platy structure; slightly hard, friable, sticky and plastic; common very fine and few fine roots; few fine tubular pores; violently effervescent; disseminated lime; very strongly alkaline (pH 9.4); clear smooth boundary.

A12ca—4 to 13 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; massive; hard, friable, very sticky and plastic; few very fine and fine roots; many very fine interstitial pores; few very fine tubular pores; violently effervescent; disseminated lime; strongly alkaline (pH 8.8); gradual smooth boundary.

C1ca—13 to 24 inches; light gray (10YR 7/2) clay loam, brown (10YR 5/3) moist; massive; hard, very friable, very sticky and plastic; weakly cemented; very few very fine roots; many very fine interstitial pores and few fine tubular pores; violently effervescent; disseminated lime; moderately alkaline (pH 8.0); abrupt smooth boundary.

C2—24 to 40 inches; light gray (10YR 7/2) fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, sticky and slightly plastic; many very fine interstitial pores and common very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline (pH 8.0); abrupt smooth boundary.

C3—40 to 60 inches; light gray (10YR 7/2) fine sandy loam, pale brown (10YR 6/3) moist; massive; hard, friable, sticky and slightly plastic; weakly cemented; many very fine interstitial pores and common very fine tubular pores; slightly effervescent; disseminated lime; moderately alkaline (pH 8.0).

The soil is moistened by capillary rise from a fluctuating water table and by precipitation.

The A horizon is 9 to 15 inches thick. The dry soil material is light gray, gray, light brownish gray, or grayish brown; moist material is dark grayish brown, grayish brown, or brown. Texture ranges from fine sandy loam to loam. The horizon has weak platy structure or is massive. Reaction is strongly alkaline or very strongly alkaline, and alkalinity decreases with increasing depth.

The C horizon when dry is gray, light gray, or light brownish gray, and when moist it is dark grayish brown, very dark grayish brown, brown, pale brown, or dark brown. It is sandy loam, loam, or clay loam. In some places, the C horizon is weakly cemented with lime and silica, but this horizon is very friable or friable when moist.

104—Balman loam. This is a nearly level, somewhat poorly drained soil on hummocky basin edges and low lake terraces in the areas of New Pine Creek, the Likely Basin, and Rattlesnake Creek. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 8 percent of the acreage is Balman loam, wet; 3 percent is Pineal silt loam; and 3 percent is Modoc gravelly loam, 0 to 9 percent slopes.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is 6 to 7 inches. The water table is at a depth of 48 to 72 inches, but it fluctuates with the irrigation of the surrounding soils. The water table limits the rooting depth of most locally grown crops. This soil is flooded for as long as a month in spring. The soil is slightly to strongly affected by salts or alkali, or both.

This soil is used for range, pasture, and wildlife habitat. Capability unit IIIw–6 (dryland); Alkali Terrace range site; Storie Index 7.

105—Balman loam, wet. This is a nearly level, poorly drained soil on basin rims on the south edge of Pine Creek Basin. It is lower on the landscape than Balman loam. It has a profile similar to the one described as representative of the series, except the surface layer is 3 to 5 inches thick and is clay loam in places, and the soil is poorly drained.

Included with this soil in mapping and making up about 8 percent of the acreage is Pineal silt loam; 5 percent is Buntingville clay loam, 0 to 2 percent slopes; and 3 percent is Balman loam.

Runoff is very slow, and there is no hazard of erosion. Available water holding capacity is 4 to 6 inches. The water table is at a depth of 24 to 40 inches, but it fluctuates with irrigation of the surrounding soils. The rooting depth of most locally grown crops is limited by the water table. There is up to a month of flooding in spring. A pronounced accumulation of water-soluble salts is near the surface.

This soil is used for range, pasture, and wildlife habitat. Capability unit IIIw–6 (dryland); Alkali Terrace range site; Storie Index 4.

Barnard Series

The Barnard series consists of well drained soils on old terraces. The soils have a silica-cemented hardpan. They formed in alluvium derived from basic igneous rocks. The slope ranges from 0 to 15 percent. The elevation ranges from 4,300 to 4,800 feet. Annual rainfall is 10 to 14 inches, average annual air temperature is 46° to 48° F, and the frost-free period is 70 to 80 days. The vegetation is shrubs and grasses and consists mainly of big sagebrush, rabbitbrush, cheatgrass, mustard, and bluebunch wheatgrass.

In a representative profile the surface layer is grayish brown, neutral gravelly loam about 7 inches thick. The subsoil is dark brown, neutral heavy clay loam and dark reddish gray, neutral clay about 15 inches thick. The substratum is brown, mildly alkaline, cobbly heavy clay loam 14 inches thick. A silica-cemented hardpan that has thin, continuous laminar layers is at a depth of 36 inches.

Permeability is slow. The effective rooting depth is 26 to 40 inches.

Barnard soils are used for range, pasture, irrigated

alfalfa, and some dryland grain. They are suitable for irrigated grass and legume hay and irrigated small grain.

Representative profile of Barnard gravelly loam, 0 to 9 percent slopes, on an old terrace at a point 0.4 mile east of Highway 395 on Highway 299 toward Cedarville and 39 feet north of the north highway fence in SW¼NE¼ sec. 27, T. 43 N., R. 13 E.

A11—0 to 2 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine interstitial pores and few very fine tubular pores; 15 percent pebbles, by volume; neutral (pH 6.8); clear smooth boundary.

A12—2 to 7 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine interstitial pores and few very fine tubular pores; 16 percent pebbles, by volume; neutral (pH 6.8); gradual smooth boundary.

B1t—7 to 10 inches; dark brown (7.5YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) moist; strong medium angular blocky structure; hard, friable, sticky and plastic; common very fine roots and few very fine roots on ped faces; common very fine tubular pores and few very fine interstitial pores; common moderately thick clay films on peds and few moderately thick clay films in pores; neutral (pH 6.6); gradual smooth boundary.

B2t—10 to 22 inches; dark reddish gray (5YR 4/2) clay, dry and moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, very friable, sticky and very plastic; common very fine roots on ped faces; few very fine tubular pores; few thin clay films in pores; few intersecting slickensides and numerous pressure faces; neutral (pH 7.0); gradual wavy boundary.

C1—22 to 36 inches; brown (7.5YR 5/4) cobbly heavy clay loam, dark brown (7.5YR 4/4) moist; massive; hard, very friable, sticky and plastic; few fine interstitial pores; few thin clay films bridging sand grains; 25 percent cobbles and pebbles, by volume; slightly effervescent; soft masses of lime; mildly alkaline (pH 7.8); clear wavy boundary.

C2sim—36 to 47 inches; brown (7.5YR 5/4) cobbly sandy clay loam, dry and moist; massive; very firm; common fine interstitial pores; strongly cemented with silica; opal coatings on cobbles and pebbles; silica partly filling interstices and bridging sand grains; 20 percent cobbles and pebbles, by volume; mildly alkaline (pH 7.5); abrupt smooth boundary.

C3sim—47 to 68 inches; light brown (7.5YR 6/4) hardpan, brown (7.5YR 5/4) moist; common medium distinct reddish yellow (7.5YR 6/6) mottles, dark brown (7.5YR 4/4) moist; massive; 1/16-inch thick seams of light yellowish brown (10YR 6/4) discontinuous opal lamellae bands dry and moist; cobbles and pebbles have opal coatings; mildly alkaline (pH 7.5).

Depth to the hardpan ranges from 26 to 40 inches. The solum is 20 to 30 inches thick.

The A horizon is 6 to 10 inches thick. It is dark grayish brown to brown in hue of 10YR. It is gravelly loam, cobbly loam, or clay loam. Where it is loam, it is 15 percent pebbles, by volume. Reaction is slightly acid or neutral.

The Bt horizon ranges from 14 to 20 inches in thickness. It has dry colors of dark grayish brown to dark yellowish brown, grayish brown to yellowish brown, reddish gray, dark reddish gray, or reddish brown. It has moist colors of very dark grayish brown to dark yellowish brown or dark reddish gray to dark reddish brown. It is heavy clay loam, cobbly silty clay, silty clay, or clay that has moderate or strong angular blocky or prismatic structure. Cobbles, where they are present, make up about 20 percent of this horizon, and pebbles make up about 10 percent. Reaction is neutral or mildly alkaline. In some places the Bt horizon is slightly effervescent in the lower part.

The Csim horizon is within a depth of 40 inches and contains continuous and discontinuous silica lamellae. The continuous lamellae are in the upper part. Where there are no silica lamellae, silica coatings fill the interstices. Coarse fragments make up as much as 30 percent of the volume.

106—Barnard gravelly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is commonly on older terraces and alluvial fans throughout Warm Springs Valley and the Alturas Basin. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 4 percent of the acreage is Bieber gravelly loam, 0 to 9 percent slopes; 4 percent is Modoc gravelly loam, 0 to 9 percent slopes; 3 percent is Ladd sandy loam, 0 to 2 percent slopes; and about 2 percent is a soil that is similar to this Barnard soil but has a weakly cemented hardpan.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 4.0 to 5.5 inches.

This soil is used for range and pasture and, in small areas, for irrigated alfalfa and dryland grain. It is suitable for irrigated grain. Capability unit IIIe–3 (irrigated) and IVe–3 (dryland); Dry Loamy range site; Storie Index 20.

107—Barnard cobbly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is commonly on older terraces and alluvial fans throughout Warm Springs Valley and the Alturas Basin. The mapped areas are small and are irregular in shape. This soil has a profile similar to the one described as

representative of the series, except the surface has 25 to 35 percent, by volume, cobbles.

Included with this soil in mapping and making up about 10 percent of the acreage is Barnard gravelly loam, 0 to 9 percent slopes, and 3 percent is Bieber gravelly loam, 0 to 9 percent slopes. Also included are areas of a Barnard soil that has a surface layer of very cobbly clay loam.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 3.5 to 4.5 inches. The surface cobbles make cultivation impractical.

This soil is used for range. Capability unit VIs–1 (dryland) ; Dry Loamy range site; Storie Index 20.

108—Barnard clay loam, 9 to 15 percent slopes. This strongly sloping soil is commonly on older alluvial fans throughout Warm Springs Valley and the Alturas Basin. The mapped areas are small and irregular in shape. This soil has a profile similar to the one described as representative of the series, but the surface layer is clay loam.

Included with this soil in mapping and making up about 6 percent of the acreage is Barnard gravelly loam, 0 to 9 percent slopes; and 6 percent is Daphnedale cobbly loam, 9 to 30 percent slopes. Also included are some areas of a Barnard soil that has a surface layer of heavy loam.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 5 to 6 inches. Because of the slope, careful management is needed to prevent erosion.

This soil is used for range and for irrigated forage crops and irrigated grain crops. It is suited to dryland pasture. Capability unit IVe–3 (irrigated) and IVe–3 (dryland) ; Dry Loamy range site; Storie Index 22.

Bieber Series

The Bieber series consists of well drained soils on old terraces. These soils have a silica-cemented hardpan. They formed in alluvium derived from basic igneous rocks. The slope ranges from 0 to 15 percent. The elevation ranges from 4,300 to 5,000 feet. Annual rainfall is 10 to 14 inches, average temperature is 47° to 49° F, and the frost-free period is 70 to 80 days. Vegetation is brush and grass. It consists of low sagebrush, lupine, cheatgrass, alfilaria, mustard, Idaho fescue, bluegrass, and scattered western juniper.

In a representative profile the surface layer is grayish brown, slightly acid gravelly loam about 6 inches thick. The subsoil is dark grayish brown, slightly acid clay loam and dark brown, neutral clay about 12 inches thick. An indurated silica-cemented hardpan is at a depth of 18 inches.

Permeability is slow.

Bieber soils are used for range and pasture and, in small areas, for dryland rye hay. They are suitable for irrigated grass and legume hay or pasture and irrigated small grain.

Representative profile of Bieber gravelly loam, 0 to 9 percent slopes, on an old terrace 400 feet east and 920 feet south of the center of the NW¼SE¼ sec. 27, T. 42 N., R. 13 E.

A1—0 to 6 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine interstitial and tubular pores; 15 percent pebbles, by volume; slightly acid (pH 6.5) ; clear smooth boundary.

B1t—6 to 13 inches; dark grayish brown (10YR 5/2) clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; hard, very friable, sticky and slightly plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; common thin clay films in pores and on peds; 15 percent pebbles, by volume; slightly acid (pH 6.5) ; abrupt smooth boundary.

B2t—13 to 18 inches; dark brown (7.5YR 4/4) clay, dry and moist; strong coarse angular blocky structure; very hard, very friable, very sticky and plastic; few very fine interstitial pores and few very fine tubular pores; 15 percent pebbles, by volume, concentrated in the upper part; white (N 8/0) silica coatings, dry and moist, on bottom of pebbles; continuous thick clay films on peds and many moderately thick clay films lining pores; neutral (pH 7.0) ; abrupt smooth boundary.

IIC1sim—18 to 22 inches; light brown (7.5YR 6/4) moderately thick indurated hardpan; continuous caps on the top of horizon 1 to 2 millimeters thick underlain by cemented bands 1 to 2 centimeters apart; 40 percent rounded pebbles, by volume; strongly effervescent; fine filaments of lime; abrupt smooth boundary.

IIC2sim—22 to 60 inches; light brown (7.5YR 4/4) massive indurated hardpan; 60 percent rounded pebbles and 10 percent cobbles, by volume; strongly effervescent; lime and silica pendants on underside of coarse fragments.

Depth to the hardpan is 8 to 20 inches. In some areas of hummocky microrelief, this range occurs within a short distance. Depth to stratified gravelly and cobbly alluvium is about 16 to more than 60 inches. The profile above the hardpan consists of as much as 25 percent, by volume, rock fragments that are mostly pebbles. There are few cobbles.

The A horizon ranges from 2 to 8 inches in thickness. It has dry colors of brown to dark grayish brown and moist colors of dark brown or very dark grayish brown. It is sandy loam to clay loam that has weak or moderate platy, granular, or subangular blocky structure. Consistence is slightly hard or hard and friable or very friable. Reaction is slightly acid or neutral.

The B1t horizon has color and consistence similar to the A1 horizon. It is clay loam or heavy clay loam that has moderate or weak angular blocky or platy structure. It is slightly acid or medium acid.

The B2t horizon ranges from 4 to 8 inches in thickness. It has dry colors of light yellowish brown to dark yellowish brown and moist colors of dark brown or

dark yellowish brown. Hue is 10YR or 7.5YR. The B2t horizon is clay or heavy clay loam that has strong or moderate prismatic or strong angular blocky structure. It is very sticky or sticky. Reaction is slightly acid to moderately alkaline.

The hardpan is slightly acid to moderately alkaline, and in some places the hardpan has filaments and coatings of lime.

109—Bieber gravelly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is commonly on old terraces throughout Warm Springs Valley and the Alturas Basin. It has the profile described as representative of the series (fig. 1).

Included with this soil in mapping and making up about 3 percent of the acreage is Barnard gravelly loam, 0 to 9 percent slopes; 2 percent is Daphnedale-Delma loams, 2 to 9 percent slopes; 2 percent is Lovejoy silt loam, 0 to 5 percent slopes; 1 percent is a soil that is similar to the Bieber soil but that has a weakly cemented hardpan; and 1 percent is Casuse sandy loam, 2 to 9 percent slopes. In the Pine Creek area, Pineal silt loam makes up 2 percent of this unit.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is 2 to 3 inches. Effective rooting depth is 8 to 20 inches.

This soil is used for range and for dryland pasture and small grains (fig. 2). It is suitable for irrigated pasture and small grain. Capability unit IVe–3 (irrigated) and VIe–1 (dryland); Hardpan Terrace range site; Storie Index 11.

110—Bieber gravelly loam, 9 to 15 percent slopes. This strongly sloping soil is commonly on terrace breaks. A large area of this soil is at the mouth of Pine Creek. This soil has a profile similar to the one described as representative of the series, but the surface layer is about 30 percent gravel, by volume.

Included with this soil in mapping and making up about 5 percent of the acreage is Bieber gravelly loam, 0 to 9 percent slopes; 2 percent is Daphnedale cobbly loam, 9 to 30 percent slopes; and 2 percent is Barnard clay loam, 9 to 15 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 2 to 3 inches. Effective rooting depth is 8 to 20 inches. The more steeply sloping areas of this map unit require a high degree of management.

This soil is used for range and is suitable for irrigated pasture or hay grown in a rotation with irrigated small grain. Capability unit IVe–3 (irrigated) and VIe–1 (dryland); Hardpan Terrace range site; Storie Index 8.

111—Bieber cobbly loam, 2 to 15 percent slopes, eroded. This gently sloping to strongly sloping soil is commonly on terraces. It has a profile similar to the one described as representative of the series, except the depth to an indurated hardpan is less. About 30 percent of the original surface layer has been removed. In these areas the relief consists of mounds that are 2 to 20 feet in width and interspersed with depressions. Numerous grass plants are pedestalled because of soil movement. The entire profile is about 20 percent cobbles, by volume.

Included with this soil in mapping and making up about 5 percent of the acreage is a Thoms very cobbly loam and an Exel loam that has 0 to 9 percent slopes; 3 percent is Bieber gravelly loam, 0 to 9 percent slopes; and 3 percent is Daphnedale cobbly loam, 9 to 30 percent slopes.

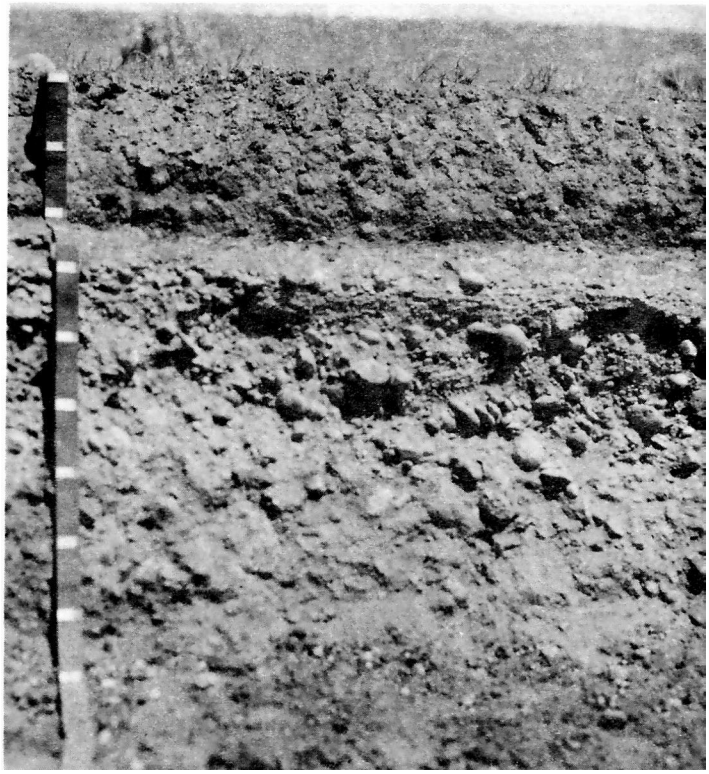

Figure 1.—**Profile of Bieber gravelly loam, 0 to 9 percent slopes. White markings are 6 inches apart.**

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 2 to 3 inches. Effective rooting depth is 8 to 16 inches.

This soil is used for range. Capability unit VIIe–1 (dryland); Hardpan Terrace range site; Storie Index 8.

Buntingville Series

The Buntingville series consists of somewhat poorly drained soils on alluvial fans. These soils formed in loamy alluvium derived mainly from basic igneous rocks such as tuff and basalt. They are underlain by loamy alluvium. The slope ranges from 0 to 9 percent. The elevation ranges from 4,300 to 4,400 feet. Annual rainfall is 12 to 14 inches, average annual air temperature is 48° to 50° F, and the frost-free season is 90 days. Vegetation is mostly grass and consists of giant wildrye, bluegrass, cheatgrass, medusahead, mustard, and scattered big sagebrush.

In a representative profile the surface layer is dark gray, slightly acid clay loam about 7 inches thick. The subsoil is very dark gray, dark gray, and grayish brown, mottled, neutral and mildly alkaline clay loam about 44 inches thick. Below the subsoil and extending to a depth of 60 inches or more is an old, buried soil that is light brownish gray, mildly alkaline clay loam.

Permeability is moderately slow, and available water capacity is 9.5 to 11 inches. The effective rooting

Figure 2.—**An area of Bieber gravelly loam, 0 to 9 percent slopes, in a recently cultivated field. This soil is commonly planted to dryland wheatgrass.**

depth is more than 60 inches during the growing season. The water table fluctuates between a depth of 3 and 5 feet and is subject to frequent, brief periods of overflow from February to May.

Buntingville soils are used for irrigated pasture, alfalfa, and mixed grass and legume hay. In some areas, they are used for dryland pasture. These soils are suitable for dryland and irrigated small grain.

Representative profile of Buntingville clay loam, 0 to 2 percent slopes, on a nearly level alluvial fan, 0.4 mile southwest on old Highway 139 from Modoc National Forest sign, 230 feet west of the center of old Highway 139, and 3 feet southwest of the southeast-northwest fence in NE¼SW¼ sec. 22, T. 42 N., R. 9 E.

A11—0 to 3 inches; dark gray (10YR 4/1) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; common fine interstitial pores and few fine tubular pores; slightly acid (pH 6.5) ; abrupt smooth boundary.

A12—3 to 7 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; hard, very friable, sticky and slightly plastic; many microroots and common very fine and fine roots; common very fine tubular pores and few fine interstitial pores; slightly acid (pH 6.5) ; clear smooth boundary.

B21t—7 to 18 inches; dark gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; few fine interstitial pores and few very fine and fine tubular pores; few thin clay films in pores and on peds; neutral (pH 7.0) ; gradual smooth boundary.

B22t—18 to 32 inches; very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; strong medium and coarse subangular structure; very hard, friable, sticky and plastic; few fine roots; few fine interstitial pores and common very fine tubular pores; few thin clay films in pores and

on peds; fine rounded soft masses of gypsum; neutral (pH 7.0); abrupt smooth boundary.

B3t—32 to 51 inches; grayish brown (2.5Y 5/2) sandy clay loam, very dark grayish brown (2.5Y 3/2) moist; common fine distinct brownish yellow (10YR 6/6) mottles; massive; hard, very friable, slightly sticky and slightly plastic; few very fine roots; many fine interstitial pores and very few very fine tubular pores; continuous clay lamellae ½- to 1-inch thick; strongly effervescent; irregular filaments and seams of lime; mildly alkaline (pH 7.5); abrupt smooth boundary.

B2tb—51 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few very fine tubular pores; common thin clay films on peds and in pores; mildly alkaline (pH 7.5).

The solum ranges from 27 to 39 inches in thickness. The upper 10 to 20 inches is free of carbonates, but carbonates are below a depth of 20 inches in places. Distinct mottles are in or immediately below the mollic epipedon. The fine gravel content is 0 to 2 percent, by volume, throughout the profile.

The A horizon ranges from 5 to 10 inches in thickness. It has dry colors of dark gray and moist colors of very dark gray or very dark grayish brown. It is loam or clay loam and has weak to strong granular or subangular blocky structure. Reaction is slightly acid or neutral.

The B horizon ranges from 39 to 51 inches in thickness. It has hue of 10YR and 2.5Y. The B horizon has dry colors of gray to very dark gray and grayish brown to very dark grayish brown and moist colors of very dark gray to black and very dark grayish brown to very dark brown. It is clay loam, loam, or sandy clay loam that has weak to strong, fine to coarse subangular blocky or prismatic structure. A buried horizon or a C horizon is below the B horizon.

112—Buntingville clay loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans slightly above and along the Pit River and its tributaries. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 4 percent of the acreage is Pit silty clay loam, 0 to 2 percent slopes; 3 percent is Alturas loam; 3 percent is Lakeview loam, 0 to 2 percent slopes; and 2 percent is a soil that is similar to this Buntingville soil but that has a higher content of clay in the subsoil. Where gullies have cut through the soil, there are small areas that are drained and that do not have a water table.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated pasture, alfalfa and mixed grass and legume hay, and, in small areas, for small grain. Capability unit IIIw–2 (irrigated); not placed in a range site; Storie Index 65.

113—Buntingville clay loam, 2 to 9 percent slopes. This gently sloping to moderately sloping soil is on alluvial fans throughout the survey area.

Included with this soil in mapping and making up about 6 percent of the acreage is Barnard very cobbly loam, 0 to 9 percent slopes; 3 percent is Pasquetti silty clay loam, drained; and 3 percent is Pit silty clay loam, 0 to 2 percent slopes. Also included are some areas of Buntingville soils that have a surface layer of loam or that are 5 to 10 percent gravel, by volume. Where gullies have cut through the soil, there are small areas that are drained and that do not have a high water table.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for dryland barley, wheat, and pasture and for irrigated mixed grass and legume and alfalfa hay. Capability unit IIIe–1 (irrigated) and IVe–1 (dryland); not placed in a range site; Storie Index 58.

Calimus Series

The Calimus series consists of well drained soils on alluvial fans. These soils formed in alluvium derived from basalt, andesite, and obsidian rocks. The slope ranges from 0 to 9 percent. The elevation ranges from 4,700 to 4,900 feet. Annual rainfall is 14 to 16 inches, average annual air temperature is 47° to 49° F, and the frost-free period is 90 to 100 days. Vegetation is shrubs and grasses. It consists of big sagebrush, bitterbrush, bluebunch wheatgrass, Idaho fescue, and cheatgrass.

In a representative profile the surface layer is grayish brown, slightly acid gravelly loam and dark grayish brown, slightly acid clay loam about 20 inches thick. To a depth of 37 inches the underlying material is dark brown, slightly acid loam, and to a depth of 60 inches or more it is brown, slightly acid very gravelly loamy sand.

Permeability is moderate, and available water capacity is 7 to 10 inches. The effective rooting depth is more than 60 inches.

Calimus soils are used for irrigated alfalfa and grass and legume hay.

Representative profile of Calimus gravelly loam, 2 to 5 percent slopes, on a gently sloping alluvial fan, 0.5 mile south of the Oregon State line and 0.3 mile west of U.S. Highway 395, 138 feet north of center of east-west road and 70 feet west of center of north-south road in the NE¼SW¼ of sec. 24, T. 48 N., R. 14 E.

A11—0 to 9 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots and common very fine roots; common fine interstitial pores and common very fine tubular pores; 15 percent gravel, by volume; slightly acid (pH 6.5); gradual smooth boundary.

A12—9 to 20 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium sub-

angular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine and fine roots; common fine interstitial pores and common very fine and fine tubular pores; 10 percent gravel, by volume; slightly acid (pH 6.3); gradual smooth boundary.

C1—20 to 37 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common fine interstitial pores and common very fine tubular pores; very few thin clay films bridging sand grains; 10 percent gravel, by volume; krotovina 4 inches in diameter; slightly acid (pH 6.3); clear wavy boundary.

IIC2—37 to 60 inches; brown (10YR 5/3) very gravelly loamy sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; many fine interstitial pores and very few fine tubular pores; 60 percent rounded gravel, by volume; slightly acid (pH 6.5).

The A horizon ranges from 20 to 26 inches in thickness. Hue is 10YR. The A horizon has dry colors of gray, dark gray, grayish brown, or dark grayish brown and moist colors of very dark gray, black, very dark grayish brown, or very dark brown. It is gravelly loam, loam, or clay loam. Reaction ranges from slightly acid through neutral.

The C horizon has hue of 10YR and 7.5YR. It has dry colors of dark brown or brown and moist colors of very dark grayish brown, very dark brown, or dark brown. It is gravelly sandy clay loam, loam, or gravelly clay loam. Reaction ranges from slightly acid through mildly alkaline. In places, the lower part of the C horizon is slightly effervescent with disseminated lime.

Depth to the IIC horizon is more than 36 inches. In places the IIC horizon is stratified with finer-textured material.

114—Calimus loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is loam.

Included with this soil in mapping and making up about 5 percent of the acreage is Donica gravelly clay loam, 2 to 9 percent slopes; 3 percent is Drews loam, 0 to 5 percent slopes; and 2 percent is a soil that is similar to this Calimus soil but that is strongly calcareous in the lower part of the surface layer and in the underlying material.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated alfalfa, mixed grass and legume hay, and, in small areas, for small grain. Capability unit IIIc–1 (irrigated); not placed in a range site; Storie Index 100.

115—Calimus loam, 2 to 9 percent slopes. This gently to moderately sloping soil is on alluvial fans in the area of New Pine Creek. It has a profile similar to the one described as representative of the series, but the surface layer is loam.

Included with this soil in mapping and making up about 7 percent of the acreage is Donica gravelly clay loam, 2 to 9 percent slopes. Making up 5 percent is Calimus gravelly loam, 2 to 5 percent slopes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated alfalfa, mixed grass and legume hay, and, in small areas, for small grain. Capability unit IIIe–1 (irrigated); not placed in a range site; Storie Index 95.

116—Calimus gravelly loam, 2 to 5 percent slopes. This gently sloping soil is on alluvial fans in the area of New Pine Creek. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Donica gravelly clay loam, 2 to 9 percent slopes; 3 percent is Drews loam, 0 to 5 percent slopes; 3 percent is Drews gravelly loam, 0 to 9 percent slopes; and about 2 percent is a soil, generally on the lower part of the alluvial fans, that is similar to this Calimus soil but that is strongly calcareous in the lower part of the surface layer and in the underlying material.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated alfalfa, mixed grass and legume hay, and pasture. Capability unit IIIe–1 (irrigated); not placed in a range site; Storie Index 63.

117—Calimus clay loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans near the edge of Goose Lake. It has a profile similar to the one described as representative of the series, except the surface layer is clay loam, and carbonates are in the lower part of the underlying material.

Included with this soil in mapping and making up about 5 percent of the acreage is Calimus loam, 0 to 2 percent slopes; 3 percent is Pit silty clay loam, 0 to 2 percent slopes; and 2 percent is Drews clay loam, wet, 0 to 2 percent slopes. In places an intermittent perched water table is at a depth of 48 inches for short periods.

Runoff is slow, and the hazard of erosion is slight. This soil receives runoff from higher areas.

This soil is used for irrigated mixed grass and legume and alfalfa hay and for irrigated pasture. It is also suitable for small grain. Capability unit IIIc–1 (irrigated); not placed in a range site; Storie Index 85.

Casuse Series

The Casuse series consists of well drained soils on terraces and highly dissected escarpments. The soils formed in material that was weathered from the underlying, weakly cemented tuff. The tuff is high in content of ash and pumice. The slope ranges from 2 to 50 percent. The elevation ranges from 4,300 to 4,700 feet. Annual rainfall is 8 to 14 inches, average annual air temperature is 46° to 50° F, and the frost-free period is 80 to 90 days. Vegetation is junipers, shrubs, and grasses. It consists of western juniper, big sagebrush, rabbitbrush, Canby bluegrass, Sandberg bluegrass, squirreltail, cheatgrass, and wild buckwheat. Numerous chimney rocks are in areas of these soils.

In a representative profile the surface layer is brown, medium acid sandy loam about 2 inches thick. The subsoil is brown, slightly acid and neutral clay loam

about 10 inches thick. Weakly cemented tuff is at a depth of 12 inches.

Permeability is moderate.

Casuse soils are used for range, wildlife habitat, and, in small areas, for dryland wheatgrass and cereal rye.

Representative profile of Casuse sandy loam, 2 to 9 percent slopes, on a high terrace 100 feet south of dirt road, 0.35 mile west of reservoir, and 2.1 miles west of West Side Road in NE¼NE¼ of sec. 17, T. 41 N., R. 12 E.

A1—0 to 2 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; moderate medium platy structure; soft, very friable, slightly sticky and slightly plastic; common very fine tubular pores, few very fine vesicular pores, and few very fine interstitial pores; medium acid (pH 5.8); abrupt smooth boundary.

B1—2 to 8 inches; brown (7.5YR 5/4) clay loam; dark brown (7.5YR 4/4) moist; massive; hard, very friable, sticky and slightly plastic; common very fine interstitial pores, and few very fine tubular pores; 10 percent gravel, by volume; slightly acid (pH 6.3); clear smooth boundary.

B2t—8 to 12 inches; brown (7.5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; hard, very friable, sticky and plastic; few very fine roots; few very fine tubular and interstitial pores; neutral (pH 6.8); clear smooth boundary.

C1r—12 to 19 inches; pink (7.5YR 7.4) soft slightly weathered fractured tuff that contains pumice; strongly effervescent; fine irregularly shaped seams of lime on fracture planes; many thick clay films on fracture planes; abrupt smooth boundary.

C2r—19 to 26 inches; strong brown (7.5YR 5/6) soft fractured tuff that contains pumice; roots follow continuous fracture planes in upper part.

The depth to weathered tuff and the thickness of the solum are 8 to 20 inches.

The A horizon is 1 to 5 inches thick. It has hue of 10YR or 7.5YR. The dry soil material is brown or grayish brown, and moist material is dark brown or very dark brown. This horizon is sandy loam or loam. It has weak to moderate subangular blocky or platy structure, or it is massive. Consistence is soft or slightly hard. Reaction is medium acid or slightly acid.

The B2t horizon is 7 to 15 inches thick. It is dark brown, brown, yellowish brown, dark yellowish brown, or reddish brown when dry and dark brown, dark yellowish brown, or dark reddish brown when moist. It is sandy clay loam or clay loam and has weak or moderate subangular blocky structure. Consistence is slightly hard or hard. Reaction is slightly acid or neutral.

118—Casuse sandy loam, 2 to 9 percent slopes. This undulating to rolling soil is commonly on terraces southwest of the town of Alturas.

Included with this soil in mapping and making up about 5 percent of the acreage is a soil that is similar to this Casuse soil but that does not have a layer of clay accumulation in the subsoil. Making up as much as 3 percent is a soil that is similar to this Casuse soil but that is more than 20 inches deep to bedrock.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is about 2 inches. The effective rooting depth is 12 to 20 inches.

This soil is used for range, wildlife habitat, and, in small areas, for dryland wheatgrass and cereal rye. Capability unit VIe–1 (dryland); Shallow Loamy range site; Storie Index 23.

Daphnedale Series

The Daphnedale series consists of well drained soils on old dissected lake terraces and escarpments. The soils formed in old lake deposits derived from basic igneous rocks, diatomite, tuff, and other pyroclastic material. They are underlain by soft tuff. The slope ranges from 2 to 50 percent. The elevation ranges from 4,460 to 5,300 feet. Annual rainfall is 10 to 15 inches, average annual air temperature is 46° to 49° F, and the frost-free period is 80 to 100 days. Vegetation is junipers, shrubs, and grasses. It consists of western juniper, rabbitbrush, big sagebrush, giant wildrye, bluegrass, bluebunch wheatgrass, Idaho fescue, and cheatgrass.

In a representative profile the surface layer is very dark grayish brown, mildly alkaline stony loam and loam about 12 inches thick. The subsoil is very dark grayish brown, mildly alkaline clay loam and dark brown, mildly alkaline heavy clay loam about 13 inches thick. The substratum is dark brown clay loam 10 inches thick. Soft sedimentary tuff is at a depth of 35 inches.

Permeability is slow.

Daphnedale soils are used for range, wildlife habitat, dryland pasture and hay. In small more nearly level areas, they are used for irrigated hay. In these small areas they are suitable for irrigated grain.

Representative profile of Daphnedale stony loam, 30 to 50 percent slopes, on a steep side slope of an escarpment below a basalt-capped lava plateau, about 7 miles south of the town of Davis Creek, 0.78 mile west of Highway 395 on dirt road and 1,585 feet southeast of dirt road in the SE¼NE¼ of sec. 24, T. 44 N., R. 13 E.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) stony loam, very dark brown (10YR 2/2) moist; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine interstitial pores and few very fine tubular pores; stones and cobbles make up about 40 percent of the surface area; mildly alkaline (pH 7.5); clear smooth boundary.

A3—7 to 12 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; common very fine roots; common very

fine interstitial pores and few very fine tubular pores; mildly alkaline (pH 7.5); clear smooth boundary.

B1t—12 to 18 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine roots; common very fine interstitial pores and few very fine tubular pores; few moderately thick clay films on peds and in pores; 15 percent cobbles, by volume; mildly alkaline (pH 7.5); gradual smooth boundary.

B2t—18 to 25 inches; dark brown (10YR 4/3) heavy clay loam, dark brown (7.5YR 3/2) moist; moderate medium and coarse angular blocky structure; hard, friable, sticky and plastic; few very fine roots; few very fine interstitial pores and few very fine and fine tubular pores; common moderately thick clay films on peds and in pores; 15 percent cobbles, by volume; mildly alkaline (pH 7.5); gradual wavy boundary.

C1—25 to 35 inches; dark brown (10YR 4/3) clay loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and medium roots; few very fine interstitial pores; common very fine and few fine tubular pores; krotovinas 3 inches in diameter that are filled with material from the A and B horizons; mildly alkaline (pH 7.5); abrupt smooth boundary.

C2r—35 to 43 inches; brown (10YR 5/3) sedimentary tuff.

Depth to soft tuff is 25 to 40 inches. The solum ranges from 20 to 35 inches in thickness.

The A horizon ranges from 11 to 17 inches in thickness. It has dry colors of very dark grayish brown, dark grayish brown, dark brown, or brown and moist colors of very dark grayish brown, very dark brown, and dark brown. It is stony sandy loam, stony loam, stony clay loam, loam, sandy loam, or cobbly loam. Consistence is soft or slightly hard. Reaction is neutral or mildly alkaline.

The B2t horizon ranges from 6 to 10 inches in thickness. It has dry colors of very dark grayish brown, dark grayish brown, brown, or dark brown and moist colors of very dark brown, dark brown, or dark yellowish brown. It is heavy clay loam or clay that has subangular or angular blocky structure. Consistence is hard or very hard. Reaction is neutral or mildly alkaline.

The C1 horizon ranges from 0 to 11 inches in thickness. It has dry colors of dark grayish brown, dark brown, or brown and moist colors of very dark grayish brown or dark brown. It is clay loam or loam. Reaction is mildly alkaline or moderately alkaline.

119—Daphnedale loam, 2 to 9 percent slopes. This gently sloping and moderately sloping soil is commonly on old lake terraces in the area of Parker Creek, in Warm Springs Valley, and in areas north of the town of Alturas. It has a profile similar to the one described as representative of the series, but the surface is not stony.

Included with this soil in mapping and making up about 5 percent of the acreage is Barnard gravelly loam, 0 to 9 percent slopes; 5 percent is Delma cobbly loam, 0 to 9 percent slopes; and 3 percent is Ager clay, 2 to 15 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 5 to 6 inches. The rooting depth is 25 to 35 inches.

This soil is used for pasture, range, dryland grain, and, in small areas, for irrigated hay. It is suitable for irrigated grain. Capability unit IVe–1 (irrigated) and IVe–1 (dryland); Loamy range site; Storie Index 24.

120—Daphnedale cobbly loam, 9 to 30 percent slopes. This strongly sloping and moderately steep soil is commonly on toe slopes of escarpments. It has a profile similar to the one described as representative of the series, but cobbles cover 5 to 25 percent of the surface area. In areas near basalt tablelands, this soil generally has more surface cobbles than in other areas.

Included with this soil in mapping and making up about 5 percent of the acreage is Ager clay, 2 to 15 percent slopes. Making up about 5 percent is Casuse sandy loam, 2 to 15 percent slopes; Deven very stony clay loam, 2 to 30 percent slopes; and Delma cobbly loam, 9 to 30 percent slopes. Making up about 2 percent is Rock outcrop. Also included are small areas of soils that do not have cobbles on the surface.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 5 to 6 inches. The effective rooting depth is 25 to 30 inches.

This soil is used for range, recreation, wildlife habitat, and pasture. Capability unit IVe–7 (irrigated) and IVe–7 (dryland); Loamy range site; Storie Index 14.

121—Daphnedale stony loam, 30 to 50 percent slopes. This steep soil is commonly on escarpments in the Alturas Basin and Warm Springs Valley. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Delma loam, 30 to 50 percent slopes; about 3 percent is a soil that is similar to this Daphnedale soil but is less than 20 inches deep and does not have a subsoil; and 2 percent is Ager cobbly clay, 2 to 15 percent slopes. Also included is one area, about 6 miles northeast of Alturas, of soils that have a surface layer of sandy loam.

Runoff is rapid, and the hazard of erosion is moderate. Available water capacity is 5 to 6 inches. The effective rooting depth is 25 to 30 inches.

This soil is used for range and for wildlife habitat. Capability unit VIe–1 (dryland); Loamy range site; Storie Index 5.

122—Daphnedale-Delma loams, 2 to 9 percent slopes. These gently sloping and moderately sloping soils are on terraces along California Highway 299 between Clover Swale and Blacks Canyon. Daphnedale loam makes up about 50 percent of this map unit. It occurs on side slopes or where the parent material is soft and more deeply weathered. Delma loam makes up about 30 percent of the unit. It occurs on ridgetops or in places where the parent material is hard and is less

weathered. The Daphnedale soil in this map unit has a profile similar to the one described as representative of the series, except the surface is not stony. The Delma soil in this unit has a profile similar to the one described as representative of the Delma series, except the surface layer is loam.

Included with these soils in mapping and making up 10 percent of the acreage is Ager clay, 2 to 15 percent slopes; 5 percent is a soil that is shallow to hard diatomite; 3 percent is Modoc sandy loam, 0 to 9 percent slopes; and 2 percent is Bieber gravelly loam, 0 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. The rooting depth is 25 to 30 inches in the Daphnedale soil and 8 to 12 inches in the Delma soil. Available water capacity is 5 to 6 inches in the Daphnedale soil and 1 to 2 inches in the Delma soil.

The Daphnedale soil is used for dryland pasture, range, and grain. It is suitable for irrigated pasture, hay, and grain. The Delma soil is used for pasture, range, and wildlife habitat. Capability unit IVe–1 (irrigated) and IVe–1 (dryland); Storie Index 24; Daphnedale soil in Loamy range site and Delma soil in Shallow Loamy range site.

Daphnedale Variant

The Daphnedale variant consists of well drained soils on old lake terraces and escarpments. The soils formed in old lake deposits derived from basic igneous tuff and from other pyroclastic rocks. They are underlain by old lake sediment. The slope ranges from 5 to 50 percent. The elevation ranges from 4,300 to 4,800 feet. Annual rainfall is 14 to 16 inches, average annual air temperature is 47° to 49° F, and the frost-free period is 80 to 90 days. The vegetation is junipers, shrubs, and grasses. It is mostly western juniper, big sagebrush, rabbitbrush, giant wildrye, bluebunch wheatgrass, Idaho fescue, squirreltail, and cheatgrass.

In a representative profile the surface layer is grayish brown, slightly acid very cobbly loam and grayish brown, slightly acid clay loam about 11 inches thick. The subsoil extends to a depth of 60 inches or more. It is dark brown, slightly acid heavy clay loam in the upper part; brown, slightly acid clay in the middle part; and yellowish brown, neutral clay in the lower part.

Permeability is slow, and the available water capacity is 9 to 11 inches. The effective rooting depth is more than 60 inches.

These soils are used for range and wildlife habitat.

Representative profile of Daphnedale very cobbly loam, deep variant, 30 to 50 percent slopes, on a plateau escarpment 4.4 miles north of the junction of U.S. Highways 395 and 299 to Cedarville, then 330 feet north on old Highway 299, and 160 feet east upslope in SW¼NW¼ of sec. 1, T. 43 N., R. 13 E.

A11—0 to 3 inches; grayish brown (10YR 5/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate thick and very thick platy structure; slightly hard, very friable, nonsticky and slightly plastic; few very fine roots; many very fine interstitial pores and few very fine tubular pores; 45 percent cobbles and 5 percent stones, by volume, on the surface; about 5 percent gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

A12—3 to 11 inches; grayish brown (10YR 5/2) clay loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine and medium roots; many very fine interstitial pores and few very fine tubular pores; 10 percent gravel, by volume; slightly acid (pH 6.5); clear wavy boundary.

B1t—11 to 18 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few fine, medium, and coarse roots and common very fine roots; few fine interstitial pores and few very fine tubular pores; few thin clay films in pores and on peds; slightly acid (pH 6.3); gradual smooth boundary.

B21t—18 to 26 inches; dark brown (7.5YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) moist; weak fine prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; few very fine, fine, medium, and coarse roots; common very fine and fine tubular pores; common thin clay films on peds and in pores; 10 percent gravel, by volume; slightly acid (pH 6.5); gradual wavy boundary.

B22t—26 to 44 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak fine prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; very few very fine and coarse roots; common very fine tubular pores; common thin clay films on peds and in pores; 10 percent gravel, by volume; slightly acid (pH 6.5); gradual smooth boundary.

B3t—44 to 60 inches; yellowish brown (10YR 5/4) clay, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; very few very fine roots; many very fine tubular pores; common thin clay films in pores and on peds; 5 percent gravel, by volume; neutral (pH 7.0).

The solum is more than 60 inches thick.

The A horizon ranges from 8 to 13 inches in thickness. It has dry colors of grayish brown or brown in hue of 10YR and moist colors of very dark grayish brown or very dark brown. It is loam or clay loam. The surface consists of as much as 50 percent cobbles and 10 percent stones, by volume. Reaction ranges from slightly acid through neutral.

The B horizon ranges from 47 to 52 inches in thickness. The B2t horizon has dry colors of brown or dark brown in hue of 7.5YR and 10YR and moist color of dark brown. It is heavy clay loam or clay that has weak

prismatic or moderate angular blocky structure. It is 5 to 10 percent rounded and angular rock fragments, by volume. Reaction ranges from slightly acid through neutral.

123—Daphnedale very cobbly loam, deep variant, 5 to 15 percent slopes. This moderately sloping to strongly sloping soil is on uplands.

Included with this soil in mapping and making up about 5 percent of the acreage are outcrops of rock; 3 percent is Bieber gravelly loam, 0 to 9 percent slopes; and 3 percent is Daphnedale loam, 2 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range. Because of the small size of areas and isolated distribution of this soil, it is not suited to cultivation. Capability unit VIs–1 (dryland); Loamy range site; Storie Index 15.

124—Daphnedale very cobbly loam, deep variant, 30 to 50 percent slopes. This steep soil is on escarpments. A large area is on the escarpment north of the mouth of Crooks Canyon, and other areas are on escarpments along the North Fork of the Pit River north of Parker Creek. This soil has the profile described as representative of the Daphnedale, deep variant.

Included with this soil in mapping and making up about 10 percent of the acreage are outcrops of rock; 3 percent is Rubble land; and 1 percent is Bieber gravelly loam, 9 to 15 percent slopes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range and wildlife habitat. Capability unit VIs–1 (dryland); Loamy range site; Storie Index 5.

125—Daphnedale clay loam, deep variant, 5 to 15 percent slopes. This moderately sloping to strongly sloping soil is on uplands. It has a profile similar to the one described as representative of the Daphnedale, deep variant, except it has a surface layer of clay loam and has fewer cobbles on the surface. Cobbles make up as much as 10 percent of the surface, by volume.

Included with this soil in mapping and making up about 5 percent of the acreage is Lorella loam, 5 to 30 percent slopes; making up 3 percent is Daphnedale loam, 2 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range. Capability unit IVe–3 (dryland); Loamy range site; Storie Index 18.

Delma Series

The Delma series consists of well drained soils on old dissected lake terraces and escarpments. The soils formed in old lake sediment derived from basic igneous rock, diatomite, tuff, and other pyroclastic material. They are underlain by soft, old lake sediment. The slope ranges from 0 to 50 percent. The elevation ranges from 4,300 to 5,300 feet. Annual precipitation is 10 to 16 inches, average annual air temperature is 46° to 49° F, and the frost-free period is 80 to 100 days. Vegetation is shrub, grass, and juniper. It consists of big sagebrush, bitterbrush, bluebunch wheatgrass, Idaho fescue, squirreltail, cheatgrass, and scattered western juniper.

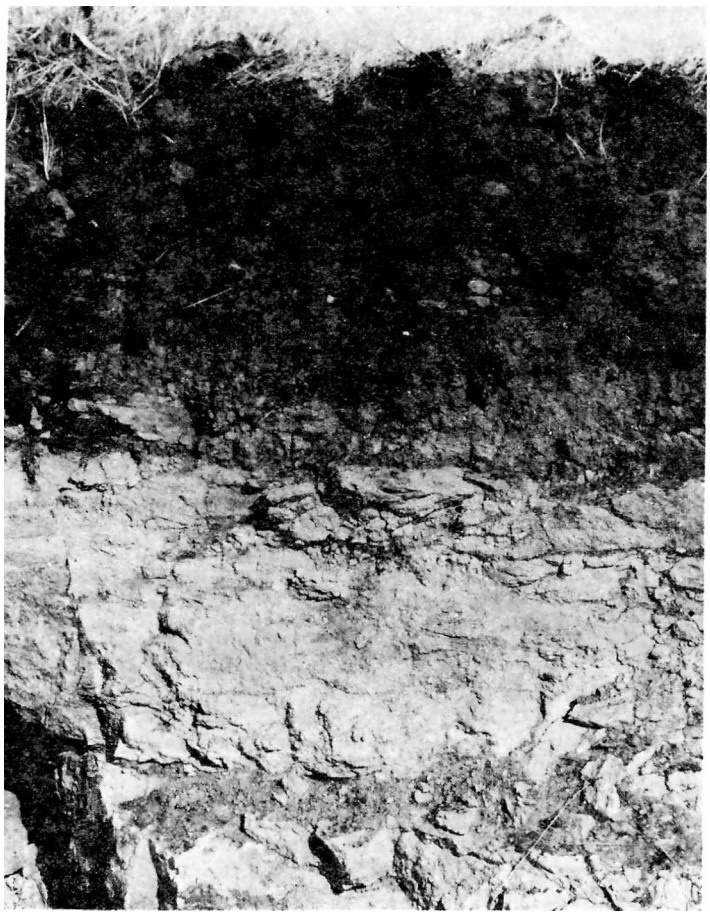

Figure 3.—**Profile of a Delma soil. The dark brown clay subsoil overlies white, weakly consolidated lake sediment.**

In a representative profile the surface layer is grayish brown, slightly acid cobbly loam and grayish brown and brown, slightly acid and neutral loam about 13 inches thick. The subsoil is dark brown, neutral clay about 5 inches thick. White, weakly consolidated lake sediment that contains seams of lime is at a depth of 18 inches (fig. 3).

Permeability is moderately slow.

Delma soils are used for range, wildlife habitat, and watershed and for dryland pasture and hay.

Representative profile of Delma cobbly loam, 9 to 30 percent slopes, on a dissected lake terrace used for dryland hay, 50 feet north of the center of dirt road, 280 feet east of fence corner, 2.3 miles east of County Road 76 in NE¼NE¼ of sec. 22, T. 42 N, R. 11 E.

Ap—0 to 4 inches; grayish brown (10YR 5/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; 5 percent rounded pebbles, by volume; 15 percent rounded cobbles, by volume; ¼-inch crust on surface;

slightly acid (pH 6.5); abrupt smooth boundary.

A12—4 to 8 inches; grayish brown (10YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine interstitial pores and very few very fine tubular pores; slightly acid (pH 6.5); clear smooth boundary.

A3—8 to 13 inches; brown (10YR 5/3) loam, dark brown (7.5YR 3/2) moist; weak medium and coarse subangular blocky structure; hard, very friable, sticky and slightly plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; very few thin clay films as colloidal stains; neutral (pH 6.8); abrupt smooth boundary.

B2t—13 to 18 inches; dark brown (7.5YR 3/2) clay, dark brown (7.5YR 3/2) moist; moderate fine and medium prismatic structure; very hard, very firm, sticky and plastic; common very fine roots; few very fine interstitial pores; 10 percent angular gravel, by volume; continuous moderately thick clay films on peds and in pores; neutral (pH 7.0); abrupt smooth boundary.

Cr—18 to 40 inches; white (10YR 8/1) weakly consolidated lake sediment that contains seams of lime ½- to 1-inch thick.

The depth of soft lake sediment or tuff is 8 to 20 inches.

The A horizon ranges from 4 to 13 inches in thickness. It has hue of 10YR or 7.5YR. It has dry colors of brown, grayish brown, or dark grayish brown and moist colors of brown, very dark brown, or very dark grayish brown. A dry value of 6 is in the upper few inches of the A horizon in some places. Where the upper 7 inches are mixed, the value is 5. The A horizon is loam or clay loam that has weak to strong granular, subangular blocky, or platy structure. It may have up to 25 percent cobbles, by volume, on the surface. Reaction is medium acid to neutral.

The B2t horizon ranges from 4 to 10 inches in thickness. It has dry and moist colors of brown to very dark grayish brown. It is heavy clay loam or clay that has moderate subangular blocky, angular blocky, or prismatic structure. Reaction is slightly acid or neutral.

The C horizon has dry colors of white and very pale brown to pink or pinkish gray and moist colors of brown to very dark gray.

126—Delma loam, 15 to 30 percent slopes, eroded. This moderately steep soil is commonly on dissected terraces and escarpments on the west side of Blacks Canyon. This soil has a profile similar to the one described as representative of the series, except the surface layer contains 5 percent, by volume, rounded gravel, and about half of the original surface layer has been removed by erosion. The present surface layer is 5 to 6 inches thick.

Included with this soil in mapping and making up about 6 percent of the acreage is Delma cobbly loam, 0 to 9 percent slopes; 4 percent is a soil that is similar to this Delma soil but that does not have a clay subsoil and is less than 10 inches deep to diatomite; and 2 percent is Daphnedale cobbly loam, 9 to 30 percent slopes.

Runoff is rapid, and the hazard of erosion is high. Available water capacity is 1 to 2.5 inches. Effective rooting depth is 8 to 12 inches.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIe–1 (dryland); Shallow Loamy range site; Storie Index 32.

127—Delma loam, 30 to 50 percent slopes. This steep soil is commonly on lake terrace escarpments in places where lava plateaus break to valleys. This soil has a profile similar to the one described as representative of the series, except the surface layer is not cobbly. In some places, however, cobbles make up as much as 10 percent of the surface, by volume.

Included with this soil in mapping and making up about 5 percent of the acreage is Daphnedale stony loam, 30 to 50 percent slopes; 3 percent is Ager cobbly clay, 30 to 50 percent slopes. Making up 4 percent is Casuse cobbly sandy loam, 30 to 50 percent slopes, a soil that is similar to this Delma soil but from which about half of the original surface layer has been removed by erosion, and areas of Tuff outcrop.

Runoff is rapid, and the hazard of erosion is high. Available water capacity is 1 to 2.5 inches. Effective rooting depth is 11 to 14 inches.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIIe–1 (dryland); Shallow Loamy range site; Storie Index 11.

128—Delma cobbly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is commonly on lake terraces throughout Warm Springs and Alturas Valleys. This soil has a profile similar to the one described as representative of the series, except that 20 percent of the surface is cobbles and about 15 to 20 percent of the surface layer is gravel.

Included with this soil in mapping and making up about 6 percent of the acreage is Daphnedale loam, 2 to 9 percent slopes; 3 percent is Ager clay, 2 to 15 percent slopes; 2 percent is Barnard gravelly loam, 0 to 9 percent slopes; and 2 percent is Casuse sandy loam, 2 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 2.5 to 3 inches. Effective rooting depth is 11 to 16 inches.

This soil is used for range and for dryland and irrigated pasture and hay. Capability unit IVe–1 (irrigated) and VIe–1 (dryland); Shallow Loamy range site; Storie Index 28.

129—Delma cobbly loam, 9 to 30 percent slopes. This strongly sloping and moderately steep soil is commonly on lake terraces throughout Warm Springs Valley. It has the profile described as representative of the series. There is as much as 25 percent cobbles and 15 percent gravel at the surface.

Included with this soil in mapping and making up about 5 percent of the acreage is Daphnedale cobbly loam, 9 to 30 percent slopes; 3 percent is Ager clay, 2 to 15 percent slopes; 2 percent is Barnard clay loam, 9 to 15 percent slopes; and 2 percent is Delma loam, 15 to 30 percent slopes, eroded.

Runoff is rapid, and the hazard of erosion is high.

Available water capacity is 2.5 to 3 inches. Effective rooting depth is 11 to 14 inches.

This soil is used for range, wildlife habitat, and pasture. Capability unit VIe–1 (dryland); Shallow Loamy range site; Storie Index 20.

Deven Series

The Deven series consists of well drained soils on lava plateaus and steep plateau escarpments. The soils formed in residuum from basalt, andesite, and hard tuff. They are underlain by hard basalt. The slope ranges from 0 to 50 percent. The elevation ranges from 4,400 to 5,800 feet. Annual rainfall is 10 to 14 inches, and annual snowfall is 24 to 48 inches. Average annual air temperature is 44° to 49° F, and the frost-free period is 70 to 90 days. Vegetation is juniper, shrubs, and grass. It consists of western juniper, big sagebrush, bitterbrush, squaw–apple, sandberg bluegrass, stipa species, squirreltail, cheatgrass, and mustard.

In a representative profile the surface layer is brown, slightly acid clay loam about 2 inches thick. The subsoil is dark reddish brown, slightly acid clay 14 inches thick. Hard, fractured basalt is at a depth of 16 inches.

Permeability is slow.

Deven soils are used for range, wildlife habitat, watershed, and recreation.

Representative profile of Deven clay loam, 0 to 9 percent slopes, on a nearly level to moderately sloping lava plateau about 5 miles northwest of Alturas, 0.75 mile south on Crowder Flat Road from Modoc National Forest boundary, and 75 feet east of road in the NE¼SW¼ sec. 6, T. 42 N., R. 12 E.

A1—0 to 2 inches; brown (10YR 5/3) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; many very fine interstitial pores; slightly acid (pH 6.3); clear smooth boundary.

B1t—2 to 7 inches; brown (7.5YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, very friable, sticky and plastic; common very fine, fine, and medium roots; common very fine tubular pores and few very fine interstitial pores; slightly acid (pH 6.5); clear wavy boundary.

B2t—7 to 16 inches; dark reddish brown (5YR 3/4) clay, dark reddish brown (5Y 3/2) moist; moderate medium and coarse angular blocky structure; hard, very friable, sticky and plastic; few very fine and common fine and medium roots; few very fine tubular and interstitial pores; continuous moderately thick clay films on peds and in pores; slightly acid (pH 6.5); abrupt irregular boundary.

R—16 inches; gray (N 5/0) hard fractured basalt.

Depth to hard fractured basalt is 13 to 20 inches. Rock fragments consisting of basalt pebbles, cobbles, and stones make up 0 to 20 percent of the B2t horizon. They are most numerous in the lower part. The soil is slightly acid or neutral throughout.

The A horizon ranges from 1 to 3 inches in thickness. It has dry colors of brown, grayish brown, or dark grayish brown and moist colors of dark brown, very dark brown, or very dark grayish brown. Hue is 10YR or 7.5YR. The A horizon is loam or clay loam that has weak very thin to medium platy, subangular blocky, or granular structure.

The B2t horizon ranges from 12 to 17 inches in thickness. It has dry colors of yellowish brown or brown to dark reddish brown and moist colors of dark yellowish brown to dark reddish brown. It is heavy clay loam or clay that has angular blocky or prismatic structure. The content of rock fragments increases with increasing depth.

130—Deven clay loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is commonly on lava plateaus. A large area is on the south edge of Devils Garden. This soil has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Karcal very cobbly clay, 0 to 9 percent slopes; 3 percent is Daphnedale cobbly loam, 9 to 30 percent slopes; 3 percent is Ninekar very stony silt loam, 0 to 9 percent slopes; 2 percent is Puls extremely stony clay loam, 0 to 9 percent slopes; and 2 percent is Rock outcrop.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is about 3 inches. The effective rooting depth is 16 to 20 inches.

This soil is used for range, wildlife habitat, and recreation. Capability unit VIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 24.

131—Deven very stony clay loam, 30 to 50 percent slopes. This steep soil is commonly on plateau escarpments. Large areas are in the Graven Ridge area. This soil has the profile similar to the one described as representative of the series, except the surface layer is stony. Stones and cobbles make up 15 to 35 percent of the surface layer.

Included with this soil in mapping and making up about 8 percent of the acreage is Rock outcrop. Making up about 5 percent is a soil, on north-facing side slopes, that is similar to this Deven soil but that is 20 to 40 inches deep to bedrock, has a dark brown loam surface layer, and has a brown heavy loam subsoil.

Runoff is rapid, and the hazard of erosion is high. Available water capacity is 2 to 3 inches. The effective rooting depth is 13 to 20 inches.

This soil is used for range, wildlife habitat, and recreation. Capability unit VIIs–1 (dryland); Shallow Stony Uplands range site; Storie Index 3.

132—Deven-Rock outcrop complex, 2 to 30 percent slopes. This map unit is gently sloping to moderately steep on hummocky lava plateaus and side slopes. Large areas of this map unit are north and south of Graven Ridge. Deven very stony clay loam makes up 55 percent of the unit. This soil is on mounds or in intermound positions. Rock outcrop makes up about 30 percent of the unit. It is in intermound positions and on edges of faulted ridges. The Deven soil in this map unit has a profile similar to the one described as representative of the series, except that stones and cobbles make up 15 to 35 percent of the surface layer.

Included with this unit in mapping and making up about 10 percent of the acreage are Packwood cobbly loam, 2 to 30 percent slopes, and Ditchcamp loam, 2 to 30 percent slopes; about 3 percent is Puls extremely stony clay loam, 0 to 9 percent slopes; and about 2 percent is a soil, on north-facing side slopes, that is similar to this Deven soil but that is 20 to 40 inches deep to bedrock, has a dark brown loam surface layer, and has a brown heavy loam subsoil.

Runoff is rapid on the Deven soil and very rapid on the Rock outcrop. The hazard of erosion is high on the Deven soil and slight on the Rock outcrop. Available water capacity is about 3 inches. The effective rooting depth is 16 to 20 inches.

The soils in this unit are used for range, wildlife habitat, watershed, and recreation. Capability unit VIIs–1 (dryland); Storie index 8; Deven part in Shallow Stony Uplands range site and Rock outcrop not placed in a range site.

Ditchcamp Series

The Ditchcamp series consists of well drained soils on hummocky lava plateaus and low mounds. The soils formed in material weathered from basic igneous rock. They have an indurated, silica-cemented hardpan overlying hard basalt. The slope ranges from 0 to 9 percent. The elevation ranges from 4,900 to 5,400 feet. Annual precipitation is 12 to 16 inches, the average annual air temperature is 47° to 49° F, and the frost-free period is about 80 days. Vegetation is juniper, shrubs, and grass. It consists of western juniper, big sagebrush, scattered bitterbrush, bluegrass, and cheatgrass.

In a representative profile the surface layer is brown, slightly acid loam about 9 inches thick. The subsoil is brown and reddish brown, slightly acid clay loam and reddish brown, neutral clay about 22 inches thick. Below the subsoil is a light brown, massive, silica-cemented hardpan about 5 inches thick. Hard basalt is at a depth of 36 inches.

Permeability is slow, and the available water capacity is 3.5 to 5 inches. The effective rooting depth is 21 to 35 inches.

Ditchcamp soils are used for range.

Representative profile of Ditchcamp loam, in an area of Packwood-Ditchcamp complex, on a hummocky, nearly level lava plateau 30 feet east of dirt road and 0.3 mile northeast of Modoc National Forest boundary or 0.35 mile northeast of Lauer Reservoir Road (33 feet north of the representative profile of Packwood soil) in NW¼SW¼ sec. 3, T. 43 N., R. 13 E.

A1—0 to 9 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and few fine roots; common very fine interstitial and tubular pores; few thin clay films bridging mineral grains; slightly acid (pH 6.4); clear smooth boundary.

B1t—9 to 20 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; common very fine tubular pores and few very fine interstitial pores; few moderately thick clay films on peds and in pores; slightly acid (pH 6.4); clear smooth boundary.

B21t—20 to 25 inches; reddish brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/4) moist; moderate coarse angular blocky structure; hard, friable, very sticky and plastic; few very fine, fine, and medium roots; few very fine interstitial pores and common very fine tubular pores; bleached silica sand grains on top of horizon; slightly acid (pH 6.4); abrupt smooth boundary.

B22t—25 to 31 inches; reddish brown (5YR 5/3) clay, dark reddish brown (5YR 3/4) moist; strong medium angular blocky structure; very hard, firm, very sticky and very plastic; very few very fine and few fine roots; very few very fine tubular pores; many thick clay films on peds and in pores; 15 percent cobbles, by volume; neutral (pH 6.8); abrupt smooth boundary.

Csim—31 to 36 inches; light brown (7.5YR 6/4) massive indurated silica hardpan; common fine distinct black (N 2/0) manganese mottles and concretions; very hard and very firm.

R—36 inches; hard fractured basalt.

Depth to the hardpan and the thickness of the solum are 21 to 35 inches.

The A horizon ranges from 7 to 12 inches in thickness. It has hue of 10YR to 7.5YR. It is sandy loam or loam that has weak subangular blocky or platy structure or is massive. Cobbles and stones are scattered in some places; more commonly, however, the coarse fragments are concentrated at the edges of mounds. Reaction is slightly acid or neutral.

The Bt horizon ranges from 14 to 23 inches in thickness. It has hue of 7.5YR and 5YR. It is clay loam in the upper part and heavy clay loam or clay in the lower part. The lower part of the Bt horizon has as much as 20 percent cobbles, by volume. The lower part of the B2t horizon has moderate to strong angular blocky structure. Reaction is slightly acid or neutral.

The indurated Csim horizon is massive or is layered with laminar silica lenses 1 to 2 millimeters thick and 2 to 5 centimeters apart.

Ditchcamp soils are mapped only in a complex with Packwood soils.

Donica Series

The Donica series consists of somewhat excessively drained soils on alluvial fans. The soils formed in gravelly and cobbly alluvium derived from basalt, andesite, and obsidian. The slope ranges from 2 to 9 percent. The elevation ranges from 4,800 to 5,000 feet. The average annual air temperature is 49° F, the average annual precipitation is 16 to 20 inches, and the frost-free growing period is about 80 to 90 days. Vegetation is shrubs and grasses and consists of wild plum, big

sagebrush, cheatgrass, wild mustard, and perennial grasses.

In a representative profile the surface layer is grayish brown, slightly acid gravelly clay loam 14 inches thick. The subsoil is brown, slightly acid gravelly coarse sandy loam and loam about 19 inches thick. The substratum, to a depth of 60 inches or more, is brown, slightly acid gravelly coarse sand.

Permeability is moderately rapid, and the available water capacity is 4 to 5 inches. Roots penetrate to a depth of 60 inches or more.

Donica soils are used for irrigated alfalfa and range.

Representative profile of Donica gravelly clay loam, 2 to 9 percent slopes, 15 feet north of east-west fence and about 700 feet east of Highway 395 in NW¼NW¼ sec. 1, T. 47 N., R. 14 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; many fine roots; many fine interstitial pores and few very fine tubular pores; 25 percent gravel, by volume; slightly acid (pH 6.3); gradual smooth boundary.

A12—4 to 14 inches; grayish brown (10YR 5/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; common fine interstitial pores; 20 percent gravel, by volume; slightly acid (pH 6.5); gradual wavy boundary.

B21t—14 to 29 inches; brown (7.5YR 5/2) gravelly coarse sandy loam, dark brown (7.5YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; very few very fine, medium, and coarse roots; many fine interstitial pores; 10 percent cobbles and 40 percent gravel, by volume; slightly acid (pH 6.5); clear wavy boundary.

B22—29 to 33 inches; brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; very few fine and medium roots; many fine interstitial pores and common very fine tubular pores; 10 percent cobbles and 25 percent gravel, by volume; slightly acid (pH 6.5); gradual wavy boundary.

IIC—33 to 60 inches; brown (7.5YR 5/2) gravelly coarse sand, dark brown (7.5YR 3/2) moist; single grained (dry and moist); loose, nonsticky and nonplastic; very few fine and medium roots; many fine interstitial pores; 15 percent cobbles and 40 percent gravel, by volume; opal coatings on bottom of pebbles and cobbles; slightly acid (pH 6.5).

The solum ranges from 25 to 37 inches in thickness.

The A horizon ranges from 10 to 20 inches in thickness. It is grayish brown or brown and has hue of 10YR or 7.5YR. It is gravelly clay loam and gravelly loam that generally is massive but has weak granular structure in places.

The B2 horizon has hue of 10YR or 7.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3. It is gravelly sandy loam, gravelly loam, or gravelly clay loam.

The C horizon is brown or grayish brown and has hue of 7.5YR or 10YR. It is gravelly loamy coarse sand, gravelly coarse sand, very gravelly loamy coarse sand, or gravelly sandy loam. Gravel and cobbles make up 35 to 70 percent, by volume, of the 10- to 40-inch control section. Stones are in some places.

133—Donica gravelly clay loam, 2 to 9 percent slopes. This gently sloping to moderately sloping soil is on the upper part of alluvial fans.

Included with this soil in mapping and making up about 8 percent of the acreage is Calimus gravelly loam, 2 to 5 percent slopes. Making up 5 percent is Drews gravelly loam, 0 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mostly for irrigated alfalfa. Where it is not irrigated, it is used for range. Capability unit IIIe–4 (irrigated); VIIe–1 (dryland); Sandy range site; Storie Index 39.

Drews Series

The Drews series consists of well drained soils on alluvial fans and lake terraces. The soils formed in alluvium derived from volcanic rock. The slope ranges from 0 to 30 percent. The elevation ranges from 4,500 to 4,800 feet. The average annual air temperature is about 49° F, the average annual precipitation is 14 to 16 inches, and the frost-free period is about 90 to 100 days. Vegetation is grass and brush. Big sagebrush is the predominant brush.

In a representative profile the surface layer is dark grayish brown, mildly alkaline loam and dark grayish brown, neutral clay loam about 11 inches thick. The subsoil is dark grayish brown and brown, neutral and mildly alkaline clay loam about 22 inches thick. The substratum is brown, mildly alkaline sandy clay loam about 8 inches thick. It is underlain by an old, buried soil that extends to a depth of 60 inches. This buried soil is dark grayish brown, mildly alkaline clay loam and brown, moderately alkaline clay loam.

Permeability is moderately slow. The effective rooting depth is more than 60 inches.

Drews soils are used for irrigated small grain and alfalfa. They are also suitable for irrigated pasture.

Representative profile of Drews loam, 0 to 5 percent slopes, 1.0 mile west of Highway 395 on State Line Road and 108 feet south of road and 3 feet east of fence in the NW¼NE¼ sec. 23, T. 48 N., R. 14 E.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; many fine interstitial pores and few very fine tubular pores; mildly alkaline (pH 7.5); clear smooth boundary.

A3—3 to 11 inches; dark grayish brown (10YR

4/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine interstitial pores and very few fine and few very fine tubular pores; 5 percent rounded gravel, by volume; krotovinas, 2½ inches in diameter, filled with material from the A1 horizon; neutral (pH 7.0); gradual smooth boundary.

B1—11 to 22 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium angular blocky structure; hard, friable, sticky and slightly plastic; few very fine roots; few fine interstitial pores and common very fine tubular pores; 5 percent rounded gravel, by volume; neutral (pH 7.0); clear smooth boundary.

B2t—22 to 33 inches; brown (7.5YR 4/2) clay loam, dark brown (10YR 3/2) moist; moderate medium angular blocky structure; hard, friable, sticky and plastic; few very fine roots; few fine interstitial pores and common very fine tubular pores; common moderately thick clay films on peds and few thin clay films in pores; 5 percent rounded gravel, by volume; mildly alkaline (pH 7.5); clear smooth boundary.

C1—33 to 41 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine interstitial pores and common very fine tubular pores; 5 percent rounded gravel, by volume; mildly alkaline (pH 7.5); clear smooth boundary.

A1b—41 to 59 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine interstitial pores and common very fine and fine tubular pores; mildly alkaline (pH 7.5); clear wavy boundary.

B2tb—59 to 67 inches; brown (7.5YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, sticky and slightly plastic; few fine roots; few fine interstitial pores and common very fine tubular pores; common thin clay films in pores; moderately alkaline (pH 8.0).

The solum ranges from 30 to 43 inches in thickness. The A horizon ranges from 8 to 15 inches in thickness. It is dark grayish brown, dark gray, or gray in any neutral hue or in hue of 10YR. Reaction ranges from neutral through mildly alkaline. Gravel makes up as much as 5 percent, by volume, of the A horizon.

The B horizon ranges from 20 to 28 inches in thickness. It is brown, dark brown, grayish brown, or dark grayish brown in hue of 10YR or 7.5YR. It is sandy clay loam or clay loam that has subangular blocky or angular blocky structure. Reaction ranges from neutral through mildly alkaline.

The C horizon is brown, grayish brown, dark brown, or dark grayish brown in hue of 10YR or 7.5YR. It is sandy loam, very gravelly loamy sand, very cobbly loamy sand, or sandy clay loam. Reaction ranges from mildly alkaline through moderately alkaline.

134—Drews loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on alluvial fans and lake terraces. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Drews gravelly loam, 0 to 9 percent slopes; 2 percent is Drews clay loam, 2 to 5 percent slopes; 2 percent is Calimus loam, 0 to 2 percent slopes; and 3 percent is a soil that is similar to this Drews soil but is calcareous in the lower part of the profile.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is 8 to 12 inches. Water from the mountains commonly moves to the valley bottoms through the very gravelly or very cobbly, substratum aquifer.

This soil is used principally for irrigated alfalfa, small grain, and pasture. Capability unit IIIe–1 (irrigated); not placed in a range site; Storie Index 72.

135—Drews gravelly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on the middle part of alluvial fans and lake terraces. It has the profile similar to the one described as representative of the series, except the surface layer is about 20 to 30 percent gravel, by volume.

Included with this soil in mapping and making up about 5 percent of the acreage is Drews loam, 0 to 5 percent slopes; and 3 percent is Donica gravelly clay loam, 2 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is slight. Available water capacity is 8 to 12 inches.

This soil is used for irrigated alfalfa and pasture. Because of the gravelly surface layer, seedbed preparation requires more intensive management. Capability unit IIIe–1 (irrigated); not placed in a range site; Storie Index 48.

136–Drews gravelly loam, 15 to 30 percent slopes. This moderately steep soil is on breaks of lake terraces and alluvial fans, mostly along Willow Creek. It has a profile similar to the one described as representative of the series, except the surface layer is 2 or 3 inches thinner and is about 20 to 30 percent volcanic gravel, by volume.

Included with this soil in mapping and making up about 3 percent of the acreage is Drews gravelly loam, 0 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 8 to 12 inches.

This soil is used for range and dryland pasture. Capability unit IVe–1 (dryland); Loamy range site; Storie Index 33.

137—Drews clay loam, 2 to 5 percent slopes. This gently sloping soil is on the lower part of alluvial fans and on lake terraces. It has a profile similar to the one described as representative of the series, except the surface layer is clay loam. In some mapped areas near Goose Lake, gravel strata are in the substratum. In

places, carbonates are present in the lower part of the profile.

Included with this soil in mapping and making up about 2 percent of the acreage is Drews gravelly loam, 0 to 9 percent slopes; and 2 percent is Drews clay loam that has slopes of less than 2 percent. An area just north of the mouth of Willow Creek is affected by sodium salts.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is 8 to 12 inches.

This soil is used for irrigated alfalfa and small grain. Capability unit IIIe–1 (irrigated); not placed in a range site; Storie Index 65.

138—Drews clay loam, wet, 0 to 2 percent slopes. This nearly level soil is on alluvial fans, generally at a low elevation. It has a profile similar to the one described as representative of the series, except the surface layer is clay loam and is gray or dark gray, the subsoil is silty clay loam, and in places the substratum is slightly cemented or contains gravel strata. Runoff from higher areas causes this soil to be wet for brief but significant periods.

Included with this soil in mapping and making up about 3 percent of the acreage is Goose Lake silt loam; about 2 percent is Pit silty clay loam, 0 to 2 percent slopes.

Runoff is very slow, and there is no hazard of erosion. Available water capacity is 8.5 to 11.0 inches. Because of runoff from higher-lying areas and soil wetness, this soil is well suited to pasture or grass hay.

This soil is used for irrigated hay and pasture. Capability unit IIIw–2 (irrigated); not placed in a range site; Storie Index 62.

Exel Series

The Exel series consists of well drained soils that have a silica cemented hardpan on mounds of lake terraces. The soils formed in unconsolidated, coarse textured alluvium derived from basic igneous and pyroclastic rocks. The slopes range from 0 to 5 percent. The elevation ranges from 4,750 to 5,200 feet. Annual precipitation is 12 to 16 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is about 80 days. Vegetation is shrubs and grasses. It consists of low sagebrush, Sandberg bluegrass, Idaho fescue, and cheatgrass.

In a representative profile, the surface layer is light brownish gray and brown, slightly acid loam about 11 inches thick. The subsoil is brown, slightly acid cobbly clay loam and reddish brown, slightly acid very cobbly clay loam and gravelly clay loam about 19 inches thick. Below that is a reddish brown and pink, silica-cemented hardpan that is about 50 percent or more coarse fragments, by volume.

Permeability is slow, and the available water capacity is 4 to 5 inches. The effective rooting depth is 21 to 35 inches.

Exel soils are used for range.

Representative profile of Exel loam, in an area of Thoms-Exel complex, on a mounded, nearly level to gently sloping lake terrace about 9 miles northeast of the town of Alturas on the south side of State Highway 299, or 1,900 feet south and 1,600 feet west of E¼ corner sec. 18, T. 43 N., R. 14 E.

A1—0 to 5 inches; light brownish gray (10YR 6/2) loam, dark brown (10YR 3/3) moist; moderate medium and coarse granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores and few very fine tubular pores; slightly acid (pH 6.5); clear smooth boundary.

A3—5 to 11 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common very fine interstitial and tubular pores; few thin clay films as bridges between mineral grains; slightly acid (pH 6.5); clear wavy boundary.

B21t—11 to 17 inches; brown (7.5YR 5/2) cobbly clay loam, dark brown (7.5YR 3/2) moist; moderate medium and coarse angular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine interstitial and tubular pores; many moderately thick clay films on peds and common thin clay films in pores; 10 percent gravel and 10 percent cobbles, by volume; slightly acid (pH 6.5); clear wavy boundary.

B22t—17 to 25 inches; reddish brown (5YR 5/3) very cobbly clay loam, reddish brown (5YR 4/4) moist; strong medium angular blocky structure; very hard, firm, sticky and very plastic; very few very fine roots; few very fine interstitial and tubular pores; many moderately thick clay films on peds and common moderately thick clay films in pores; 15 percent gravel and 40 percent cobbles, by volume; slightly acid (pH 6.5); gradual irregular boundary.

B31t—25 to 30 inches; reddish brown (5YR 4/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; very few very fine roots; few very fine interstitial and tubular pores; many moderately thick clay films on peds and few moderately thick clay films in pores; 15 percent gravel and 10 percent cobbles, by volume; slightly acid (pH 6.5); gradual irregular boundary.

B32si—30 to 35 inches; reddish brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; reddish yellow (7.5YR 6/6) silica-cemented bands 1 centimeter thick; weak medium angular blocky structure; hard, very firm, sticky and plastic; very few very fine interstitial pores; 50 percent gravel and cobbles, by volume; common moderately thick clay films on peds; thin coating of silica on bottoms of pebbles and cobbles; neutral (pH 6.8); abrupt wavy boundary.

C1sim—35 to 47 inches; pink (7.5YR 7/4) indurated hardpan with common fine distinct black (N 2/0) manganese mottles; continuous opal cappings less than 1 millimeter thick; pebbles and cobbles coated with silica; 10 percent gravel and 80 percent cobbles, by volume.

The thickness of the solum and depth to the hardpan are 21 to 35 inches. The A horizon ranges from 8 to 13 inches in thickness. It is brown, grayish brown, pale brown, and light brownish gray in hue of 10YR and 7.5YR. It is sandy loam or loam. Cobbles, pebbles, or stones are on the lower part of the mounds. Reaction is slightly acid or neutral.

The Bt horizon ranges from 13 to 22 inches in thickness. It is reddish brown, brown, or dark brown in hue of 7.5YR and 5YR. The upper part of the Bt horizon mostly has hue of 7.5YR, and the lower part has hue of 5YR. This horizon is gravelly clay loam, cobbly clay loam, or sandy clay loam. It generally has less than 35 percent gravel and cobbles, by volume, although some horizons have slightly more than that. A thin discontinuous horizon of very gravelly clay commonly occurs just above the hardpan.

Exel soils are mapped only in a complex with Thoms soils. Exel soils are on mounds, and Thoms soils are in intermound areas.

Fluvaquents

139—Fluvaquents. This map unit consists of the very poorly drained soils along the shore of Goose Lake. The soils formed in unconsolidated, highly stratified alluvium. The texture ranges from clay to sand and gravel. The soil material is gray, greenish gray, and bluish gray and is mottled. The slope ranges from 0 to 2 percent. The elevation ranges from 4,700 to 4,725 feet. Annual rainfall is about 14 inches, average annual air temperature is 47° F, and the frost-free period is 70 to 90 days. The water table is at a depth of 4 to 12 inches, depending on the lake level. The soils are strongly salt-affected. Vegetation is mostly rushes, saltgrass, and sedges.

Included with this soil in mapping are some areas of Tandy loamy fine sand.

These soils are used for range and wildlife habitat. Capability unit VIIw–1 (dryland); Saline Bottom range site; Storie Index 10.

Gleason Series

The Gleason series consists of well drained soils on uplands. The soils formed in residuum from tuff, agglomerate, and rhyolite. They are underlain by hard tuff agglomerate. The slope ranges from 9 to 50 percent. The elevation ranges from 4,500 to 5,800 feet. Annual rainfall is 17 to 20 inches, annual snowfall is 30 to 50 inches, average annual air temperature is 45° to 50° F, and the frost-free period is 70 to 80 days. Vegetation is open forest and consists of Jeffrey pine, mountain-mahogany, bitterbrush, rabbitbrush, squawcarpet, bluebunch wheatgrass, fescue, and squirreltail.

In a representative profile, the surface layer is grayish brown, slightly acid loam and medium acid sandy loam about 22 inches thick. The underlying material, to a depth of 35 inches, is light gray, slightly acid gravelly sandy loam. Below this, it is very pale brown, slightly acid very gravelly coarse sand. Hard tuff agglomerate is at a depth of 50 inches.

Permeability is moderately rapid, and the available water capacity is 3 to 4.5 inches. The effective rooting depth is 40 to 60 inches.

Gleason soils are used for woodland, grazable woodland, and wildlife habitat.

Representative profile of Gleason loam, 9 to 30 percent slopes, on an upland slope about 8 miles north of Davis Creek, 30 feet south and 90 feet west of E¼ corner sec. 10, T. 46 N., R. 14 E.

O1—1 inch to 0; litter of pine needles.

A11—0 to 4 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; slightly acid (pH 6.5); clear smooth boundary.

A12—4 to 16 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial and tubular pores; less than 10 percent obsidian gravel, by volume; medium acid (pH 6.0); clear wavy boundary.

AC—16 to 22 inches; grayish brown (10YR 5/2) sandy loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine and fine, common medium, and few coarse roots; many very fine tubular pores; less than 10 percent obsidian gravel, by volume; medium acid (pH 6.0); gradual smooth boundary.

C1—22 to 35 inches; light gray (10YR 7/2) gravelly sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine roots, common coarse roots; many very fine interstitial pores; 15 percent gravel, by volume; slightly acid (pH 6.2); gradual smooth boundary.

C2—35 to 50 inches; very pale brown (10YR 7/3) very gravelly coarse sand, light yellowish brown (10YR 6/4) moist; massive; hard, firm, nonsticky and nonplastic; few fine roots; few very fine interstitial pores; 50 percent weathered tuff gravel, by volume; slightly acid (pH 6.2); gradual smooth boundary.

R—50 inches; pale brown (10YR 6/3) hard tuff agglomerate.

Depth to hard tuff is 40 to 60 inches. Rock fragments make up 5 to 40 percent of the upper part of the A horizon and less than 35 percent of the 10- to 40-inch control section. The lower part of the A horizon and upper part of the C horizon are about 10 to 20 percent rock fragments, and the lower part of the C horizon is

Figure 4.—**Ponderosa pine and Jeffrey pine in an area of Gleason loam, 9 to 30 percent slopes.**

as much as 70 percent rock fragments. Most fragments are volcanic, including obsidian and tuff. Reaction is slightly acid to medium acid throughout.

The A horizon ranges from 10 to 32 inches in thickness. The A11 horizon has dry colors of grayish brown, dark grayish brown, gray, or dark gray and moist colors of dark brown, very dark brown, very dark grayish brown, or black in hue of 10YR. It is sandy loam or loam that has granular or subangular blocky structure or that is massive. Consistence is soft or slightly hard. The A12 horizon has dry colors of light brownish gray, grayish brown, brown, or light brown and moist colors of dark yellowish brown to brown.

The C horizon ranges from 23 to 30 inches in thickness. It has colors of very pale brown, light gray, or pinkish gray in hue of 10YR or 7.5YR and moist colors of light yellowish brown to brown. It is sandy loam, loamy coarse sand, or coarse sand. The lower part of the C horizon grades to hard rock.

140—Gleason loam, 9 to 30 percent slopes. This strongly sloping to moderately steep soil is commonly on uplands in the western part of the Warner Mountains south of Lassen Creek. It has the profile described as representative of the series.

Included with this soil in mapping is a soil that is similar to this Gleason soil but that is more than 60 inches to bedrock. Also included and making up 5 percent of the acreage is a soil that is similar to this Gleason soil but that has a weakly developed subsoil; 2 percent is a soil that is similar to this Gleason soil but that is less than 40 inches deep to bedrock; and 1 percent is a soil that is similar to this Gleason soil but that has slopes of 5 to 9 percent. Also included are Gleason soils that have a surface layer of gravelly loam, gravelly sandy loam, or sandy loam. In these soils, obsidian and tuff gravel make up about 10 to 40 percent of the surface layer.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for grazable woodland, woodland, wildlife habitat, and recreation. This soil has a site index rating of 62 if it is used to grow ponderosa pine. Equipment limitations, plant competition, and the hazard of windthrow are slight. The seedling mortality rate is moderate. Species to favor in existing stands are ponderosa pine, Jeffrey pine, and incense-cedar. This soil is well suited to plantings of ponderosa pine and Jeffrey pine (fig. 4). Capability unit IVe–1 (dryland); not placed in a range site; Storie Index 32.

141—Gleason gravelly loam, 30 to 50 percent slopes.

This steep soil is commonly on uplands in the western part of the Warner Mountains south of Lassen Creek. It has a profile similar to the one described as representative of the series, except the surface layer is gravelly loam that has about 15 to 25 percent by volume obsidian or tuff gravel or both. In places the parent material is mostly rhyolite.

Included with this soil in mapping and making up about 10 percent of the acreage is a soil that is similar to this Gleason soil but that is less than 40 inches deep to bedrock; and 5 percent is a soil that is similar to this Gleason soil but that has a subsoil. Also included are soils that have a surface layer of dark gray or very dark gray gravelly sandy loam or loam.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for grazable woodland, woodland, recreation, and wildlife habitat. It has a site index rating of 62 if it is used to grow ponderosa pine. Plant competition and the hazard of windthrow are slight. Equipment limitation and the seedling mortality rate are moderate. Species of trees to favor in existing stands are ponderosa pine, Jeffrey pine, and incense-cedar. This soil is well suited to plantings of ponderosa pine and Jeffrey pine. Capability unit VIe–1 (dryland); not placed in a range site; Storie Index 5.

Goose Lake Series

The Goose Lake series consists of poorly drained soils in basins and on low lake terraces. These soils formed in moderately fine textured alluvium derived from basic igneous rock including basalt, andesite, obsidian, and tuff. The slope ranges from 0 to 2 percent. The elevation ranges from 4,350 to 4,800 feet. Annual rainfall is 12 to 14 inches, average annual air temperature is 46° to 47° F, and the frost-free period is 70 to 80 days. Vegetation is meadow grasses and consists of bluegrass, timothy, sedges, and rushes.

In a representative profile, the surface layer is dark gray, slightly acid silt loam about 8 inches thick. The subsurface layer is light gray, slightly acid silt loam about 13 inches thick. The subsoil is about 36 inches thick. It is dark gray, neutral silty clay in the upper 13 inches; grayish brown, mottled, moderately alkaline silty clay in the next 5 inches; pale brown, mottled, moderately alkaline clay loam in the next 8 inches; and pale brown, mottled, neutral sandy clay loam in the lower 10 inches. The substratum is light yellowish brown, mottled, mildly alkaline loam to a depth of 67 inches or more.

Permeability is slow, and the available water capacity is 9 to 12 inches. The effective rooting depth is more than 60 inches during most of the growing season. Depth to the water table is 12 to 36 inches in spring and early in summer. The water level commonly depends on the irrigation methods used on surrounding soils. These soils are flooded in spring for as long as 30 days.

Goose Lake soils are used for irrigated meadow pasture and hay.

Representative profile of Goose Lake silt loam, on a nearly level low lake terrace about 0.25 mile west of Lakeshore Ranch headquarters along dirt road, 25 feet north of east-west fence, and 210 feet west of gate in SW¼SW¼ sec. 12, T. 45 N., R. 13 E.

A1—0 to 8 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; massive; soft, very friable, slightly sticky and slightly plastic; many very fine and medium roots and common fine roots; common very fine interstitial pores and many very fine tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

A21—8 to 14 inches; light gray (10YR 7/1) silt loam, black (10YR 2/1) moist; moderate very thin platy structure; hard, very friable, slightly sticky and slightly plastic; common very fine and medium roots; common very fine tubular pores; slightly acid (pH 6.5); clear wavy boundary.

A22—14 to 21 inches; light gray (10YR 6/1) heavy silt loam, very dark gray (10YR 3/1) moist; moderate very coarse and coarse subangular blocky structure; hard, very friable, sticky and slightly plastic; common very fine and medium roots; common very fine and fine tubular pores; slightly acid (pH 6.5); abrupt irregular boundary.

B21t—21 to 34 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong medium and coarse prismatic structure; very hard, very firm, sticky and very plastic; few very fine and common medium inped roots; few very fine and fine tubular pores; thick clay films on peds and in pores; neutral (pH 7.0); clear wavy boundary.

B22t—34 to 39 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; few medium distinct iron mottles of reddish brown (2.5YR 5/4) and dark gray (10YR 4/1); moderate coarse angular blocky structure; very hard, firm, sticky and very plastic; few very fine roots; few very fine tubular pores; common moderately thick clay films in pores; moderately alkaline (pH 8.0); clear smooth boundary.

B31t—39 to 47 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 3/3) moist; few medium distinct iron mottles of strong brown (7.5YR 5/6) common fine distinct organic mottles of dark grayish brown (2.5YR 4/2) moist; weak medium prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; common very fine roots; very few fine tubular pores; many moderately thick clay films in pores; moderately alkaline (pH 8.0); gradual smooth boundary.

B32—47 to 57 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; many medium distinct iron mottles of yellowish red (5YR 5/6) dry, many medium distinct manganese mottles of very dark gray (N 3/0) and few fine distinct iron mottles of dark brown (7.5YR 4/4) moist; weak medium sub-

angular blocky structure; hard, friable, slightly sticky and plastic; few very fine roots; very few fine tubular pores; few thin clay films on peds; neutral (pH 7.0); clear smooth boundary.

IIC—57 to 67 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; many medium distinct reddish brown (5YR 4/4) and reddish yellow (7.5YR 6/8) iron mottles; massive; hard, very friable, slightly sticky and slightly plastic; no roots; common very fine interstitial pores; mildly alkaline (pH 7.5).

The solum ranges to more than 60 inches in thickness.

The A1 horizon ranges from 6 to 10 inches in thickness. It has dry colors of dark gray to gray and moist colors of very dark gray to very dark grayish brown or of black to very dark brown. Reaction of the A1 horizon ranges from slightly acid to neutral. The structure of the A1 horizon is platy or massive. The A2 horizon ranges from 6 to 15 inches in thickness. It has dry colors of light gray to gray and moist colors of dark gray to black. It has platy or subangular blocky structure.

The Bt horizon ranges from 21 to 35 inches in thickness. It has dry colors of gray to pale brown and brown, dark gray to brown and dark brown, and very dark gray to dark brown. It has moist colors of dark gray to dark brown, very dark gray to dark brown, and black or very dark brown. It is heavy clay loam, silty clay loam, silty clay, or clay. It has strong prismatic or angular blocky structure in the upper part and weak prismatic, angular, or subangular blocky structure in the lower part. Reaction of the Bt horizon ranges from neutral through moderately alkaline. Mottles that are indicative of gleying are below a depth of 32 inches. In places this horizon is about 5 percent, by volume, rounded basalt gravel in the lower part. Carbonates are below a depth of 40 inches in some places.

142—Goose Lake silt loam. This is a nearly level soil that commonly is on low lake terraces and in basins. One area of this soil is around the southern end of Goose Lake, and another area is in the lower basin at Pine Creek.

Included with this soil in mapping and making up about 6 percent of the acreage is Pit silty clay loam, 0 to 2 percent slopes; 4 percent is Drews clay loam, wet, 0 to 2 percent slopes; and 3 percent is Buntingville clay loam, 0 to 2 percent slopes.

Runoff is slow, and the hazard of erosion is slight. If this soil is cultivated, the structure deteriorates because of the high silt content and soil blowing is a hazard.

This soil is used for irrigated meadow pasture and hay. Capability unit IIIw–2 (irrigated); not placed in a range site; Storie Index 30.

Gravel Pits

143—Gravel pits. This map unit consists of open excavations from which soil material has been removed to provide a source of gravel. Sand generally is mixed with the gravel. The pits are throughout the survey area generally on terraces and fans. They are common in areas of Donica, Bieber, Modoc, and Barnard soils and Typic Xerorthents. The elevation ranges from 4,400 to 5,500 feet.

The materials in the pits include sand, gravel, and cobbles derived from basic igneous rocks. Recently excavated pits are barren, but older pits have sparse stands of rabbitbrush, big sagebrush, and cheatgrass.

Runoff is slow, and the hazard of erosion is slight. Drainage, permeability, and available water capacity are too variable to be rated.

Areas of this map unit are used for mining operations. Capability unit VIIIs–1; not placed in a range site; Storie Index 10.

Jenny Series

The Jenny series consists of moderately well drained soils in basins. The soils formed in alluvial deposits derived from volcanic rocks. The slope ranges from 0 to 5 percent. The elevation ranges from 4,700 to 5,000 feet. Annual precipitation is 13 to 15 inches, average annual air temperature is 46° to 48° F, and the frost-free period is 80 to 90 days. Vegetation is rabbitbrush, big sagebrush, medusahead, mustard, and other annuals.

In a representative profile, the surface layer is very dark gray, slightly acid and very dark grayish brown, neutral silty clay about 30 inches thick. The underlying material, to a depth of 37 inches, is dark brown, mildly alkaline silty clay loam. Below that, to a depth of more than 60 inches, it is brown, calcareous clay loam and loam.

Permeability is slow, and the available water capacity is 9 to 11 inches. The effective rooting depth is 60 inches or more.

These soils are used for irrigated pasture, hay, and range.

Representative profile of Jenny silty clay, 0 to 5 percent slopes, 6 feet south and 9 feet west of eastern corner of fence 1.25 miles south of West Side Road on dirt road to Orchard reservoir in SW¼NE¼ sec. 30, T. 45 N., R. 14 E.

A11—0 to 1 inch; dark gray (10YR 4/1) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to moderate fine granular; hard, friable, sticky and plastic; common very fine roots; common very fine interstitial pores; slightly acid (pH 6.3); abrupt smooth boundary.

A12—1 inch to 20 inches; very dark gray (10YR 3/1) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic structure; very hard, friable, very sticky and plastic; common very fine inped and many very fine exped roots; few very fine tubular pores; few intersecting slickensides; slightly acid (pH 6.5); gradual smooth boundary.

A13—20 to 30 inches; very dark grayish brown (10YR 3/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong medium and coarse prismatic structure;

very hard, friable, very sticky and plastic; few very fine inped roots; few very fine tubular pores; few intersecting slickensides; neutral (pH 7.0); clear smooth boundary.

IIC1—30 to 37 inches; dark brown (10YR 3/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse angular blocky structure; very hard, friable, very sticky and plastic; few very fine roots; few very fine tubular pores; common moderately thick clay films on peds and in pores; mildly alkaline (pH 7.3); clear smooth boundary.

IIC2—37 to 55 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; massive; hard, friable, sticky and plastic; weakly cemented; very few very fine roots; common very fine tubular pores; common moderately thick clay films in pores; violently effervescent; irregular filaments and seams of segregated lime; moderately alkaline (pH 8.0); gradual smooth boundary.

IIC3—55 to 62 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine interstitial pores; common very fine tubular pores; many thin clay films in pores; 10 percent obsidian gravel, by volume; strongly effervescent; fine irregular filaments of segregated lime; moderately alkaline (pH 8.0).

The solum ranges from 24 to 37 inches in thickness. The soil develops cracks every year as it dries, but the cracks are closed during moist weather in winter.

The A horizon ranges from 24 to 47 inches in thickness. It is gray, dark gray, very dark gray, grayish brown, or very dark grayish brown in hue of 10YR or 7.5YR. It is silty clay loam, silty clay, or clay. It has fine granular or thin platy structure in the upper part and medium or coarse prismatic structure in the lower part. Reaction is slightly acid to neutral.

The C horizon is dark brown, brown, dark grayish brown, or grayish brown in hue of 10YR or 7.5YR. It is loam, clay loam, or silty clay loam. The C horizon has subangular or angular blocky structure or is massive. The consistence is slightly hard, hard, or very hard. Reaction is mildly alkaline to moderately alkaline. The C horizon generally is calcareous.

144—Jenny silty clay loam, overwash, 0 to 5 percent slopes. This nearly level to gently sloping soil is on basin rims near Graven Reservoir. It has a profile similar to the one described as representative of the series, except that it has an overwash of silty clay loam 8 inches thick. The overwash is light brownish gray when dry and dark brown when moist. In places it ranges to loam.

Included with this soil in mapping and making up about 5 percent of the acreage is Ninekar very stony silt loam, 0 to 9 percent slopes; 3 percent is Jenny silty clay, 0 to 5 percent slopes; 3 percent is Karcal very cobbly clay, 0 to 9 percent slopes; and 1 percent is Packwood and Ditchcamp soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for range and irrigated hay. Capability unit IIIe–1 (irrigated) and IVe–1 (dryland); Clayey Slopes range site; Storie Index 77.

145—Jenny silty clay, 0 to 5 percent slopes. This nearly level to gently sloping soil is in basins southwest of Davis Creek near Kelly, Graven, and Lauer Reservoirs. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Pit silty clay loam, 0 to 2 percent slopes; 3 percent is Rumbo loam, 0 to 2 percent slopes; and 3 percent is Pit clay, 2 to 5 percent slopes. In the areas near Kelly Reservoir, this soil is saline and the mapped areas include areas of Reba loam, 0 to 5 percent slopes.

Runoff is slow, and there is no erosion hazard. This soil is wet for a brief period in spring and does not have a water table.

This soil is used for range and irrigated pasture, and hay. Capability unit IIIe–5 (irrigated) and IVe–5 (dryland); Clayey Slopes range site; Storie Index 60.

Karcal Series

The Karcal series consists of well drained soils on lava plateaus. The soils formed in residuum derived from basic igneous rocks. They are underlain by hard basalt bedrock. The slope ranges from 0 to 9 percent. The elevation ranges from 4,300 to 5,800 feet. Annual rainfall is 10 to 16 inches, average annual air temperature is 45° to 47° F, and the frost-free period is 70 to 80 days. Vegetation is shrubs and grass. It consists of rabbitbrush, big sagebrush, cheatgrass, medusahead, lupine, and a few scattered western juniper.

In a representative profile, the surface layer is about 21 inches thick. It is brown, neutral cobbly clay in the upper 6 inches and brown, neutral and mildly alkaline clay in the lower 15 inches. Hard fractured basalt is at a depth of 21 inches.

Permeability is slow, and the available water capacity is 2 to 3 inches. The effective rooting depth is 20 to 30 inches.

Karcal soils are used for range, wildlife habitat, and watershed. In some places they are mapped in a complex with Ninekar soils.

Representative profile of Karcal cobbly clay, in an area of Karcal-Ninekar complex, 0 to 9 percent slopes, on a nearly level lava plateau about 5 miles southeast of the town of Likely, 4 miles southeast on West Valley Reservoir Road (County Road 66) from its intersection with Jess Valley Road, 81 feet north of old dirt road in SW¼NW¼ sec. 19, T. 39 N., R. 14 E.

A11—0 to 6 inches; brown (7.5YR 5/2) cobbly clay, brown (7.5YR 5/4) moist; strong medium and coarse subangular blocky structure, strong fine granular structure in upper ½ inch; hard, very friable, sticky and plastic; common very fine roots; few very fine tubular pores; 30 percent cobbles, by volume; stones cover 10 percent of the surface; cracks 0.5 centimeter wide; neutral (pH 7.0); clear smooth boundary.

A12—6 to 13 inches; brown (7.5YR 5/4) clay,

brown (7.5YR 4/4) moist; strong coarse and very coarse prismatic structure; very hard, very friable, sticky and plastic; few very fine and fine roots; few very fine tubular pores; few intersecting slickensides in lower half of horizon; cracks 1.5 centimeters wide; neutral (pH 7.0); clear wavy boundary.

A13—13 to 21 inches; brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; strong medium and coarse angular blocky structure; very hard, very friable, sticky and very plastic; few very fine roots; few very fine tubular pores; 15 percent angular basalt cobbles, by volume; common intersecting slickensides; cracks 1.5 centimeters wide; mildly alkaline (pH 7.5); abrupt wavy boundary.

R—21 inches; dark gray (N 4/0) fractured basalt that has coatings of silica and lime; discontinuous pockets of cemented lime and silica in fractures.

Depth to fractured basalt is 20 to 30 inches (fig. 5). Cracks form in the soil from July to October, and they are closed the rest of the year.

Few to common intersecting slickensides are in the A13 horizon. Rock fragments, mostly rounded cobblestones and a few stones, make up 15 to 60 percent of the A11 horizon. Angular basalt cobbles make up as much as 15 percent of the A13 horizon.

The A horizon ranges from 20 to 30 inches in thickness. When dry it is brown, grayish brown, or dark grayish brown, and when moist it is brown or dark grayish brown. In some places the lower part of the A horizon is dark brown when dry and when moist. It is clay or silty clay. The A11 horizon has strong subangular blocky or granular structure, and the A12 and A13 horizons have weak to strong prismatic or angular blocky structure. Consistence is slightly hard or hard near the surface and hard or very hard in the A13 horizon. The A horizon is very friable or friable throughout.

146—Karcal very cobbly clay, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on lava plateaus. A large area is west of Lower Cummings Reservoir. This soil has a profile similar to the one described as representative of the series, except that cobbles cover 50 to 60 percent of the surface. Also included are areas of this soil where cobbles cover 15 to 60 percent of the surface.

Included with this soil in mapping and making up about 5 percent of the acreage is Rock outcrop; 2 percent is Deven clay loam, 0 to 9 percent slopes; 2 percent is Puls extremely stony clay loam, 0 to 9 percent slopes; 1 percent is a soil that is similar to this Karcal soil but is less than 20 inches deep to bedrock; and 1 percent is a soil that is similar to this Karcal soil but has a thin hardpan overlying the basalt. Soils that have cobbles covering 15 to 60 percent of the surface or that are near faults and are underlain by sediment are also included.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range and wildlife habitat. Capability unit VIs–1 (dryland); Clayey Slopes range site; Storie Index 17.

Figure 5.—**In this profile of a Karcal soil, hard basalt bedrock is at a depth of 2 feet. Arrows indicate the lower boundary of the A11 and A12 horizons.**

147—Karcal-Ninekar complex, 0 to 9 percent slopes. This complex consists of nearly level to moderately sloping soils on lava plateaus. A large area is northeast of the town of Likely on the Likely Tableland. The Karcal soil makes up about 50 percent of the acreage and is on slightly lower positions on the lava plateau than the Ninekar soil. The Ninekar soil makes up 40 percent of the acreage and is on the slightly higher positions. The Karcal soil has the profile described as representative of that series.

Included with these soils in mapping and making up about 4 percent of the acreage is Deven clay loam, 0 to 9 percent slopes; 3 percent is Rock outcrop; and 2 percent is Ager cobbly clay, 2 to 5 percent slopes. In areas near Danhauser Reservoir, the soils formed in local alluvium overlying basalt and the depth to bedrock is more than 40 inches. In some areas of this map unit on the Likely Tableland, the soils have a weakly cemented hardpan overlying basalt.

Runoff is medium, and the hazard of erosion is moderate. Cobbles and stones on the surface hinder cultivation, but these coarse fragments can be removed or windrowed, and the areas can be seeded to grass to increase forage production.

The soils in this complex are used for range, watershed, and wildlife habitat. Capability unit VIs–1 (dryland); Clayey Slopes range site; Storie Index 17.

Kinkel Series

The Kinkel series consists of well drained, gently sloping to very steep soils on uplands. The soils formed in material that was weathered mostly from welded tuff rock. The slope ranges from 2 to 50 percent. The elevation ranges from 5,200 to 5,800 feet. Average annual precipitation is 18 to 20 inches, average annual air temperature is 45° F, and the frost-free period is about 80 days. The vegetation is conifer trees, mainly ponderosa pine and incense-cedar.

In a representative profile, the surface layer is dark gray, slightly acid loam about 8 inches thick. The subsurface layer is pinkish gray, medium acid clay loam about 18 inches thick. The subsoil is pinkish gray and reddish brown cobbly clay loam about 27 inches thick. Hard welded tuff is at a depth of 53 inches.

Permeability is moderately slow, and the available water capacity is 6.5 to 8.5 inches. The rooting depth is 45 to more than 60 inches.

Kinkel soils are used for woodland and wildlife habitat.

Representative profile of Kinkel loam, 30 to 50 percent slopes, about 550 feet southeast from the point at which Pleasant Creek crosses a dirt road and about 50 feet west of old logging road in SW¼NE¼ sec. 24, T. 47 N., R. 14 E.

O1—1 inch to 0; undecomposed litter from pine and incense-cedar trees.

A1—0 to 8 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium and coarse granular structure; soft, very friable, nonsticky and slightly plastic; many very fine and medium roots and common fine roots; many fine interstitial pores and few very fine tubular pores; 10 percent angular gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

A2—8 to 26 inches; pinkish gray (7.5YR 6/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many medium and fine, common very fine, and few coarse roots; common fine interstitial pores and common very fine tubular pores; 10 to 15 percent angular gravel, by volume; medium acid (pH 5.8); gradual wavy boundary.

B21t—26 to 37 inches; pinkish gray (7.5YR 6/2) cobbly clay loam, dark brown (7.5YR 4/2) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; common medium and fine, few coarse, and very few very fine roots; few fine interstitial pores and few very fine tubular pores; few thin clay films in pores; about 40 percent cobbles and stones, by volume; medium acid (pH 6.0); clear wavy boundary.

B22t—37 to 53 inches; reddish brown (5YR 5/4) heavy cobbly clay loam, reddish brown (5YR 4/4) moist; moderate medium and coarse subangular blocky structure; hard, friable, very sticky and plastic; few very fine roots; very few very fine tubular pores; common moderately thick clay films in pores; about 45 percent cobbles and stones, by volume; medium acid (pH 6.0); clear wavy boundary.

R—53 inches; hard welded tuff.

The solum ranges from 45 to 60 inches in thickness.

The A1 horizon ranges from 7 to 10 inches in thickness. It is gray, dark gray, grayish brown, or dark grayish brown in hue of 10YR. The A2 horizon ranges from 16 to 20 inches in thickness. The A horizon is loam or clay loam and is 10 to 15 percent gravel and cobbles, by volume.

The B horizon ranges from 12 to 20 inches in thickness. It is pinkish gray, brown, reddish brown, or dark brown in hue of 7.5YR and 5YR. It is clay loam or heavy clay loam, and is 35 to 50 percent cobbles and stones, by volume. Stones are more numerous with increasing depth. Reaction in the B horizon ranges from medium acid through slightly acid.

The Kinkel soils in this survey area are a taxadjunct to the Kinkel series because they are a few degrees cooler than the range that is defined for the Kinkel series. The difference, however, does not alter the use and behavior of the soils. The total acreage is small.

148—Kinkel loam, 2 to 15 percent slopes. This gently sloping to strongly sloping soil is on low uplands.

Included with this soil in mapping and making up about 3 percent of the acreage is Kinkel loam, 30 to 50 percent slopes. Some areas of Kinkel soils that have a surface layer of gravelly loam are also included.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for woodland and wildlife habitat. Equipment limitations and the windthrow hazard are slight. Seedling mortality and plant competition are moderate. Species to manage in existing stands are ponderosa pine, Jeffrey pine, white fir, and incense-cedar. Ponderosa pine and Jeffrey pine are recommended for planting on this soil. Where the soil is used to grow ponderosa pine, the site index is 78. Capability unit IVe–1 (dryland); not placed in a range site; Storie Index 34.

149—Kinkel loam, 30 to 50 percent slopes. This steep soil occurs on north-facing slopes in the uplands. It has the profile described as representative of the series.

Included with this soil in mapping is Woodcock stony loam, 30 to 50 percent slopes.

Runoff is rapid, and the hazard of erosion is high.

This soil is used principally for woodland and wildlife habitat. The windthrow hazard is slight. Plant competition and seedling mortality are moderate. Equipment limitations are severe. Species to manage

in existing stands are ponderosa pine, Jeffrey pine, white fir, and incense-cedar. Ponderosa pine and Jeffrey pine are recommended for planting on this soil. Where the soil is used for ponderosa pine, the site index is 78. Capability unit VIe–1 (dryland); not placed in a range site; Storie Index 9.

Ladd Series

The Ladd series consists of well drained soils on alluvial fans. The soils formed in alluvium derived from basic igneous rocks. The slope ranges from 0 to 9 percent. The elevation ranges from 4,300 to 5,050 feet. Annual precipitation is 12 to 16 inches, average annual air temperature is 46° to 48° F, and the frost-free period is 80 to 100 days. Vegetation is shrubs, grass, and juniper. It consists of big sagebrush, rabbitbrush, bluebunch wheatgrass, Idaho fescue, cheatgrass, mustard, and scattered western juniper.

In a representative profile, the surface layer is grayish brown and dark grayish brown, slightly acid sandy loam about 12 inches thick. The subsoil is 28 inches thick. The upper part of the subsoil is dark brown, slightly acid sandy clay loam 11 inches thick, and the lower part is dark yellowish brown, neutral clay loam about 17 inches thick. The substratum is brown, neutral sandy loam to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is 9 to 12 inches. The effective rooting depth is more than 60 inches.

Ladd soils are used mostly for irrigated and dryland pasture and hay.

Representative profile of Ladd sandy loam, 2 to 9 percent slopes, on an alluvial fan 75 feet west of dirt road (County Road 62) that leads to Bayley Reservoir and 2.1 miles northwest of its junction with Westside Road (County Road 60) in NW¼SW¼ sec. 28, T. 41 N., R. 12 E.

A11—0 to 4 inches; grayish brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine and few fine roots; many very fine interstitial pores; 5 percent gravel, by volume; slightly acid (pH 6.3); abrupt smooth boundary.

A12—4 to 12 inches; dark grayish brown (10YR 4/2) sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine roots; few very fine and fine tubular pores; 5 percent gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

B1—12 to 23 inches; dark brown (10YR 4/3) sandy clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and very few coarse tubular pores; few thin clay films in pores; 5 percent gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

B2t—23 to 40 inches; dark yellowish brown (10YR 4/4) clay loam, dark brown (7.5YR 4/2) moist; weak medium and coarse subangular blocky structure; hard, friable, slightly sticky and plastic; few very fine and fine roots; very few very fine interstitial pores; common moderately thick clay films on peds; 10 percent gravel, by volume; neutral (pH 6.8); abrupt smooth boundary.

C—40 to 60 inches; brown (7.5YR 5/4) sandy loam, dark reddish brown (5YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; very few very fine roots; many very fine interstitial pores; distinct wavy bands of finer textured material that are ⅛ inch thick in lower part; 5 percent gravel, by volume; neutral (pH 7.0).

The solum is 34 to 45 inches thick and is slightly acid or neutral.

The A horizon ranges from 10 to 15 inches in thickness. It is grayish brown, dark grayish brown, brown, or dark brown in hue of 10YR. It is sandy loam, loam, or gravelly loam. It has platy or granular structure or is massive.

The B horizon ranges from 24 to 30 inches in thickness. It is brown, dark brown, yellowish brown, or dark yellowish brown in hue of 10YR and 7.5YR. It is loam, sandy clay loam, clay loam, or silty clay loam. It has subangular or angular blocky structure. Gravel makes up as much as 15 percent of the B2t horizon.

The C horizon is brown, dark brown, light yellowish brown, yellowish brown, or dark yellowish brown in hue of 10YR and 7.5YR. It is sandy loam or loam. Reaction is neutral or mildly alkaline. In places the lower part of the C horizon is weakly calcareous.

150—Ladd sandy loam, 0 to 2 percent slopes. This nearly level soil is commonly on alluvial fans in small, narrow drainageways in Warm Springs Valley. Most areas are small and irregular in shape.

Included with this soil in mapping is a soil that is similar to this Ladd soil but is calcareous in the lower part of the subsoil and in the substratum. Also included, making up 3 percent of the acreage, is Buntingville clay loam, 0 to 2 percent slopes; 2 percent is Ladd sandy loam, 2 to 9 percent slopes; and 2 percent is Calimus loam, 0 to 2 percent slopes. Also included are some areas of soils near the center of the valley that have a surface layer of loam.

Runoff is very slow, and there is no hazard of erosion.

This soil is used for irrigated pasture, hay, and grain crops; dryland pasture and hay; and range. The small and irregularly shaped areas of this soil affect its use for agriculture. Capability unit IIIc–1 (irrigated); IVe–1 (dryland); Loamy range site; Storie Index 81.

151—Ladd sandy loam, 2 to 9 percent slopes. This gently sloping and moderately sloping soil is commonly on alluvial fans throughout Warm Springs Valley. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is a soil that is similar to this Ladd soil but is calcareous in the lower part of

Figure 6.—**This area of Ladd sandy loam, 2 to 9 percent slopes, is used for irrigated grass and alfalfa hay. Tuff outcrop-Casuse, eroded complex, 30 to 50 percent slopes, is in the background.**

the subsoil and in the substratum; 3 percent is Buntingville clay loam, 2 to 9 percent slopes; 2 percent is Lakeview loam, 0 to 2 percent slopes; 2 percent is Calimus loam, 2 to 9 percent slopes; and 2 percent is Modoc gravelly loam, 0 to 9 percent slopes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated and dryland hay and pasture, irrigated grain crops, and range (fig. 6). Capability unit IIIe–1 (irrigated); IVe–1 (dryland); Loamy range site; Storie Index 77.

Lakeview Series

The Lakeview series consists of moderately well drained soils in basins and on alluvial fans. The soils formed in stratified alluvium derived from basic igneous rocks. The slope ranges from 0 to 5 percent. The elevation ranges from 4,200 to 5,200 feet. Annual precipitation is 14 to 18 inches, average annual air temperature is 47° to 49° F, and the frost-free period is 80 to 100 days. The vegetation is perennial grass and annual plants. The perennials include bluegrass, brome, and wildrye, and the annuals include mustard and cheatgrass. Rabbitbrush is in some places.

In a representative profile, the surface layer is very dark grayish brown, dark grayish brown, and very dark gray slightly acid loam about 49 inches thick. The underlying material is very dark grayish brown, slightly acid loam to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is 8 to 10 inches. The effective rooting depth is 60 inches or more.

Lakeview soils are used for irrigated hay and pasture. They receive runoff from higher-lying soils in spring.

Representative profile of Lakeview loam, 0 to 2 percent slopes, 0.6 mile east of U.S. Highway 395 on dirt road up Thoms Creek and 165 feet south of middle culvert in SW¼NE¼ sec. 1, T. 43 N., R. 13 E.

A11—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and medium roots; common very fine interstitial pores; common very fine tubular pores; 5 percent, by volume, rounded gravel on the surface; slightly acid (pH 6.5); abrupt smooth boundary.

A12—7 to 31 inches; dark grayish brown (10YR 4/2) loam, dark brown (10YR 3/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine and few medium roots; few very fine interstitial pores and few very fine and common medium tubular pores; brown (10YR 5/3) layers 1 to 4 inches

thick; slightly acid (pH 6.5); clear smooth boundary.

A13b—31 to 49 inches; very dark gray (10YR 3/1) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine interstitial pores and few very fine and fine tubular pores; krotovinas 1 inch to 4 inches in diameter filled with material from the A11 or A12 horizon; slightly acid (pH 6.5); gradual wavy boundary.

C—49 to 60 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine interstitial pores and common very fine tubular pores; few thin clay films bridging sand grains; slightly acid (pH 6.5).

The A horizon ranges from 42 to 56 inches in thickness. It is dark grayish brown, very dark grayish brown, dark gray, or very dark gray. It is loam, silt loam, or clay loam. It has granular or subangular blocky structure or is massive. It is slightly hard to hard but is not both massive and hard in the same place. Reaction ranges from slightly acid to neutral.

The C horizon is dark grayish brown, very dark grayish brown, dark gray, or very dark gray in hue of 10YR. It is sandy loam, loam, or silt loam. It has angular blocky structure or is massive. Consistence is slightly hard to very hard. Reaction is slightly acid to neutral.

152—Lakeview loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans and in basins. The areas are long and narrow and are irregular in shape. Recently deposited material is common in many places. This soil has the profile described as representative of the series.

Included with this soil in mapping is Buntingville clay loam, 0 to 2 percent slopes. Also included, making up 3 percent of the acreage, is Pit silty clay loam, 0 to 2 percent slopes; 2 percent is Drews loam, 0 to 5 percent slopes; and 2 percent is Salisbury gravelly loam, 0 to 9 percent slopes. Small areas of salt-affected soils in Russell Slough and some areas of soils that have slopes of about 2.5 percent are also included.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated pasture and hay. Some areas are difficult to irrigate because of their size and shape. Capability unit IIIc–1 (irrigated); not placed in a range site; Storie Index 95.

153–Lakeview clay loam, 2 to 5 percent slopes. This gently sloping soil is on recent alluvial fans at the mouth of Franklin Creek. It has a profile similar to the one described as representative of the series, except the surface layer is clay loam and consists of about 10 percent cobbles, by volume. Channeling has occurred in places where the creek has changed course.

Included with this soil in mapping and making up about 5 percent of the acreage is Salisbury very cobbly loam, 0 to 9 percent slopes; 3 percent is Salisbury gravelly loam, 0 to 9 percent slopes; and 2 percent is Pit silty clay loam, 0 to 2 percent slopes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated pasture and hay. Capability unit IIIe–1 (irrigated); not placed in a range site; Storie Index 31.

Lithic Xerorthents

Lithic Xerorthents consist of well drained soils on lava plateaus in uplands. The soils are variable in texture but are mostly loamy. They are 4 to 10 inches deep to bedrock. They are in eroded or truncated areas.

The vegetation is mainly western juniper and scattered perennial grasses.

Runoff is rapid, and the hazard of erosion is high.

Lithic Xerorthents are used mainly for watershed and recreation.

Lithic Xerorthents are mapped only in a complex with Rock outcrop.

Lolak Series

The Lolak series consists of poorly drained, nearly level soils on smooth lake basins adjacent to lakes that have a fluctuating water level. The soils formed in fine textured lacustrine sediment derived from tuff, basalt, and volcanic ash. They are underlain by stratified lacustrine sediment. The slope ranges from 0 to 2 percent. The elevation ranges from 4,650 to 4,725 feet. Annual precipitation is 12 to 15 inches, the average annual air temperature is 46° to 48° F, and the frost-free period is about 80 days. The vegetation is scattered saltgrass and pickleweed.

In a representative profile, the surface layer is light brownish gray calcareous silty clay loam and clay loam about 15 inches thick. The underlying material, to a depth of 44 inches, is light olive gray and light gray calcareous silty clay. Below this, to a depth of 60 inches or more, it is light brownish gray calcareous sand.

Permeability is very slow, and the available water capacity is 9 to 10 inches. The effective rooting depth is 60 inches or more. Depth to a water table is 12 to 24 inches. These soils have salts or alkali, or both, throughout the profile, but the largest concentration is near or at the surface.

Lolak soils are used for range.

Representative profile of Lolak silty clay loam, on the edge of a level lake basin 360 feet east of stock pond and 760 feet north of east-west dirt road, 2.7 miles south and west on dirt road from Westside Road to stock pond and 5 miles southwest of the town of Davis Creek in NW¼NW¼ sec. 27, T. 45 N., R. 13 E.

A11—0 to 9 inches; light brownish gray (2.5Y 6/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; very hard, friable, very sticky and plastic; common very fine roots; common very fine interstitial and tubular pores; strongly effervescent; disseminated lime; strongly alkaline (pH 8.6); clear smooth boundary.

A12—9 to 15 inches; light brownish gray (2.5Y

6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; hard, friable, very sticky and plastic; very few very fine roots; common very fine tubular pores and very few very fine interstitial pores; strongly effervescent; disseminated lime; strongly alkaline (pH 8.8); abrupt smooth boundary.

C1—15 to 32 inches; light olive gray (5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; common fine prominent bluish gray (5B 5/1) moist iron mottles which change or disappear on exposure to air; weak fine and medium subangular blocky structure; very hard, firm, sticky and very plastic; very few very fine roots; very few very fine tubular pores; strongly effervescent; disseminated lime; strongly alkaline (pH 8.6); clear smooth boundary.

C2—32 to 44 inches; light gray (5Y 7/2) silty clay, grayish brown (2.5Y 5/2) moist; massive, very hard, firm, sticky and plastic; very few very fine interstitial pores; strongly effervescent; disseminated lime; very strongly alkaline (pH 9.2); abrupt smooth boundary.

IIC3—44 to 60 inches; light brownish gray (2.5Y 6/2) sand; dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine interstitial pores; violently effervescent; disseminated lime; strongly alkaline (pH 8.8).

The A horizon ranges from 7 to 10 inches in thickness. It is light brownish gray, light gray, pale brown, yellowish brown, or light yellowish brown in hue of 5Y, 2.5Y, and 10YR. Iron mottles, which are in some or all parts of the profile below a depth of 15 inches, change or disappear if they are exposed to the air. Texture of the 10- to 40-inch control section is silty clay that is stratified with thin lenses of clay loam and fine sand. Thick layers of sand or gravelly sand are below a depth of 40 inches in some places. The soil has angular or subangular blocky structure or is massive. Consistence of dry soil is hard or very hard except in the sand layers.

154—Lolak silty clay loam. This is a nearly level soil on smooth lake basins adjacent to the southern end of Goose Lake.

Included with this soil in mapping and making up about 3 percent of the acreage is Fluvaquents.

Runoff is very slow, and there is no hazard of erosion.

This soil is used for range and wildlife habitat. Capability unit VIIw–1 (dryland); Saline Bottom range site; Storie Index 1.

Lorella Series

The Lorella series consists of well drained soils on upland slopes. The soils formed in material that was weathered from basic igneous rocks such as basalt, rhyolite, and lapilli tuff. They are underlain by rhyolite. The slope ranges from 5 to 50 percent. The elevation ranges from 4,700 to 5,300 feet. Annual precipitation is 14 to 18 inches, average annual air temperature is 46° to 48° F, and the frost-free period is 80 to 100 days. The vegetation is brush and grass and consists mostly of bitterbrush, rabbitbrush, scattered juniper, mountainmahogany, stipa, Idaho fescue, and bluebunch wheatgrass.

In a representative profile, the surface layer is dark grayish brown, mildly alkaline cobbly clay loam about 2 inches thick. The subsoil is very dark grayish brown cobbly clay loam and dark brown cobbly clay about 17 inches thick. Hard rhyolite bedrock is at a depth of 19 inches.

Permeability is slow.

Lorella soils are used for range, wildlife habitat, and watershed.

Representative profile of Lorella cobbly clay loam, 30 to 50 percent slopes, on the south side of a drainage outlet 55 feet west of the center of U.S. Highway 395, 6.5 miles north of the town of Davis Creek, 520 feet north and 80 feet east of SE corner sec. 16 in sec. 15, T. 46 N., R. 14 E.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) cobbly clay loam, very dark brown (10YR 2/2) moist; weak medium and coarse granular structure; soft, friable, sticky and plastic; common very fine roots; common very fine interstitial pores; 15 percent rhyolite cobbles, by volume; mildly alkaline (pH 7.4); abrupt smooth boundary.

B21t—2 to 10 inches; very dark grayish brown (10YR 3/2) cobbly heavy clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine and few fine and medium roots; few very fine interstitial pores; common tubular pores; common moderately thick clay films on peds and in pores; 20 percent rhyolite cobbles and 5 percent gravel, by volume; mildly alkaline (pH 7.4); clear wavy boundary.

B22t—10 to 19 inches; dark brown (7.5YR 3/2) cobbly clay, dark brown (7.5YR 3/2) moist; strong coarse angular blocky structure; very hard, friable, very sticky and very plastic; few very fine and coarse roots; common very fine tubular pores; many moderately thick clay films on peds and in pores; 40 percent rhyolite cobbles, by volume; neutral (pH 7.0); abrupt irregular boundary.

R—19 inches; gray (5YR 5/1) hard rhyolite; few thin clay films in rock fractures.

Depth to bedrock and the thickness of the solum are 10 to 20 inches.

The A horizon ranges from 0 to 6 inches in thickness. It is dark grayish brown, very dark grayish brown, brown, dark brown, and very dark brown in hue of 10YR and 7.5YR. It is loam, clay loam, cobbly loam, cobbly clay loam, very cobbly clay loam, or very cobbly loam. It has granular or platy structure or is massive.

The consistence of dry soil is soft or slightly hard. Reaction is slightly acid to mildly alkaline.

The B horizon ranges from 7 to 17 inches in thickness. It is dark grayish brown, very dark grayish brown, dark brown, or very dark brown in hue of 10YR and 7.5YR. It is very cobbly or cobbly heavy clay loam or clay. It has weak to moderate prismatic or angular blocky or moderate to strong subangular blocky structure. Consistence of dry material is hard or very hard; of wet material it is sticky and plastic or very plastic. Reaction is neutral to mildly alkaline. Pressure faces are common in the Bt horizon. Cobbles and stones make up 20 to 50 percent of the Bt horizon but average more than 35 percent.

155—Lorella loam, 5 to 30 percent slopes. This moderately sloping to moderately steep soil is on pediments south of Thoms Creek. It has a profile similar to the one described as representative of the series, except that the surface layer is loam and is not cobbly.

Included with this soil in mapping and making up about 10 percent of the acreage is Daphnedale clay loam, deep variant, 5 to 15 percent slopes; 4 percent is Deven very stony clay loam, 2 to 30 percent slopes; and 1 percent is Rock outcrop.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 1 to 2.5 inches. The rooting depth is 15 to 20 inches. Because of the many faults in areas of this soil, there are many small springs and wet areas.

This soil is used for pasture, range, and wildlife habitat. Capability unit VIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 12.

156—Lorella loam, 5 to 30 percent slopes, eroded. This moderately sloping to moderately steep soil is on uplands south of Ryegrass Swale. It has a profile similar to the one described as representative of the series, except that the surface layer is about 3 inches thick and is not cobbly. Bedrock, mainly basalt, is at a depth of 10 to 15 inches.

Included with this soil in mapping and making up about 8 percent of the acreage is Deven very stony clay loam, 2 to 30 percent slopes; 3 percent is Rock outcrop.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 1 to 2 inches.

This soil is used for wildlife habitat and watershed. Capability unit VIIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 10.

157—Lorella loam, 30 to 50 percent slopes. This steep soil is on mountainous uplands near Thoms Creek. It has a profile similar to the one described as representative of the series, except that the surface layer is not cobbly.

Included with this soil in mapping and making up 10 percent of the acreage is Deven very stony clay loam, 30 to 50 percent slopes; 3 percent is Daphnedale very cobbly clay loam, deep variant, 30 to 50 percent slopes; and 2 percent is Lithic Xerorthents and Rock outcrop.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 1 to 2.5 inches. The rooting depth is 15 to 20 inches.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 7.

158—Lorella cobbly clay loam, 15 to 30 percent slopes. This moderately steep soil is on toe slopes in Goose Lake Valley. It has a profile similar to the one described as representative of the series, except that the surface layer is 4 to 6 inches thick.

Included with this soil in mapping and making up 5 percent of the acreage is Daphnedale clay loam, deep variant, 5 to 15 percent slopes; 3 percent is Lorella loam, 5 to 30 percent slopes; 2 percent is Deven very stony clay loam, 2 to 30 percent slopes; and 1 percent is Rock outcrop.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 1 to 2.5 inches. The rooting depth is 15 to 20 inches.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 11.

159—Lorella cobbly clay loam, 30 to 50 percent slopes. This steep soil is on mountainous uplands. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 10 percent of the acreage is Daphnedale very cobbly loam, deep variant, 30 to 50 percent slopes; 3 percent is Deven very stony clay loam, 30 to 50 percent slopes; 2 percent is Lorella, deep variant, 45 to 50 percent slopes; and 1 percent is Rubble land.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 2 to 2.5 inches. The rooting depth is 15 to 20 inches.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 6.

160—Lorella cobbly clay loam, 30 to 50 percent slopes, eroded. This steep soil is on south-facing mountainous uplands in Goose Lake Valley north of Pleasants Creek. It has a profile similar to the one described as representative of the series, except that the depth to bedrock is about 10 to 15 inches, and cobbles and stones make up about 50 percent of the subsoil.

Included with this soil in mapping and making up about 6 percent of the acreage is Rock outcrop; 4 percent is Lithic Xerorthents; and 5 percent is McQuarrie stony loam, 30 to 50 percent slopes, eroded.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 1 to 1.5 inches. The rooting depth is 10 to 15 inches. Because of the hazard of erosion and shallowness, this soil has little value for range.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIIe–1 (dryland); Shallow Stony Uplands range site; Storie Index 17.

Lorella Variant

The Lorella variant consists of well drained soils on side slopes in uplands. The soils formed in colluvium and residuum from basalt, andesite, and tuff. They are underlain by hard andesite. The slope ranges from 30 to 50 percent. The elevation ranges from 4,400 to 5,400 feet. Annual rainfall is 12 to 14 inches, average annual air temperature is 46° to 48° F, and the frost-free period is 80 to 100 days. The vegetation is juniper, shrubs, and grass. It consists of western juniper, big

sagebrush, rabbitbrush, bluegrass, squirreltail, and cheatgrass.

In a representative profile, the surface layer is very dark grayish brown, neutral very stony loam and very cobbly loam about 10 inches thick. The subsoil is dark brown and reddish brown, slightly acid very cobbly heavy clay loam and very stony clay about 30 inches thick. Hard fractured andesite is at a depth of 40 inches.

Permeability is slow, and the available water capacity is 5 to 6 inches. The effective rooting depth is 30 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Lorella very stony loam, deep variant, in an area of Lorella, deep variant-Rubble land association, steep, on a colluvial upland slope 0.4 mile northwest of wire gate or 0.5 mile northwest of dirt road to Christenson Ranch headquarters, and about 350 feet northwest of spring in NW¼NW¼ sec. 11, T. 39 N., R. 12 E.

A11—0 to 5 inches; very dark grayish brown (10YR 3/2) very stony loam, very dark gray (10YR 3/1) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots and common fine roots; common very fine interstitial pores; few very fine tubular pores; 40 percent stones and cobbles on surface, by volume; neutral (pH 6.8); clear smooth boundary.

A12—5 to 10 inches; very dark grayish brown (10YR 3/2) very cobbly loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common medium, very fine and fine roots and few coarse roots; common very fine interstitial pores; few very fine tubular pores; 50 percent cobbles, by volume; neutral (pH 6.8); clear wavy boundary.

B21t—10 to 25 inches; dark brown (7.5YR 3/2) very cobbly heavy clay loam, dark brown (7.5YR 3/2) moist; strong medium and coarse angular blocky structure; very hard, friable, sticky and plastic; few very fine, fine, and coarse roots; few very fine tubular pores; 40 percent cobbles and stones, by volume; many moderately thick clay films on peds and in pores; slightly acid (pH 6.5); gradual wavy boundary.

B22t—25 to 40 inches; reddish brown (5YR 4/3) very stony clay, dark reddish brown (5YR 3/3) moist; moderate medium angular blocky structure; very hard, friable, sticky and plastic; few very fine and fine roots; few very fine tubular pores; 60 percent stones, by volume; continuous moderately thick clay films on peds and in pores; slightly acid (pH 6.5); clear wavy boundary.

R—40 inches; gray hard fractured andesite.

Depth to hard andesite or basalt is 30 to 40 inches. The soil is slightly acid or neutral throughout. The mollic epipedon is 24 to 30 inches thick and includes part of the argillic horizon. Rock fragments make up 40 to 60 percent of the textural control zone.

The A horizon is 8 to 10 inches thick. It is dark grayish-brown, very dark grayish brown, dark brown, or very dark brown in hue of 10YR and 7.5YR. It is very stony loam or very stony clay loam that has granular or subangular blocky structure. Consistence is soft or slightly hard.

The Bt horizon is 22 to 30 inches thick. It is dark brown, very dark brown, or reddish brown in hue of 7.5YR and 5YR. It is very cobbly or very stony heavy clay loam or clay that has subangular blocky or angular blocky structure.

161—Lorella, deep variant-Rubble land association, steep. This association is on steep colluvial and residual slopes in Stones Canyon and on the western escarpment of the Likely Basin. The Lorella variant which has a surface layer of very stony loam makes up about 35 percent of the association. This soil formed in colluvium and has slope of 45 to 50 percent. Rubble land makes up 30 percent of the association. It is scattered throughout the mapped areas. A Deven soil that has a surface layer of very stony clay loam makes up 20 percent of the association. This soil formed in residuum. It is on the upper part of slopes.

The Lorella variant has the representative profile. Rubble land consists of barren colluvial areas in which about 90 percent of the surface is covered by loose stones and boulders, mainly basalt. The Deven soil has a profile similar to the one described as representative of the Deven series, except that the surface layer is stony.

Included with this unit in mapping and making up about 8 percent of the acreage is Karcal very cobbly clay, 0 to 9 percent slopes; 5 percent is Daphnedale stony loam, 30 to 50 percent slopes; and 2 percent is Rock outcrop and Lithic Xerorthents.

Runoff is rapid and the hazard of erosion is high on the Lorella variant and the Deven soil. The hazard of erosion and rate of runoff were not estimated for the Rubble land part.

The soils in this association are used for range, watershed, and wildlife habitat. Storie Index 3; Lorella variant in capability unit VIIe–1 (dryland) and Dry Loamy range site; Rubble land in capability unit VIIIs–1 (dryland) and not placed in a range site.

Lovejoy Series

The Lovejoy series consists of moderately well drained soils on lake terraces. The soils formed in alluvium that was derived from volcanic rock. They have an indurated silica-cemented hardpan. The slope ranges from 0 to 5 percent. The elevation ranges from 4,700 to 4,800 feet. Annual precipitation is 14 to 16 inches, the average annual air temperature is 48° F, and the length of the frost-free period is about 80 days. Vegetation consists of shrubs and grass, mainly low sagebrush, cheatgrass, and bluegrass.

In a representative profile, the surface layer is light brownish gray, slightly acid silt loam about 3 inches thick. The next layer is gray, slightly acid silt loam about 5 inches thick. The subsoil is dark brown,

neutral clay and brown, mildly alkaline heavy clay loam about 13 inches thick. An indurated silica-cemented hardpan is at a depth of 21 inches.

Permeability is very slow, and the available water capacity is 3 to 4 inches. The rooting depth is 20 to 30 inches.

Lovejoy soils are used for range.

Representative profile of Lovejoy silt loam, 0 to 5 percent slopes, 35 feet south of fence and 0.3 mile west of the north-south ½ corner line in SW¼NW¼ sec. 30, T. 45 N., R. 13 E.

A1—0 to 3 inches; light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate thin platy structure; hard, very friable, sticky and slightly plastic; few fine roots; many fine interstitial pores and few fine tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

A&B—3 to 8 inches; gray (10YR 6/1) silt loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; common very fine roots; common fine interstitial pores and few very fine tubular pores; slightly acid (pH 6.3); abrupt smooth boundary.

B21t—8 to 16 inches; dark brown (7.5YR 3/2) clay, dark brown (7.5YR 3/2) moist; strong medium and coarse columnar structure; very hard, extremely firm, very sticky and plastic; few fine inped and common fine exped roots; very few very fine tubular pores; many moderately thick clay films on peds and common moderately thick clay films in pores; neutral (pH 7.0); clear smooth boundary.

B22t—16 to 21 inches; brown (7.5YR 5/4) heavy clay loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; very hard, friable, sticky and plastic; common fine roots; common very fine tubular pores and few fine interstitial pores; common moderately thick clay films on peds and in pores; mildly alkaline (pH 7.5); clear smooth boundary.

Csim—21 to 23 inches; very dark grayish brown (10YR 3/2) hardpan that has very pale brown (10YR 7/4) laminar indurated silica bands; roots matted on top of the hardpan.

Depth to the hardpan is 20 to 30 inches. Where the soil is in small drainageways, gravel is at the surface. Reaction ranges from slightly acid to neutral. In places, the surface layer has vesicular pores.

The A and A&B horizons combined are 8 to 12 inches thick. They are light brownish gray, gray, or light gray in hue of 10YR. In places, a thin, white A2 horizon caps the B2t horizon.

The B2t horizon ranges from 12 to 18 inches in thickness and is heavy clay loam or clay; dry soil material is brown or dark brown in hue of 7.5YR. Reaction ranges from neutral to mildly alkaline. Structure of the upper part of the B2t horizon is strong columnar, and that of the lower part is weak to moderate subangular blocky.

The Lovejoy soils in this survey area are a taxadjunct to the Lovejoy series because reaction of the A and B2t horizons is outside the defined range of the series. They have a slightly acid to neutral A horizon and a neutral to mildly alkaline B2t horizon. These differences, however, do not alter the use or behavior of the soils.

162–Lovejoy silt loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on lake terraces. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Bieber gravelly loam, 0 to 9 percent slopes; 2 percent is Jenny silty clay, 0 to 5 percent slopes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for range and pasture. Capability unit IVe–3 (dryland); Hardpan Terrace range site; Storie Index 23.

163—Lovejoy-Reba complex, 0 to 5 percent slopes. This complex is on dissected lake terraces in Warm Springs Valley south of Kelly Reservoir. The soils occur together in mounded areas. A Lovejoy soil that has a surface layer of very fine sandy loam makes up 40 percent of the complex, and Reba loam, 0 to 5 percent slopes, makes up 30 percent. The Reba soil is on the high mounds, and the Lovejoy soil is on lower mounds and in intermound positions.

The Lovejoy soil in this complex has a profile similar to the one described as representative of the series, except that the surface layer is very fine sandy loam. The subsurface layer is 2 to 6 inches thick. The Reba soil has a profile similar to the one described as representative of the Reba series, except that the surface layer is 5 to 8 inches thick.

Included in mapping and making up 15 percent of the acreage is Rumbo loam, 2 to 5 percent slopes, eroded; 8 percent is Ager clay, 2 to 15 percent slopes; and 7 percent is a soil that is similar to this Reba soil, except the surface layer and the upper 2 or 3 inches of the subsurface layer have been lost through erosion.

Runoff is medium. The hazard of erosion is moderate on the Lovejoy soil and slight on the Reba soil.

The soils in this complex are used for range and pasture. Grazing must be managed carefully to prevent erosion. Capability unit IVe–3 (dryland); Storie Index 73; Lovejoy soil in Hardpan Terrace range site, Reba soil in Loamy range site.

Lyonman Series

The Lyonman series consists of well drained soils on mountainous uplands. The soils formed in colluvium derived from andesite and basalt. They are underlain by hard basalt. The slope ranges from 15 to 50 percent. The elevation ranges from 5,600 to 6,200 feet. Annual precipitation is 20 to 22 inches, the average annual air temperature is 42° to 44° F, and the frost-free period is about 50 days. The vegetation consists of white fir and scattered ponderosa pine and grasses and herbs such as stipa and vetch.

In a representative profile, the surface layer is

brown, slightly acid loam about 11 inches thick. The subsoil is brown and light brown, medium acid clay loam about 33 inches thick. Hard basalt is at a depth of 44 inches.

Permeability is moderately slow, and the available water capacity is 6 to 9 inches. The effective rooting depth is 40 to 60 inches.

Lyonman soils are used for woodland, recreation, and wildlife habitat.

Representative profile of Lyonman loam, 30 to 50 percent slopes, about 36 feet east and 60 feet south of the E¼ corner of sec. 3 in the NW¼SW¼ sec. 2, T. 44 N., R. 14 E.

O1—2½ inches to 0; black (10YR 2/1) needles of white fir in various stages of decomposition; few very fine roots; slightly acid (pH 6.5); clear smooth boundary.

A11—0 to 6 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine and common very fine and medium roots; common very fine interstitial pores and many very fine tubular pores; 10 percent cobbles, by volume; slightly acid (pH 6.3); clear smooth boundary.

A12—6 to 11 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots and common coarse roots; few very fine interstitial and tubular pores; slightly acid (pH 6.3); gradual smooth boundary.

B1t—11 to 32 inches; brown (7.5YR 4/2) clay loam, dark reddish brown (5YR 3/2) moist; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and plastic; few very fine and coarse roots and common fine and medium roots; few very fine interstitial and tubular pores; common thin clay films on peds and in pores; 10 to 15 percent cobbles, by volume; medium acid (pH 6.0); gradual smooth boundary.

B2t—32 to 44 inches; light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; common fine faint (7.5YR 6/6) mottles; moderate medium and coarse angular blocky structure; hard, friable, slightly sticky and plastic; common very fine and few fine roots; common very fine and few fine tubular pores; common moderately thick clay films in pores and on peds; 30 percent cobbles, by volume; medium acid (pH 6.0); clear smooth boundary.

R—44 inches; very dark gray (N 3/0) hard basalt.

Depth to bedrock ranges from 40 inches to more than 60 inches. The O horizon is generally less than 3 inches thick.

The A horizon is 8 to 15 inches thick. It is brown, dark brown, grayish brown, or dark grayish brown in hue of 10YR and 7.5YR. It is loam or clay loam and is gravelly in places. It has granular or subangular blocky structure or is massive. Consistence is soft to slightly hard.

The B horizon is 32 to 40 inches thick. It is brown, light brown, or reddish brown in hue of 7.5YR and 5YR. It is loam or clay loam, and in places cobbles and gravel make up as much as 35 percent of this horizon. In places, reddish yellow iron mottles are in the lower part of the B horizon.

There is a C horizon in some places. The C horizon is light brown or brown in hue of 7.5YR. It is loam or clay loam and is as much as 35 percent gravel, by volume. Reaction is slightly acid. In places, the C horizon has reddish yellow iron mottles.

164—Lyonman loam, 15 to 30 percent slopes. This moderately steep soil is on mountainous uplands.

Included with this soil in mapping and making up 6 percent of the acreage is McQuarrie sandy loam, 5 to 30 percent slopes; 3 percent is McQuarrie stony loam, 30 to 50 percent slopes; and 3 percent is Lakeview clay loam, 2 to 5 percent slopes.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for woodland, recreation, and wildlife habitat. The site index is 51 if this soil is used to grow white fir. Equipment limitations, seedling mortality, and the windthrow hazard are slight. Plant competition is moderate. Species to favor in existing stands and to recommend for planting are white fir, ponderosa pine, and Jeffrey pine. Capability unit VIe–1 (dryland); not placed in a range site; Storie Index 32.

165—Lyonman loam, 30 to 50 percent slopes. This steep soil is on mountain slopes in uplands. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 8 percent of the acreage is McQuarrie stony loam, 30 to 50 percent slopes; 3 percent is Lakeview clay loam, 2 to 5 percent slopes; and 2 percent is Woodcock stony loam, 30 to 50 percent slopes.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for woodland, recreation, and wildlife habitat. It has a site index rating of 51 if used to grow white fir. Seedling mortality and the hazard of windthrow are slight. Equipment limitations and plant competition are moderate. Species to favor in existing stands and to recommend for planting are white fir, ponderosa pine, and Jeffrey pine. Capability unit VIIe–1 (dryland); not placed in a range site; Storie Index 9.

McQuarrie Series

The McQuarrie series consists of well drained soils on uplands on the western side of the Warner Mountains. The soils formed in material that was weathered from andesite. They are underlain by hard andesite. The slope ranges from 5 to 50 percent. The elevation ranges from 4,900 to 5,900 feet. Annual precipitation is about 14 inches, the average annual air temperature is 45° to 49° F, and the frost-free period is 80 to 90 days. The vegetation is shrubs and grass and consists of bitterbrush, rabbitbrush, cheatgrass, squirreltail, bluegrass, and scattered juniper.

In a representative profile, the surface layer is gray-

ish brown, mildly alkaline sandy loam and brown, mildly alkaline sandy clay loam about 9 inches thick. The subsoil is dark brown, mildly alkaline clay loam about 4 inches thick. Hard andesite bedrock is at a depth of 13 inches.

Permeability is moderate, and the available water capacity is 1.5 to 3 inches. The effective rooting depth is 10 to 16 inches.

McQuarrie soils are used for range, wildlife habitat, and recreation.

Representative profile of McQuarrie sandy loam, 5 to 30 percent slopes, about 1 mile north of Highway 299 toward Cedarville on dirt road to Spaulding Ranch headquarters, and 15 feet west of side dirt road or 85 feet west of dirt road to Spaulding Ranch in SW¼SW¼ sec. 8, T. 43 N., R. 14 E.

A1—0 to 3 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; 10 percent gravel, by volume; mildly alkaline (pH 7.5); clear smooth boundary.

A3—3 to 9 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and medium roots; common very fine interstitial pores and few very fine and fine tubular pores; 10 percent gravel, by volume; mildly alkaline (pH 7.5); gradual smooth boundary.

B2t—9 to 13 inches; dark brown (10YR 4/3) clay loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; common moderately thick clay films in pores; 15 percent gravel, by volume; mildly alkaline (pH 7.5); clear smooth boundary.

R—13 inches; hard andesite.

The depth to andesite and the thickness of the solum range from 10 to 16 inches.

The A horizon is 6 to 11 inches thick. It is grayish brown, brown, dark brown, or dark grayish brown in hue of 10YR. It is sandy loam, loam, or sandy clay loam that has granular structure or is massive. Reaction ranges from neutral to mildly alkaline.

The Bt horizon is 4 to 5 inches thick. It is dark brown or brown in hue of 10YR and 7.5YR. It is loam or clay loam. Consistence is slightly hard to hard. Reaction is neutral to mildly alkaline.

166—McQuarrie sandy loam, 5 to 30 percent slopes. This moderately sloping to moderately steep soil is on uplands in areas near the upper part of Thoms Creek. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Deven clay loam, 0 to 9 percent slopes; about 3 percent is McQuarrie stony loam, 30 to 50 percent slopes; 3 percent is Daphnedale very cobbly loam, deep variant, 5 to 15 percent slopes; and 1 percent is Rock outcrop and Lithic Xerorthents.

Runoff is rapid, and the hazard of erosion is moderate.

These soils are used for range, wildlife habitat, and recreation. Capability unit VIe–1 (dryland); Shallow Loamy range site; Storie Index 26.

167—McQuarrie stony loam, 30 to 50 percent slopes. This steep soil is on mountainous uplands near Thoms Creek. It has a profile similar to the one described as representative of the series, except that the surface layer is loam and surface stones are 30 to 100 feet apart.

Included with this soil in mapping and making up about 8 percent of the acreage is Deven very stony clay loam, 30 to 50 percent slopes; about 5 percent is Lyonman loam, 30 to 50 percent slopes; and about 2 percent is McQuarrie sandy loam, 5 to 30 percent slopes.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for range, recreation, and wildlife habitat. Capability unit VIIe–1 (dryland); Shallow Loamy range site; Storie Index 3.

Modoc Series

The Modoc series consists of well drained soils on terraces and alluvial fans. The soils formed in medium textured alluvium derived from basalt, andesite, obsidian, and pyroclastic rocks. They have a silica-cemented hardpan. The slope ranges from 0 to 9 percent. The elevation ranges from 4,400 to 5,000 feet. Annual rainfall is 12 to 16 inches, average annual temperature is 47° to 49° F, and the frost-free period is 80 to 90 days. The vegetation is mainly big sagebrush, rabbitbrush, needlegrass, bluebunch wheatgrass, squirreltail, lupine, and cheatgrass.

In a representative profile, the surface layer is brown, slightly acid and neutral gravelly loam and loam about 7 inches thick. The subsoil is brown, neutral clay loam about 23 inches thick. A silica-cemented hardpan is at a depth of 30 inches.

Permeability is moderately slow above the impermeable hardpan, and the available water capacity is 4 to 6.5 inches. The rooting depth is 24 to 40 inches.

Modoc soils are used for dryland grain, range, irrigated alfalfa, and irrigated grass and legume pasture and hay.

Representative profile of Modoc gravelly loam, 0 to 9 percent slopes, on an old alluvial fan about 30 feet west of dirt road, 0.31 mile north of County Road 67 about 8 miles south of the town of Alturas in NW¼SW¼ sec. 22, T. 41 N., R. 12 E.

A11—0 to 3 inches; brown (10YR 5/3) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak very thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and very few fine and medium roots; common very fine interstitial pores and few very fine tubular pores; 15 percent rounded gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

A12—3 to 7 inches; brown (10YR 5/3) loam,

very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine interstitial pores and few very fine tubular pores; 5 percent rounded gravel, by volume; neutral (pH 7.0); clear wavy boundary.

B1—7 to 15 inches; brown (10YR 5/3) clay loam, dark brown (7.5YR 4/4) moist; weak medium and coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; few thin clay films in pores and on peds; 5 percent rounded gravel, by volume; neutral (pH 7.0); clear wavy boundary.

B2t—15 to 30 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate coarse angular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; many moderately thick clay films on peds and in pores; neutral (pH 7.0); abrupt wavy boundary.

C1sim—30 to 37 inches; light brownish gray (10YR 6/2) indurated silica-cemented hardpan that has yellow (10YR 7/6) continuous laminar bands less than 1 millimeter thick in the upper part; 20 percent fine gravel, by volume; moderately alkaline (pH 8.0).

The depth to the hardpan and the thickness of the solum are 24 to 40 inches. Rock fragments, mostly pebbles and a few cobblestones, make up as much as 20 percent of the soil material above the hardpan.

The A horizon is 6 to 12 inches thick. When dry it is brown, grayish brown, dark grayish brown, or dark brown, and when moist it is dark brown, very dark grayish brown, or very dark brown, all in hue of 10YR. It is loam, very fine sandy loam, fine sandy loam, or sandy loam that has platy, granular, or subangular blocky structure. It is as much as 20 percent gravel, by volume. Reaction ranges from slightly acid to neutral.

The B horizon is 18 to 28 inches thick. It has hue of 10YR, 7.5YR, or 5YR and is brown, dark brown, reddish brown, or dark reddish brown. The Bt horizon is sandy clay loam or clay loam. Reaction of the Bt horizon is neutral to mildly alkaline and is more alkaline with increasing depth. The B horizon is noncalcareous.

The indurated Csim horizon has laminar bands 1 to 2 millimeters thick, or it is massive in the upper part.

168—Modoc sandy loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil occurs on windreworked terraces throughout Warm Springs Valley and the Alturas basin. Most of the mapped areas are small and irregular in shape. This soil has a profile similar to the one described as representative of the series, except the surface layer is sandy loam and is 8 to 12 inches thick.

Included with this soil in mapping and making up about 5 percent of the acreage is Modoc gravelly loam, 0 to 9 percent slopes; 4 percent is Barnard gravelly loam, 0 to 9 percent slopes; 3 percent is Bieber gravelly loam, 0 to 9 percent slopes; and 3 percent is Ladd sandy loam, 2 to 9 percent slopes.

Runoff is slow, and the hazard of erosion is slight. This soil has fewer management problems than Modoc gravelly loam, 0 to 9 percent slopes. Small hummocks are in some places, but they do not restrict planting.

This soil is used for range, dryland grain, and irrigated pasture and hay. Capability unit IIIe–3 (irrigated) and IVe–3 (dryland); Loamy range site; Storie Index 34.

169—Modoc gravelly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on alluvial fans and terraces throughout the Alturas basin and in Warm Springs Valley. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 8 percent of the acreage is Barnard gravelly loam, 0 to 9 percent slopes; 5 percent is Bieber gravelly loam, 0 to 9 percent slopes; 1 percent is Lovejoy silt loam, 0 to 5 percent slopes; and 1 percent is a soil that is similar to this Modoc soil but that has a light brownish gray surface layer.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for range, dryland pasture, dryland grain, irrigated alfalfa hay, and irrigated grass and legume hay or pasture. Capability unit IIIe–3 (irrigated) and IVe–3 (dryland); Loamy range site; Storie Index 25.

Ninekar Series

The Ninekar series consists of well drained soils on lava plateaus. The soils formed in residuum derived from basalt, andesite, and tuff rocks. They are underlain by hard basalt. The slope ranges from 0 to 9 percent. The elevation ranges from 4,300 to 5,800 feet. Annual rainfall is 10 to 16 inches, average annual air temperature is 45° to 47° F, and the frost-free period is 70 to 80 days. The vegetation is mainly low sagebrush, Sandberg bluegrass, squirreltail, mustard, cheatgrass, and a few scattered western junipers.

In a representative profile, the surface layer is gray, slightly acid very stony silt loam about 3 inches thick. The subsoil is brown, neutral silty clay loam 25 inches thick. Fractured basalt is at a depth of 28 inches (fig. 7).

Permeability is very slow, and the available water capacity is 3 to 5 inches. The effective rooting depth is 20 to 38 inches.

Ninekar soils are used for range, wildlife habitat, and watershed.

Representative profile of Ninekar very stony silt loam, 0 to 9 percent slopes, on a nearly level lava plateau about 5 miles southeast of the town of Likely, 4.0 miles southeast on West Valley Reservoir Road (County Road 66) from its intersection with Jess Valley Road and 62 feet north of previous dirt road in SW¼NW¼ sec. 19, T. 39 N., R. 14 E.

A1—0 to 3 inches; gray (10YR 5/1) very stony silt loam, very dark grayish brown (10YR 3/2) moist; common fine and medium subangular blocky structure;

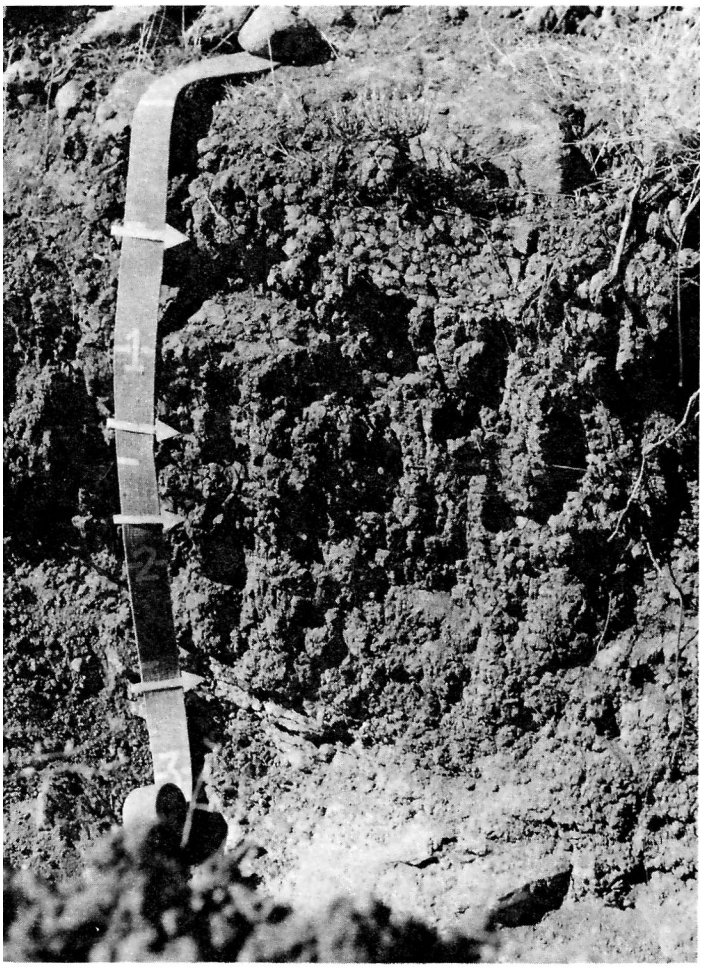

Figure 7.—**Profile of a Ninekar soil. A thin surface horizon overlies a clay subsoil. Hard bedrock is at a depth of 28 inches. Arrows indicate the lower boundary of the A1, B21t, B22t, and B3t horizons.**

hard, very friable, slightly sticky and slightly plastic; common very fine, medium, and coarse roots; few very fine interstitial and tubular pores; 30 percent stones and 25 percent cobbles, by volume, on the surface; a thin layer of bleached sand grains on the bottom of most stones; slightly acid (pH 6.2); abrupt wavy boundary.

B21t—3 to 13 inches; brown (7.5YR 4/4) silty clay loam, brown (7.5YR 4/4) moist; moderate medium and coarse prismatic structure parting to moderate medium angular blocky; very hard, very friable, sticky and plastic; common very fine medium and coarse roots; few very fine tubular pores; common thin clay films on peds; many intersecting slickensides; neutral (pH 7.0); clear wavy boundary.

B22t—13 to 20 inches; brown (7.5YR 4/4) silty clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to strong medium angular blocky; very hard, very friable, sticky and plastic; common very fine, medium, and coarse roots; few very fine tubular pores; common thin clay films on peds; many intersecting slickensides; neutral (pH 7.0); clear wavy boundary.

B3t—20 to 28 inches; brown (7.5YR 5/4) light clay loam, brown (7.5YR 4/4) moist; moderate fine and medium angular blocky structure; hard, very friable, sticky and plastic; few very fine roots; few very fine tubular pores; common moderately thick clay films on peds; moderately alkaline (pH 8.0); abrupt wavy boundary.

R—28 inches; very dark gray (N 3/0) hard fractured basalt; discontinuous 1- to 2-inch thick seams of slightly effervescent, disseminated lime and silica in rock fractures.

Depth to hard fractured basalt is 20 to 38 inches. Rock fragments make up 15 to 60 percent of the surface layer and as much as about 20 percent of the texture control section. Most of the fragments are cobbles and stones; there are a few pebbles. Reaction is slightly acid to moderately alkaline throughout the profile.

The A horizon ranges from 2 to 6 inches in thickness. It has dry colors of pale brown and brown to pinkish gray in hue of 10YR and 7.5YR and moist colors of brown to very dark grayish brown. It is loam, silt loam, or clay loam. It has subangular blocky or platy structure or is massive.

The B2t horizon ranges from 10 to 22 inches in thickness. It is yellowish brown, brown, reddish brown to very dark grayish brown, and dark reddish brown in hue of 10YR, 7.5YR, and 5YR. It is silty clay loam, heavy clay loam, or clay that has moderate or strong prismatic or angular blocky structure. Consistence is very hard or extremely hard.

170—Ninekar very stony silt loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on lava plateaus. Stones cover 0.1 to 3 percent of the surface and are 5 to 30 feet apart.

Included with this soil in mapping and making up about 5 percent of the acreage is Karcal very cobbly clay, 0 to 9 percent slopes; 3 percent is Puls extremely stony clay loam, 0 to 9 percent slopes; 2 percent is Deven very stony clay loam, 2 to 30 percent slopes; 2 percent is a soil that is similar to this Ninekar soil but is underlain by hard rock at a depth of less than 20 inches; and 1 percent is Rock outcrop.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range, watershed, and wildlife habitat. Capability unit VIs–1 (dryland); Clayey Slopes range site; Storie Index 17.

Packwood Series

The Packwood series consists of well drained soils in intermound positions on mounded lava plateaus. The soils formed in material that was weathered from extrusive, basic igneous rock. They have an indurated silica-cemented hardpan that is underlain by hard

basalt. The slope ranges from 0 to 9 percent. The elevation ranges from 4,900 to 5,400 feet. Annual precipitation is 12 to 16 inches, the average annual air temperature is 47° to 49° F, and the frost-free period is about 80 days. Vegetation is juniper, shrubs, and grass. It consists of western juniper, big sagebrush, scattered bitterbrush, bluegrass, and cheatgrass.

In a representative profile, the surface layer is grayish brown, slightly acid extremely stony loam about 2 inches thick. The subsoil is brown, slightly acid clay loam about 2 inches thick. The subsoil is brown, slightly acid clay loam about 6 inches thick. Below the subsoil is an indurated, yellowish red, platy, silica-cemented hardpan about 14 inches thick. Hard basalt is at a depth of 22 inches.

Permeability is slow, and the available water capacity is 1 to 2 inches. The effective rooting depth is 8 to 15 inches.

Packwood soils are used for range. They are mapped with Ditchcamp soils and with Rock outcrop.

Representative profile of Packwood extremely stony loam, in an area of Packwood-Rock outcrop complex, on a hummocky, nearly level lava plateau 27 feet west of dirt road and 0.3 mile northeast of Modoc National Forest boundary or 0.35 mile northeast of Lauer Reservoir Road (33 feet south of the representative profile of Ditchcamp soil) in NW¼SW¼ sec. 3, T. 43 N., R. 13 E.

A1—0 to 2 inches; grayish brown (10YR 5/2) extremely stony loam, dark brown (7.5YR 3/2) moist; moderate thick platy structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine interstitial and tubular pores; 20 percent stones and 10 percent cobbles, by volume; slightly acid (pH 6.1); clear smooth boundary.

B21t—2 to 5 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; weak medium angular blocky structure; hard, friable, sticky and plastic; common very fine roots; few very fine tubular pores; few thin clay films on peds and in pores; slightly acid (pH 6.1); clear smooth boundary.

B22t—5 to 8 inches; brown (7.5YR 4/2) heavy clay loam, dark reddish brown (5YR 3/3) moist; weak medium angular blocky structure; hard, friable, very sticky and plastic; few coarse and common very fine and fine roots; common very fine and fine interstitial pores; common moderately thick clay films on peds and in pores; slightly acid (pH 6.5); clear smooth boundary.

Csim—8 to 22 inches; yellowish red (5YR 5/6) moderately thick-layered indurated silica hardpan that has continuous caps 1 to 2 millimeters thick between layers; few fine distinct black (N 2/0) manganese mottles and concretions; extremely hard and extremely firm; abrupt smooth boundary.

R—22 inches; dark gray (N 4/0) hard fractured basalt.

The depth to the hardpan and the thickness of the solum are 8 to 16 inches.

The A horizon ranges from 2 to 4 inches in thickness. It has dry colors of grayish brown, pale brown, or light brownish gray in hue of 10YR. It is sandy loam or loam. It has platy, subangular blocky structure or is massive. The surface is extremely cobbly or extremely stony. Reaction is slightly acid or neutral.

The B horizon ranges from 7 to 11 inches in thickness. It is brown, dark brown, reddish brown, or dark reddish brown in hue of 7.5YR and 5YR. It is loam or clay loam in the upper part and clay loam or heavy clay loam in the lower part. It has weak angular blocky or moderate subangular blocky structure. Reaction is slightly acid or neutral.

The Csim horizon is massive, or it is layered and has thin, continuous, opal laminar bands in the upper part. Hard basalt is at a depth of 16 to 22 inches.

171—Packwood-Ditchcamp complex. This complex is on lava plateaus west of Graven Reservoir and is nearly level to moderately sloping. Packwood cobbly loam makes up about 40 percent of the complex. This soil is scattered throughout the mapped areas. It has a profile similar to the one described as representative of the Packwood series, except that the surface layer is 15 to 25 percent cobbles. Ditchcamp loam makes up about 25 percent of the complex. This soil is on mounds that are less than 1 foot high and are 15 to 30 feet wide. The Ditchcamp soil has the profile described as representative of the series. Puls extremely stony clay loam makes up about 25 percent of the complex. This soil is also scattered throughout the mapped areas.

Included with this complex in mapping and making up about 3 percent of the acreage is Rock outcrop; 3 percent is Karcal very cobbly clay, 0 to 9 percent slopes; 2 percent is Ninekar very stony silt loam, 0 to 9 percent slopes; and 2 percent is Lithic Xerorthents.

Runoff is slow on the Packwood soil and medium on the Puls and Ditchcamp soils. Erosion is a slight hazard on the Packwood and Ditchcamp soils and a moderate hazard on the Puls soil.

This complex is used for range. Capability unit VIIs–1 (dryland); Storie Index 13; Packwood soil in Shallow Stony Uplands range site, Ditchcamp soil in Dry Loamy range site.

172—Packwood-Rock outcrop complex. This complex is on lava plateaus around Lauer Reservoir and is nearly level to moderately sloping. Packwood extremely stony loam makes up about 45 percent of the complex. This soil is on low areas of alluvial deposits. It has the profile described as representative of the series. Rock outcrop makes up about 30 percent of the complex and is on higher areas where the vegetation consists of juniper and mountainmahogany. Ditchcamp loam makes up about 20 percent of the complex and is on circular mounds that are 10 to 30 feet wide and 2 to 4 feet higher in elevation than the other areas. The mounds have grass vegetation.

Included with this unit in mapping and making up about 3 percent of the acreage is Karcal very cobbly clay, 0 to 9 percent slopes; and making up 2 percent is Jenny silty clay, 0 to 5 percent slopes.

Runoff is slow on the Packwood soil and medium on

the Ditchcamp soil. Erosion is a slight hazard on Packwood and Ditchcamp soils and on Rock outcrop.

This complex is used for range. Capability unit VIIs–1 (dryland); Storie Index 13; Packwood soil in Shallow Stony Uplands range site, Rock outcrop not placed in a range site, and Ditchcamp soil in Dry Loamy range site.

Pasquetti Series

The Pasquetti series consists of nearly level soils in valley basins. The soils have been artificially drained; they formed under more poorly drained conditions in fine-textured alluvium that has discontinuous layers of volcanic ash. The slope ranges from 0 to 2 percent. The elevation ranges from 4,350 to 4,390 feet. Annual precipitation is 10 to 12 inches, average annual air temperature is 48° to 50° F, and the frost-free period is 80 to 90 days. Vegetation is meadow pasture. It consists of sedges, wiregrass, and bluegrass.

In a representative profile, the surface layer is very dark gray, neutral silty clay loam about 10 inches thick. The underlying material is gray, neutral sandy loam and gray and light gray, moderately alkaline silty clay loam to a depth of 60 inches or more. Discontinuous layers of ash are throughout the profile.

Permeability is slow, and the available water capacity of drained soil is 8 to 12 inches. The effective rooting depth is 60 inches or more where the soil is drained. A water table is at a depth of 36 to more than 60 inches.

Pasquetti soils are used for irrigated pasture, hay, and small grain.

Representative profile of Pasquetti silty clay loam, drained, 0.5 mile west of the northeast corner of sec. 25, T. 40 N., R. 12 E., 1.3 miles south of Westside Road on west side of drainage ditch, 150 feet south of fence, and 50 feet west of dirt road in SE¼NW¼ sec. 36 (extrapolated), T. 40 N., R. 12 E.

A1—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium and coarse granular structure; very hard, friable, sticky and plastic; many very fine roots; few very fine interstitial and tubular pores; neutral (pH 7.0); clear wavy boundary.

C1—10 to 24 inches; gray (10YR 5/1) sandy loam, black (10YR 2/1) moist; common fine distinct pink (7.5YR 5/4) and brown (7.5YR 4/4) mottles, moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; discontinuous thick very pale brown (7.5YR 7/4) ash layer 1 inch thick; neutral (pH 7.0); abrupt wavy boundary.

C2—24 to 31 inches; gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) moist; common fine distinct reddish brown (5YR 5/4) and yellowish red (5YR 5/6) mottles, moist; massive; very hard, firm, sticky and plastic; few very fine roots; many very fine interstitial pores and very few very fine tubular pores; moderately alkaline (pH 8.0); abrupt wavy boundary.

C3—31 to 60 inches; light gray (10YR 6/1) silty clay loam, very dark gray (10YR 3/1) moist; common fine distinct strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottles, moist; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; moderately alkaline (pH 8.0).

The A horizon ranges from 9 to 14 inches in thickness. It is very dark gray, dark gray, dark grayish brown, dark brown, or very dark brown in hue of 10YR and 7.5YR. It is silty clay, silty clay loam, or silt loam that is mucky in places. It has weak to moderate granular or platy structure. Consistence is very hard or hard when dry and slightly sticky or sticky and slightly plastic or plastic when wet.

The C horizon is gray, light gray, grayish brown, or light brownish gray in hue of 10YR. It is sandy loam, silty clay loam, or clay loam. It has weak or moderate subangular blocky structure or is massive. Consistence of dry soil is hard or very hard. Reaction ranges from neutral to moderately alkaline. Discontinuous layers of ash are throughout the C horizon. A water table is below a depth of 36 inches, but the depth varies depending on the season and on the irrigation practices that are used.

173—Pasquetti silty clay loam, partially drained. This is a level soil in basins in the Likely area. It is artificially drained, but it formed under poorly drained conditions. It has a profile similar to the one described as representative of the series, except the water table is at a depth of 36 to 60 inches.

Included with this soil in mapping and making up about 10 percent of the acreage is Tulana mucky loam, partially drained; making up 5 percent is Pasquetti silty clay loam, drained.

Runoff is very slow, and there is no hazard of erosion. A water table is at a depth of 36 to 60 inches.

This soil is used for irrigated pasture, hay, wheat, and barley. Capability unit IIIw–2 (irrigated); not placed in a range site; Storie Index 72.

174—Pasquetti silty clay loam, drained. This is a level soil in valley basins. It has been artificially drained. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Tulana mucky loam, drained; making up about 3 percent is Pit silty clay loam, 0 to 2 percent slopes. Also included are some small areas of Pasquetti soils that have a water table that fluctuates between a depth of 36 and 60 inches.

Runoff is very slow, and there is no hazard of erosion. The water table generally is maintained at a depth of more than 60 inches.

This soil is used for irrigated pasture, hay, wheat, barley, and alfalfa. Capability unit IIIs–3 (irrigated); not placed in a range site; Storie Index 81.

Pineal Series

The Pineal series consists of moderately well drained soils in old lake bottoms or on basin rims.

The soils have a hardpan that is strongly cemented with silica and lime. They formed in alluvium derived mostly from extrusive igneous rock, tuff, and volcanic ash. The slope ranges from 0 to 2 percent. The elevation ranges from 4,350 to 4,450 feet. Annual precipitation is 10 to 12 inches, average annual air temperature is 47° to 50° F, and the frost-free period is 80 to 90 days. Vegetation consists of rabbitbrush, giant wildrye, saltgrass, cheatgrass, and greasewood.

In a representative profile, the surface layer is light brownish gray, slightly acid silt loam about 4 inches thick. The subsurface layer is light brownish gray, neutral loam 5 inches thick. The subsoil is brown, moderately alkaline heavy clay loam about 7 inches thick. A hardpan that is strongly cemented with silica and lime is at a depth of 16 inches.

Permeability is slow above the impermeable hardpan, and the available water capacity is 1.5 to 3.5 inches. The effective rooting depth is 10 to 20 inches. The water table fluctuates, but it is at a depth of more than 5 feet.

Pineal soils are used for range and wildlife habitat.

Representative profile of Pineal silt loam, 1.5 miles south of Pine Creek Boulevard (County Road 59) on U.S. Highway 395, 48 feet south of east-west fence, and 50 feet east of W¼ corner in NW¼SW¼ sec. 6, T. 41 N., R. 13 E.

A1—0 to 4 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak thin and medium platy structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine interstitial pores; slightly acid (pH 6.2); clear smooth boundary.

A2—4 to 9 inches; light brownish gray (10YR 6/2) loam, dark brown (7.5YR 4/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; very few very fine tubular pores; clean sand grains; neutral (pH 7.2); abrupt smooth boundary.

B2t—9 to 16 inches; brown (7.5YR 5/2) heavy clay loam, dark brown (7.5YR 4/2) moist; strong medium columnar structure; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; continuous moderately thick clay films on peds; bleached caps 1 to 3 millimeters thick; moderately alkaline (pH 8.3); clear smooth boundary.

C1sica—16 to 24 inches; pale brown (10YR 6/3) clay loam, dark brown (7.5YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine interstitial and tubular pores; discontinuous indurated laminae 2 millimeters thick and about 10 percent durinodes; strongly effervescent; segregated filaments of lime; moderately alkaline (pH 8.3); abrupt smooth boundary.

C2sicam—24 to 30 inches; very pale brown (10YR 7/3) hardpan, dark brown (7.5YR 4/4) moist; layered; very hard, very firm; strongly effervescent; segregated filaments of lime; strongly alkaline (pH 8.5); clear smooth boundary.

C3—30 to 49 inches; very pale brown (10YR 7/3) clay loam, dark brown (7.5YR 4/4) moist; massive; very hard, friable, very sticky and plastic; many very fine tubular pores; moderately alkaline (pH 8.0); gradual smooth boundary.

C4—49 to 60 inches; very pale brown (10YR 7/3) light clay loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, sticky and plastic; many very fine interstitial pores; moderately alkaline (pH 8.0).

The depth to the hardpan and the thickness of the solum are 10 to 20 inches.

The A1 horizon ranges from 4 to 9 inches in thickness. It is pale brown, light brownish gray, or brown in hue of 10YR. It is very fine sandy loam, loam, or silt loam. The A2 horizon is loam or clay loam that has platy structure or is massive. Reaction of the A1 and A2 horizons is slightly acid to strongly alkaline. The A horizon is strongly effervescent in places.

The B2t horizon ranges from 6 to 10 inches in thickness. It is brown or dark brown in hue of 10YR and 7.5YR. It is heavy clay loam, silty clay loam, or clay that has strong angular blocky or prismatic structure or weak to strong columnar structure. Reaction is moderately alkaline to very strongly alkaline, and the B2t horizon is violently effervescent in places. In some places the lower part of the B2t horizon is brittle.

The C horizon is pale brown, very pale brown, or light brownish gray in hue of 10YR.

175—Pineal silt loam. This is a nearly level soil in old lake bottoms and on basin rims.

Included with this soil in mapping and making up about 5 percent of the acreage is a soil that is similar to this Pineal soil but is somewhat poorly drained and is 20 to 40 inches deep to a hardpan; 4 percent is Bieber gravelly loam, 0 to 9 percent slopes; 4 percent is Barnard gravelly loam, 0 to 9 percent slopes; and 2 percent is Buntingville clay loam, 0 to 2 percent slopes.

Runoff is very slow, and there is no hazard of erosion.

This soil is used for range and wildlife habitat. Capability unit VIs–1 (dryland); Alkali Terrace range site; Storie Index 11.

Pit Series

The Pit series consists of somewhat poorly drained soils on flood plains and bottoms of lake basins. The soils formed in alluvium derived mostly from basic igneous rocks. The slope ranges from 0 to 5 percent. The elevation ranges from 4,300 to 4,750 feet. Annual precipitation is 10 to 14 inches, average annual air temperature is 49° to 52° F, and the frost-free period is 80 to 90 days. Vegetation consists of sedges, rushes, timothy, and bluegrass in meadows.

In a representative profile, the surface layer is gray, neutral silty clay loam about 24 inches thick. The underlying material is grayish brown, mildly alkaline,

silty clay loam and sandy clay loam to a depth of 60 inches or more. The soil is calcareous in the lower part.

Permeability is slow, and the available water capacity is 9.5 to 11 inches. The effective rooting depth is 60 inches or more.

Pit soils are used for irrigated pasture, alfalfa, and hay.

Representative profile of Pit silty clay loam, 0 to 2 percent slopes, 27 feet east of the center of County Road 69 and 0.45 mile north from its intersection with Centerville Road or 210 feet north of the northern edge of wooden bridge in NE¼SW¼ sec. 2, T. 41 N., R. 10 E.

A11—0 to 5 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; common fine and very fine roots; few very fine interstitial pores and common fine tubular pores; neutral (pH 6.6); clear smooth boundary.

A12—5 to 24 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; moderate medium prismatic structure; very hard, friable, sticky and plastic; few very fine and fine roots; few very fine interstitial pores and common very fine and few fine tubular pores; numerous intersecting slickensides; neutral (pH 7.0); clear smooth boundary.

C1ca—24 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine and few fine tubular pores; numerous intersecting slickensides; violently effervescent; fine irregular filaments and soft masses of lime; mildly alkaline (pH 7.5); clear smooth boundary.

C2ca—33 to 52 inches; grayish brown (2.5Y 5/2) silty clay loam, dark brown (10YR 4/3) moist; common fine distinct brownish yellow (10YR 6/6) mottles, light olive brown (2.5Y 5/6) moist; massive; very hard, friable, sticky and plastic; few very fine roots; few fine tubular pores; violently effervescent; fine irregular filaments and soft masses of lime; mildly alkaline (pH 7.5); clear smooth boundary.

C3—52 to 61 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct pale olive (5Y 6/4) mottles, light olive brown (2.5Y 5/6) moist; massive; hard, friable, sticky and plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; slightly effervescent; fine irregular filaments and soft masses of lime; mildly alkaline (pH 7.5).

Each year, cracks form in the soil when it is dry, and close when it is wet.

The A horizon ranges from 20 to 28 inches in thickness. It has dry colors of gray, dark gray, or very dark gray in hue of 10YR and 7.5YR. It is silty clay loam, silty clay, or clay. It has moderate fine granular structure in the upper 1 inch and moderate subangular blocky, angular blocky, or prismatic structure below that depth. Consistence of wet soil is sticky or very sticky and plastic or very plastic.

The C horizon is grayish brown, dark grayish brown, brown, or dark brown in hue of 2.5Y and 10YR. It is silt loam, sandy clay loam, clay loam, or silty clay loam that has subangular blocky structure or is massive. Consistence is hard to very hard. Reaction is mildly alkaline or moderately alkaline. The lower part of the C horizon is calcareous and has mottles in hue of 10YR, 2.5Y, and 5Y.

176—Pit silty clay loam, 0 to 2 percent slopes. This nearly level soil is on flood plains along Pit River and in basins near Davis Creek. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Pasquetti silty clay loam, drained; about 3 percent is Buntingville clay loam, 0 to 2 percent slopes; 2 percent is Lakeview loam, 0 to 2 percent slopes; and 10 percent is a soil that is similar to this Pit soil but that has moist chroma of 2 in the upper 12 inches. Also included are small areas along Pit River that are affected by salts or alkali, or both. These areas are identified on the soil map by a special symbol.

Runoff is slow, and there is no hazard of erosion. A water table is at a depth of 36 to 48 inches. This soil is subject to frequent stream overflow in areas along the Pit River.

This soil is used for irrigated pasture, alfalfa, and hay (fig. 8). Capability unit IIIw–5 (irrigated); not placed in a range site; Storie Index 13.

177—Pit clay, 2 to 5 percent slopes. This gently sloping soil is on alluvial fans and flood plains near Linville Creek. It has a profile similar to the one described as representative of the series, except the surface layer is clay.

Included with this soil in mapping and making up about 3 percent of the acreage is Drews clay loam, 2 to 5 percent slopes. Also included in some small areas at the mouths of canyons are soils that have cobbles on the surface.

Runoff is slow, and the hazard of erosion is slight. A water table is at a depth of 36 to 48 inches. This soil is subject to frequent stream overflow in spring.

This soil is used for irrigated pasture, hay, and alfalfa. Capability unit IIIw–5 (irrigated); not placed in a range site; Storie Index 7.

178–Pit clay, seeped, 0 to 2 percent slopes. This nearly level soil is in low basins at the mouth of Cottonwood Creek. Drainage is a problem because of seepage from this creek and from higher-lying irrigated areas. This soil has a profile similar to the one described as representative of the series, except the surface layer is clay and the water table is at a depth of about 20 inches. A 6- to 8-inch thick mat of roots is on the surface.

Included with this soil in mapping and making up about 15 percent of the acreage is Pit clay, 2 to 5

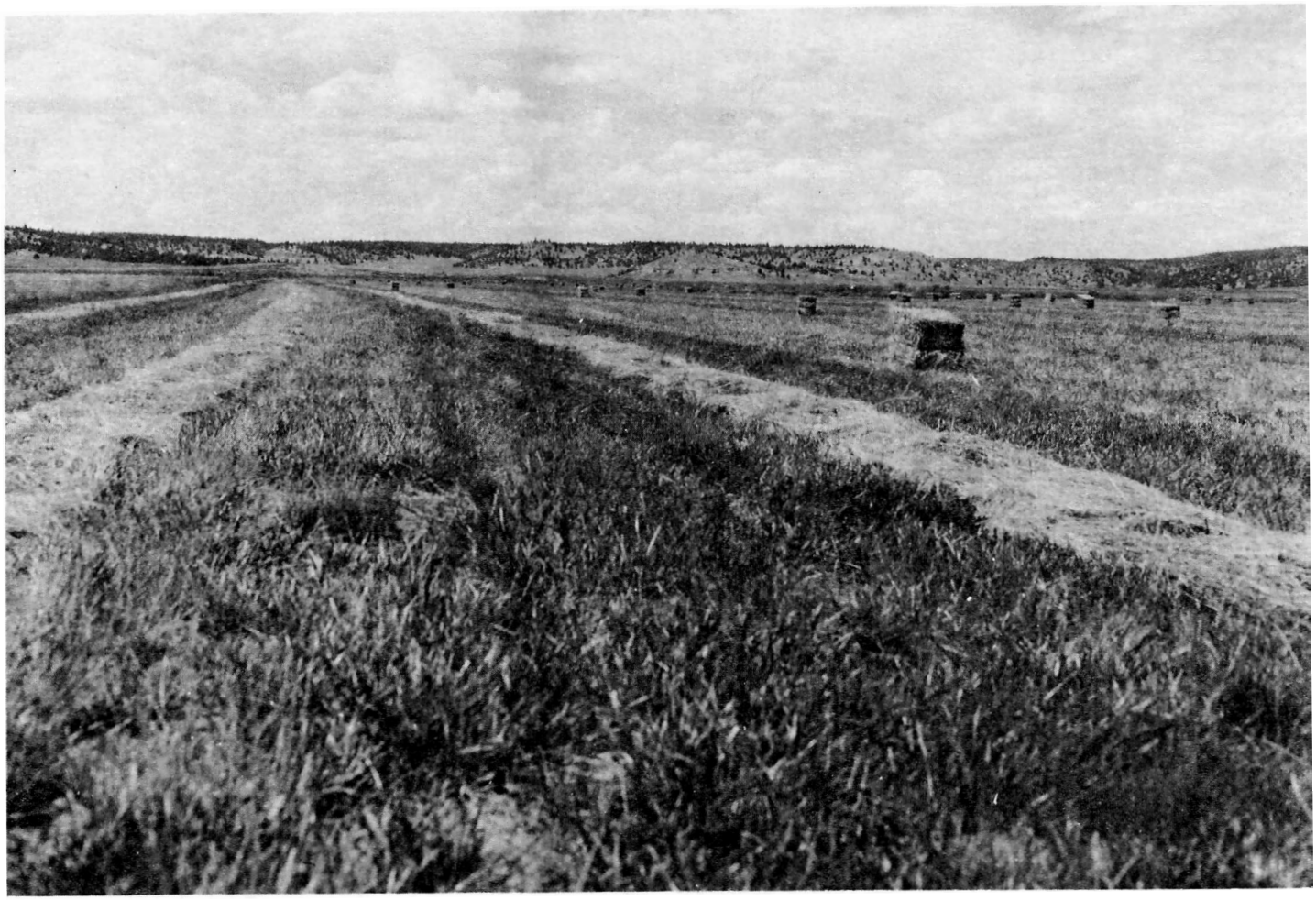

Figure 8.—**Irrigated hay on Pit silty clay loam, 0 to 2 percent slopes, a soil in capability unit IIIw–5 (irrigated).**

percent slopes; making up 3 percent is Pit silty clay loam, 0 to 2 percent slopes.

Runoff is very slow, and there is no hazard of erosion. Depth to the water table is 20 to 30 inches. The seepage of water from higher-lying areas raises the water table and causes a drainage problem on this soil. This soil is subject to frequent flooding.

This soil is used for range. Because of the high water table, it is not suited to other uses. Because of small bogs, the cutting of hay is not practicable. Capability unit Vw–1 (dryland); Wet Meadow range site; Storie Index 7.

Puls Series

The Puls series consists of well drained soils on lava plateaus in uplands. The soils formed in residuum from basalt, andesite flows, and tuff rocks. They have an indurated hardpan underlain by basalt. The slope ranges from 0 to 9 percent. The elevation ranges from 4,500 to 5,300 feet. Annual precipitation is 13 to 18 inches, average annual air temperature is 45° to 47° F, and the frost-free period is 80 to 100 days. The vegetation consists of low sagebrush, phlox, bluegrass, and scattered juniper.

In a representative profile, the surface layer is pinkish gray, slightly acid extremely stony clay loam about 5 inches thick. The subsoil is reddish brown, slightly acid clay loam and dark reddish brown, slightly acid clay about 14 inches thick. An indurated silica-cemented hardpan is at a depth of 19 inches. Basalt is at a depth of 28 inches.

Permeability is very slow, and the available water capacity is 2 to 4 inches. The rooting depth is 14 to 20 inches.

Puls soils are used for range, watershed, and wildlife habitat.

Representative profile of Puls extremely stony clay loam, 0 to 9 percent slopes, 100 feet east of the center of old U.S. Highway 395, 0.24 mile northeast from its junction with a dirt road that leads south to Willow Ranch in NE¼NE¼ sec. 2, T. 46 N., R. 14 E.

A1—0 to 5 inches; pinkish gray (7.5YR 6/2) extremely stony clay loam, brown (7.5YR 4/2) moist; weak coarse granular structure; slightly hard, friable, sticky and plastic; common very fine roots; common very fine interstitial pores and very few very fine tubular pores; 15 percent stones and 20 percent

cobbles, by volume, on the surface; slightly acid (pH 6.3); clear smooth boundary.

B1—5 to 9 inches; reddish brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine interstitial pores and few very fine tubular pores; 5 percent gravel and cobbles, by volume; slightly acid (pH 6.3); abrupt smooth boundary.

B2t—9 to 19 inches; dark reddish brown (5YR 3/3) clay, dark reddish brown (5YR 3/3) moist; strong coarse prismatic structure; very hard, extremely firm, sticky and very plastic; lower 1 inch is weakly cemented; roots on peds; few very fine interstitial and few very fine tubular pores; continuous thick clay films on peds and in pores; slightly acid (pH 6.3); clear smooth boundary.

C1sim—19 to 24 inches; reddish yellow (7.5YR 7/6) indurated silica-cemented hardpan that has common medium distinct very dark gray (N 3/0) manganese mottles; massive; slightly acid (pH 6.3); abrupt smooth boundary.

C2sim—24 to 28 inches; reddish brown (5YR 4/4) indurated silica-cemented hardpan that has many medium distinct very dark gray (N 3/0) manganese mottles; 10 percent rounded obsidian gravel, by volume.

R—28 inches; hard fractured basalt.

The depth to clay in the B2t horizon is 6 to 11 inches. The thickness of the solum and depth to the hardpan are 14 to 20 inches. Depth to basalt is 19 to 60 inches.

The A horizon ranges from 3 to 5 inches in thickness. It has dry colors of light brownish gray, pale brown, or pinkish gray in hue of 10YR and 7.5YR. It is extremely stony clay loam or loam that has weak moderate granular or platy structure.

The B horizon ranges from 11 to 17 inches in thickness. It is reddish brown, dark reddish brown, brown, or dark brown in hue of 7.5YR and 5YR. The B1 horizon is clay loam or cobbly clay loam that has weak platy or subangular blocky structure. It is 5 to 10 percent cobbles. The Bt horizon is clay that has strong prismatic structure. Reaction is slightly acid to neutral.

179—Puls extremely stony clay loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on lava plateaus. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Rubble land. About 3 percent of the acreage is Deven very stony loam, 2 to 30 percent slopes; 3 percent is Barnard gravelly loam, 0 to 9 percent slopes; 3 percent is Rock outcrop; and 2 percent is Packwood extremely stony loam.

Runoff is medium, and the hazard of erosion is moderate. There has been sheet erosion in places. In other places, the roots of clumps of bunchgrass hold the surface soil in place, and mounds 2 to 3 inches high are formed.

This soil is used for range, watershed, and wildlife habitat. Capability unit VIIs–1 (dryland); Shallow Stony Uplands range site; Storie Index 12.

180—Puls-Ninekar complex, sloping. This complex is nearly level to moderately sloping. The surface is slightly mounded on lava plateaus near West Valley Reservoir. The Puls soil makes up 45 percent of the complex. It is on and between the mounds. Where this soil is on mounds, it has no stones on the surface or has fewer stones than in other areas. The Ninekar soil makes up about 25 percent of the complex. It is between the mounds. It has a profile similar to the one described as representative of the Ninekar series, except that the surface is cobbly.

Included with this complex in mapping and making up 8 percent of the acreage is Karcal very cobbly clay, 0 to 9 percent slopes; 7 percent is Deven very stony loam, 2 to 30 percent slopes; 3 percent is Rubble land; 6 percent is Rock outcrop; and 6 percent is Lithic Xerorthents.

Runoff is medium, and the hazard of erosion is moderate.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIIs–1 (dryland); Storie Index 11; Puls soil is in Shallow Stony Uplands range site; Ninekar soil is in Clayey Slopes range site.

181—Puls-Rock outcrop complex, 0 to 9 percent slopes. This complex is on upland lava plateaus and is nearly level to moderately sloping. Puls extremely stony clay loam makes up about 60 percent of the complex. This soil is on and between mounds. Rock outcrop makes up 25 percent of the complex.

Included with this complex in mapping and making up about 10 percent of the acreage is Deven extremely stony loam, 2 to 30 percent slopes; 4 percent is McQuarrie sandy loam, 5 to 20 percent slopes; and 1 percent is Rubble land.

Runoff is medium on the Puls soil and rapid on Rock outcrop. The hazard of erosion is moderate.

This complex is used for range, watershed, and wildlife habitat. Capability unit VIIs–1 (dryland); Puls soil in Shallow Stony Uplands range site; Rock outcrop not placed in a range site; Storie Index 10.

Reba Series

The Reba series consists of well drained soils on dissected lake terraces. The soils formed in fine textured alluvium derived from basic igneous and pyroclastic rock and volcanic ash. The slope ranges from 0 to 5 percent. The elevation ranges from 4,300 to 4,500 feet. Annual precipitation is 10 to 13 inches, the average annual air temperature is 46° to 48° F, and the frost-free period is about 80 days. Vegetation is shrubs and grass. It consists mostly of rabbitbrush, big sagebrush, cheatgrass, and squirreltail.

In a representative profile, the surface layer is grayish brown, slightly acid loam about 10 inches thick. The subsurface layer is light gray, medium acid loam about 5 inches thick. The subsoil is brown and light yellowish brown, mildly alkaline clay about 14 inches

thick. The substratum, to a depth of 60 inches or more, is light gray and white, moderately alkaline, stratified clay loam that has some cemented layers.

Permeability is slow, and the available water capacity is 6 to 9 inches. The effective rooting depth is 44 to 59 inches.

Reba soils are used for range, wildlife habitat, and watershed.

Representative profile of Reba loam, 0 to 5 percent slopes, on a hummocky dissected lake terrace 420 feet south of east-west fence and 880 feet east of the west side of SW¼NW¼ sec. 8, T. 41 N., R. 11 E.

A11—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thin and medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and very few fine roots; many very fine vesicular pores and common fine tubular and very fine interstitial pores; slightly acid (pH 6.2); clear smooth boundary.

A12—5 to 10 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores and few very fine interstitial pores; slightly acid (pH 6.2); clear smooth boundary.

A2—10 to 15 inches; light gray (10YR 7/2) loam, brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and few coarse tubular and interstitial pores; medium acid (pH 6.0); abrupt smooth boundary.

B21t—15 to 22 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; strong medium prismatic structure; hard, firm, sticky and very plastic; common very fine inped roots and few fine exped roots; few very fine tubular pores; few thick and common moderately thick clay films on peds and common moderately thick clay films in pores; mildly alkaline (pH 7.5); clear smooth boundary.

B22t—22 to 29 inches; light yellowish brown (10YR 6/4) clay, brown (10YR 4/3) moist; common medium distinct reddish yellow (7.5YR 6/6) and common fine and medium distinct brownish yellow (10YR 6/8) ash mottles; moderate medium subangular blocky structure; hard, friable, sticky and very plastic; common very fine exped roots and few very fine and fine inped roots; common very fine tubular pores; few thick and many moderately thick clay films on peds and common thick clay films in pores; fine irregular noneffervescent filaments in lower 2 inches; mildly alkaline (pH 7.8); clear smooth boundary.

IIC1—29 to 34 inches; light gray (2.5Y 7/2) clay loam, light yellowish brown (2.5Y 6/4) moist; common fine distinct very dark gray (N 3/0) manganese mottles; strong medium platy structure; hard, firm, sticky and plastic; few very fine exped roots; very few thick and many moderately thick clay films on peds; moderately alkaline (pH 8.0); abrupt smooth boundary.

IIC2—34 to 47 inches; white (2.5Y 8/2) clay loam, pale yellow (2.5Y 7/4) moist; massive; very hard, very firm, sticky and plastic; few very fine roots; very few thick and many moderately thick clay films on cleavage planes; fine irregular noneffervescent filaments and medium irregular noneffervescent soft bodies; moderately alkaline (pH 8.2); abrupt smooth boundary.

IIC3sim—47 to 50 inches; white (10YR 8/1) indurated hardpan, light brownish gray (10YR 6/2) moist; extremely hard, extremely firm; neutral (pH 7.0); abrupt smooth boundary.

IIC4—50 to 60 inches; white (2.5Y 8/2) clay loam, pale yellow (2.5Y 7/4) moist; massive; very hard, very firm, sticky and plastic; moderately alkaline (pH 8.2).

An indurated hardpan, where present, is at a depth of 44 to 59 inches.

The A1 horizon ranges from 5 to 12 inches in thickness. It is grayish brown or brown in hue of 10YR or 2.5Y. It is sandy loam or loam. Gravel is on the surface. Reaction is slightly acid or medium acid. The A2 horizon ranges from 3 to 6 inches in thickness. It is light gray, light brownish gray, or pale brown in hue of 10YR or 2.5Y. It is sandy loam or loam. Reaction of the A horizon is medium acid to slightly acid.

The B2t horizon ranges from 10 to 16 inches in thickness. It is brown, yellowish brown, pale brown, or light yellowish brown in hue of 10YR. It is clay or heavy clay loam. It has strong prismatic or columnar structure in the upper part and moderate angular blocky or subangular blocky structure in the lower part. Reaction ranges from neutral to mildly alkaline.

The C horizon is light gray, white, pale brown, or light yellowish brown in hue of 2.5Y or 10YR. It is clay loam, loam, or sandy loam. Cemented horizons are common below a depth of 40 inches. Reaction ranges from neutral to moderately alkaline. The C horizon is made up of pryoclastic and lacustrine material and diatomite.

182—Reba loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on dissected lake terraces in Warm Springs Valley south of Kelly Reservoir.

Included with this soil in mapping and making up about 5 percent of the acreage is Lovejoy silt loam, 0 to 5 percent slopes. About 3 percent is a soil that is similar to this Reba soil but that does not have a surface layer. Instead, this soil has an exposed subsurface layer about 3 inches thick.

Runoff is medium, and the hazard of erosion is slight.

This soil is used for range, wildlife habitat, and watershed. Capability unit IIIe–3 (dryland); Loamy range site; Storie Index 41.

Rock Outcrop

Rock outcrop consists of barren or nearly barren areas of exposed bedrock, mainly basalt and andesite. These areas are scattered throughout the uplands. Vegetation is sparse; a few scrubby junipers grow in fractures of Rock outcrop in some areas.

Rock outcrop is used for watershed and recreation. It is mapped only in complex with other soils.

183—Rock outcrop-Lithic Xerorthents complex. This complex is on nearly level to moderately sloping upland lava plateaus throughout the survey area. Rock outcrop makes up 65 percent of the complex and is in a higher position on the landscape than Lithic Xerorthents. It consists of barren or nearly barren areas of exposed bedrock, mainly basalt, andesite, and welded tuff. Lithic Xerorthents make up 25 percent of the complex. They are well drained soils that are variable in texture but are mostly loamy. They are 4 to 10 inches deep to bedrock.

Deven clay loam, 0 to 9 percent slopes, makes up 10 percent of the mapped areas.

Runoff is very rapid on Rock outcrop and rapid on Lithic Xerorthents. The hazard of erosion is high on Lithic Xerorthents.

This complex is used for watershed, recreation, and wildlife habitat. Capability unit VIIIs–1 (dryland); not placed in a range site; Storie Index 10.

Rubble Land

184—Rubble land. Rubble land consists of small barren areas of colluvium below rimrock cappings throughout the survey area. The colluvium is 90 percent or more loose stones and boulders, dominantly basalt. The elevation ranges from 4,500 to 5,300 feet. Slope is 30 to 50 percent.

This unit is used for watershed and also has scenic value. Capability unit VIIIs–1 (dryland); not placed in a range site; Storie Index 10.

Rumbo Series

The Rumbo series consists of moderately well drained soils on slightly hummocky lake basins, terraces, and lower parts of alluvial fans. The soils formed in alluvium derived from basalt, andesite, tuff, and diatomite. They are underlain by alluvium of variable texture. The slope ranges from 0 to 5 percent. The elevation ranges from 4,300 to 4,900 feet. Annual rainfall is 10 to 14 inches, average annual air temperature is 48° to 52° F, and the frost-free period is 80 to 100 days. Vegetation is shrubs and grass. It consists of green rabbitbrush, greasewood, wild buckwheat, stunted big sagebrush, mustard, saltgrass, and great basin wildrye.

In a representative profile, the surface layer is light brownish gray, slightly acid loam about 6 inches thick. The subsoil is dark grayish brown, brown, and dark yellowish brown, moderately alkaline clay loam and heavy clay loam about 34 inches thick. The substratum, to a depth of 60 inches or more, is pale brown loamy sand and light brownish gray very gravelly loamy sand. It is moderately alkaline and strongly effervescent.

Permeability is slow, and the available water capacity is 7.5 to 9 inches. The effective rooting depth is 60 inches or more. An intermittent water table is at a depth of 40 to 60 inches for brief periods in spring.

Rumbo soils are used for range, wildlife habitat, dryland pasture and hay, and dryland wheat. In a few small areas they are used for irrigated pasture.

Representative profile of Rumbo loam, 0 to 2 percent slopes, on a slightly hummocky, nearly level alluvial fan about 0.9 mile north of the town of Canby on County Road 82, 9 feet north of telephone pole on east side of road and 20 feet east of north-south fence in NW¼NW¼ sec. 30, T. 42 N., R. 10 E.

A1—0 to 6 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak thin and medium platy structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine interstitial pores and many very fine tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

B21t—6 to 15 inches; dark grayish brown (10YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) moist; grayish brown (10YR 5/2) coating on peds, very dark grayish brown (10YR 3/2) moist; moderate coarse columnar structure; very hard, friable, sticky and plastic; common very fine roots; few very fine tubular pores; common moderately thick clay films on peds and in pores; bleached silica sand grains in upper ⅛ inch; moderately alkaline (pH 8.0); clear smooth boundary.

B22t—15 to 21 inches; brown (10YR 4/3) heavy clay loam, dark brown (10YR 3/2) moist; strong fine and medium prismatic structure parting to medium angular blocky; hard, friable, sticky and plastic; few very fine exped roots; few very fine tubular pores; continuous moderately thick clay films on peds and in pores; moderately alkaline (pH 8.0); clear wavy boundary.

B23t—21 to 35 inches; dark yellowish brown (10YR 4/4) heavy clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine prismatic structure parting to fine and medium angular blocky; hard, friable, sticky and plastic; few very fine exped roots; few very fine tubular pores; continuous moderately thick clay films on peds and in pores; moderately alkaline (pH 8.0); clear wavy boundary.

B3t—35 to 40 inches; light olive brown (2.5Y 5/4) sandy clay loam, olive brown (2.5Y 4/4) moist; massive; hard, friable, sticky and plastic; few very fine tubular and interstitial pores; common moderately thick clay films lining pores;

slightly effervescent; disseminated lime; moderately alkaline (pH 8.0); clear smooth boundary.

IIC1ca—40 to 51 inches; pale brown (10YR 6/3) loamy sand, very dark grayish brown (10YR 3/2) moist; massive; very hard, firm, nonsticky and nonplastic; common very fine interstitial pores and few very fine tubular pores; few thin clay films bridging sand grains; dark brown (7.5YR 3/2) moist lamellae that are ½ to ¾ inch thick and ¾ to 1 inch apart; common moderately thick clay films lining pores; weakly cemented; 10 percent gravel, by volume; strongly effervescent; fine rounded filaments of segregated lime; moderately alkaline (pH 8.0); clear wavy boundary.

IIC2ca—51 to 60 inches; light brownish gray (2.5Y 6/2) very gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine interstitial pores; few thin clay films as colloidal stains; weakly cemented; 70 percent gravel, by volume; strongly effervescent; fine rounded filaments of segregated lime; moderately alkaline (pH 8.0).

The A horizon ranges from ½ inch to 6 inches in thickness. It has dry colors of light brownish gray, gray, or grayish brown and moist colors of dark grayish brown, dark gray, very dark gray, or very dark grayish brown, all in hue of 10YR or 2.5Y. It is fine sandy loam, loam, or silt loam. It has weak platy or subangular structure or is massive. Consistence is slightly hard or hard. Reaction is slightly acid to mildly alkaline.

The B2t horizon ranges from 14 to 48 inches in thickness. It has dry colors of brown, grayish brown, dark gray, dark grayish brown, yellowish brown, dark yellowish brown, or gray and moist colors of dark brown, very dark grayish brown, or very dark brown, all in hue of 10YR and 7.5YR. It is heavy clay loam, silty clay loam, clay, or silty clay that has moderate or strong prismatic or columnar structure. Reaction is neutral to moderately alkaline and commonly is more alkaline with increasing depth.

The C horizon is pinkish gray, light gray, brown, pale brown, light brownish gray, or grayish brown in hue of 10YR, 7.5YR, and 2.5Y. It is loamy sand, sandy loam, clay loam, or silty clay loam. Rock fragments make up as much as 70 percent of this horizon in some places. Reaction is commonly moderately alkaline. This horizon is noncalcareous to strongly calcareous. The lower part of the C horizon is weakly cemented in some places.

185—Rumbo loam, 0 to 2 percent slopes. This nearly level soil is on lower alluvial fans and in lake basins. The mapped areas are small and scattered and are mostly north of the Pit River between Clover Swale and Blacks Canyon. This soil has the profile described as representative of the series.

Included with this soil in mapping and making up about 6 percent of the acreage is Lovejoy silt loam, 0 to 5 percent slopes; 3 percent is a soil that is similar to this Rumbo soil but that has a high content of salts and alkali throughout the profile; 2 percent is Pineal silt loam; and 2 percent is Buntingville clay loam, 0 to 2 percent slopes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for range and wildlife habitat and for dryland pasture, hay, and wheat. Capability unit IIIs–6 (dryland); Alkali Terrace range site; Storie Index 35.

186—Rumbo loam, 2 to 5 percent slopes, eroded. This gently sloping, slightly hummocky soil is on lake terraces in Warm Springs Valley. It has a profile similar to the one described as representative of the series, except about half of the original surface layer has been lost through erosion. The present surface layer is ½ to 1 inch. In some places, however, it has been completely removed by erosion.

Included with this soil in mapping and making up about 8 percent of the acreage is Delma cobbly loam, 0 to 9 percent slopes; 3 percent is Ager clay, 2 to 15 percent slopes; 3 percent is a soil that is similar to this Rumbo soil but that has salts and alkali throughout the profile; 2 percent is a soil that is less than 20 inches deep to diatomite; and 2 percent is Reba loam, 0 to 5 percent slopes.

Runoff is slow, and the hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and dryland pasture. Capability unit IIIs–6 (dryland); Alkali Terrace range site; Storie Index 17.

Salisbury Series

The Salisbury series consists of well drained soils on alluvial fans and dissected terraces. The soils have a silica-cemented hardpan. They formed in fine textured alluvium derived from basic igneous rocks. The slope ranges from 0 to 15 percent. The elevation ranges from 4,800 to 5,100 feet. Annual precipitation is 16 to 20 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is about 100 to 110 days. Vegetation is shrubs and grass. It consists of Idaho fescue, bluebunch wheatgrass, cheatgrass, big sagebrush, and scattered rabbitbrush.

In a representative profile, the surface layer is dark gray, mildly alkaline and neutral gravelly loam about 10 inches thick. The subsoil is yellowish brown and reddish brown, neutral clay loam about 13 inches thick. A light brown, silica-cemented hardpan that has thin, continuous laminar layers is at a depth of 23 inches.

Permeability is slow, and the available water capacity is 3 to 5 inches. The effective rooting depth is 20 to 32 inches.

Salisbury soils are used for irrigated grass and legume hay, alfalfa hay, pasture, wheat and barley; for dryland grain, hay, and pasture; and for range and wildlife habitat.

Representative profile of Salisbury gravelly loam, 0 to 9 percent slopes, on the middle part of the slope of an alluvial fan about 5,500 feet east of U.S. Highway 395 and 2,740 feet south of Fandango Pass Road, 6.0 miles south of the town of New Pine Creek, Oregon in NW¼NW¼ sec. 24, T. 47 N., R. 14 E.

A11—0 to 4 inches; dark gray (10YR 4/1) gravelly loam, black (10YR 2/1) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine interstitial pores and few fine tubular pores; 20 percent gravel, by volume; mildly alkaline (pH 7.8); clear smooth boundary.

A12—4 to 10 inches; dark gray (10YR 4/1) gravelly loam, black (10YR 2/1) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and very few fine roots; few very fine interstitial and tubular pores; 15 percent gravel, by volume; neutral (pH 6.8); clear smooth boundary.

B21t—10 to 14 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few very fine interstitial pores and common very fine tubular pores; few moderately thick clay films on peds and in pores; neutral (pH 6.8); clear smooth boundary.

B22t—14 to 23 inches; reddish brown (5YR 4/4) heavy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium angular blocky structure; very hard, friable, sticky and plastic; few very fine roots; very few very fine interstitial pores and few very fine tubular pores; many moderately thick clay films on peds and in pores; neutral (pH 6.8); abrupt smooth boundary.

C1sim—23 to 27 inches; light brown (7.5YR 6/4) indurated hardpan, brown (7.5YR 5/4) moist; massive; continuous laminar plates in upper part; roots follow horizontal plates; mildly alkaline (pH 7.5).

Depth to the hardpan and the thickness of the solum are 20 to 32 inches.

The A horizon ranges from 8 to 15 inches in thickness. It is dark gray, gray, dark grayish brown, or grayish brown in hue of 10YR. It is gravelly loam, very fine sandy loam, loam, clay loam, or gravelly clay loam. In some places the A horizon is 20 to 35 percent cobbles, by volume. Reaction is neutral to mildly alkaline.

The B2t horizon ranges from 12 to 17 inches in thickness. It is yellowish brown, reddish brown, brown, dark brown, or dark reddish brown in hue of 10YR, 7.5YR, or 5YR. It is clay loam, heavy clay loam, or clay that has moderate or strong subangular or angular blocky structure.

187—Salisbury very fine sandy loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on lake terraces. It has a profile similar to the one described as representative of the series, except the surface layer is very fine sandy loam and the hardpan is at a depth of 25 to 32 inches.

Included with this soil in mapping and making up about 5 percent of the acreage is Modoc sandy loam, 0 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. Because of the very fine sandy loam surface layer, this soil can be cultivated earlier in spring than the gravelly loam and clay loam soils.

This soil is used for irrigated pasture, alfalfa and grass and legume hay, wheat, and barley; for dryland grain, hay, and pasture; and for range and wildlife habitat. Capability unit IIIe–3 (irrigated and dryland); Loamy range site; Storie Index 22.

188—Salisbury gravelly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on alluvial fans and terraces. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Bieber gravelly loam, 0 to 9 percent slopes; and 3 percent is Drews loam, 0 to 5 percent slopes. In places rounded obsidian gravel makes up as much as 25 percent of the surface layer.

Runoff is medium, and the hazard of erosion is moderate. Because the surface layer is gravelly loam, this soil can be cultivated earlier in spring than the clay loam soil.

This soil is used principally for dryland grain, pasture, and hay and for range. It is also used for irrigated pasture, wheat, barley, and alfalfa and grass and legume hay and for wildlife habitat. Capability unit IIIe–3 (irrigated and dryland); Loamy range site; Storie Index 15.

189—Salisbury very cobbly loam, 0 to 9 percent slopes. This nearly level to moderately sloping soil is on low terraces. It has a profile similar to the one described as representative of the series, except the surface layer is 20 to 35 percent cobbles, by volume.

Included with this soil in mapping and making up about 8 percent of the acreage is Salisbury gravelly loam, 0 to 9 percent slopes; and 3 percent is Bieber gravelly loam, 0 to 9 percent slopes. Also included are some areas of Salisbury soils that have a surface layer of very cobbly clay loam.

Runoff is medium, and the hazard of erosion is moderate. Because of the cobbles in the surface layer, cultivation of this soil is impractical.

This soil is used principally for range and wildlife habitat. Capability unit VIs–1 (dryland); Loamy range site; Storie Index 15.

190—Salisbury clay loam, 9 to 15 percent slopes. This strongly sloping soil is on alluvial fans and terrace escarpments. It has a profile similar to the one described as representative of the series, except the surface layer is 5 to 10 inches thick.

Included with this soil in mapping and making up about 5 percent of the acreage is Salisbury gravelly clay loam, 0 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. Because of the slope, careful management is needed to prevent erosion.

This soil is used principally for range and wildlife habitat. Because of the size and shape of the areas, this

soil is not well suited to other uses. Capability unit IVe–3 (dryland) ; Loamy range site; Storie Index 16.

Tandy Series

The Tandy series consists of somewhat poorly drained soils on lake terraces. The soils formed in lacustrine sediment derived mostly from basic igneous rocks. They are underlain by stratified lake sediment. Soil blowing has caused the surface to be slightly hummocky. The slope ranges from 0 to 2 percent. The elevation ranges from 4,650 to 4,725 feet. Annual rainfall is 12 to 15 inches, average annual air temperature is 46° to 47° F, and the frost-free period is 70 to 80 days. Vegetation consists of saltgrass, cheatgrass, fescue, and scattered rabbitbrush, and small areas of tall wheatgrass have been planted.

In a representative profile, the surface layer is light brownish gray, calcareous loamy fine sand about 16 inches thick. The underlying material, to a depth of 69 inches or more, is grayish brown, light brownish gray, light gray, and brown, stratified, calcareous sandy loam, loamy fine sand, clay loam, and loamy sand.

Permeability is moderate, and the available water capacity is 6 to 10 inches. The rooting depth is 60 inches or more. A water table is at a depth of 18 to 48 inches.

Tandy soils are used for range and wildlife habitat.

Representative profile of Tandy loamy fine sand, on a slightly hummocky shore deposit at the south end of Goose Lake about 5 miles northwest of the community of Davis Creek on Eastside Road (causeway road), 0.25 mile south of the south end of the causeway and 110 feet east of road in NW¼NE¼ sec. 10, T. 45 N., R. 13 E. (projected).

A1—0 to 16 inches; light brownish gray (2.5YR 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.2) ; abrupt smooth boundary.

C1—16 to 19 inches; light brownish gray (10YR 6/2) light sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine and common fine roots; common very fine interstitial pores and few very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2) ; abrupt wavy boundary.

C2—19 to 30 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.4) ; abrupt smooth boundary.

IIA1b—30 to 48 inches; grayish brown (2.5Y 5/2) stratified sandy loam and clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; very few very fine roots; few very fine tubular pores and very few very fine interstitial pores; slightly effervescent; strongly alkaline (pH 8.6) ; clear smooth boundary.

IIC3b—48 to 61 inches; light gray (10YR 7/2) clay loam, brown (10YR 5/3) moist; slightly hard, friable, slightly sticky and slightly plastic; very few very fine roots; many very fine tubular pores; strongly effervescent; medium irregular soft masses of segregated lime; strongly alkaline (pH 9.0) ; abrupt smooth boundary.

IIIC4b—61 to 69 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; common medium distinct yellowish red (5YR 5/8) mottles, moist; single grained; loose, dry and moist; strongly alkaline (pH 8.8).

Depth to a water table is generally 34 to 48 inches, but in spring or when the lake level is high, the water table rises and may be 18 inches from the surface. Organic-matter content decreases irregularly with increasing depth. Reaction ranges from moderately alkaline to strongly alkaline throughout the profile. Depth to a buried horizon is 23 to 39 inches. Texture of the upper 23 to 36 inches of the soil, on the average, is sand, loamy sand, or loamy fine sand.

The A horizon ranges from 12 to 20 inches in thickness. It has dry colors of light brownish gray, gray, or light gray in hue of 10YR and moist colors of dark grayish brown and dark gray in hue of 10YR or 2.5Y.

The C horizon has hue of 10YR or 2.5Y. It has dry colors of light gray, light brownish gray, grayish brown, very pale brown, pale brown, or brown and moist colors of dark brown, dark grayish brown, grayish brown, very dark grayish brown, or brown. Texture is stratified sandy loam to silty clay. Buried A horizons are common.

191—Tandy loamy fine sand. This is a nearly level soil that formed in sandy alluvium underlain by lacustrine deposits on the south end of Goose Lake. Soil blowing has caused the surface to be slightly hummocky.

Included with this soil in mapping and making up about 10 percent of the acreage is active sand dunes; making up 3 percent is Fluvaquents.

Runoff is very slow, and there is no hazard of erosion. The hazard of soil blowing is moderate. This soil is subject to flooding when the lake level is uncommonly high.

This soil is used for dryland pasture, range, and wildlife habitat. Capability unit VIe–1 (dryland); Saline Bottom range site; Storie Index 11.

Thoms Series

The Thoms series consists of well drained soils on mounded lake terraces. The soils have a silica-cemented hardpan. They formed in coarse textured alluvium derived from basic igneous and pyroclastic rocks. The

slope ranges from 0 to 5 percent. The elevation ranges from 4,700 to 5,300 feet. Annual precipitation is 12 to 16 inches, the average annual air temperature is 46° to 49° F, and the frost-free period is about 80 days. Vegetation is shrubs and grasses. It consists of low sagebrush, low phlox, squirreltail, Sandberg bluegrass, and cheatgrass.

In a representative profile, the surface layer is brown, slightly acid very cobbly loam about 6 inches thick. The subsoil is dark brown, neutral clay loam about 7 inches thick. A reddish yellow, silica-cemented hardpan is at a depth of 13 inches.

Permeability is slow above the nearly impermeable hardpan, and the available water capacity is about 2 inches. The effective rooting depth is 12 to 18 inches.

Thoms soils are used for range and wildlife habitat.

Representative profile of Thoms very cobbly loam, in an area of Thoms-Exel complex, on a mounded, nearly level to gently sloping lake terrace about 9 miles northeast of the town of Alturas on the south side of State Highway 299, or 1,900 feet south and 1,618 feet west of E¼ corner of sec. 18, T. 43 N., R. 14 E.

A1—0 to 6 inches; brown (10YR 5/3) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine interstitial pores and few very fine tubular pores; 50 percent cobbles, by volume, on the surface; slightly acid (pH 6.3); clear smooth boundary.

B2t—6 to 9 inches; dark brown (7.5YR 4/4) clay loam, reddish brown (5YR 4/4) moist; moderate coarse angular blocky structure; hard, friable, sticky and plastic; few very fine exped roots; few very fine tubular pores; common moderately thick clay films in pores and on peds; 10 percent gravel and 5 percent cobbles, by volume; neutral (pH 6.8); abrupt smooth boundary.

B3t—9 to 13 inches; dark brown (5YR 4/3) heavy clay loam, brown (5YR 4/4) moist; moderate medium angular blocky structure; hard, friable, sticky and plastic; few very fine tubular and interstitial pores; common moderately thick clay films in pores and on peds; 10 percent gravel and 5 percent cobbles, by volume; neutral (pH 6.8); abrupt smooth boundary.

Csim—13 to 42 inches; reddish yellow (7.5YR 6/6) massive silica-cemented hardpan; 50 percent cobbles and 40 percent gravel, by volume; indurated bands 1 millimeter thick in upper part; silica coating on bottom of coarse fragments; common fine distinct very dark gray (N 3/0) manganese mottles.

The thickness of the solum and the depth to hardpan range from 12 to 18 inches.

The A horizon is 5 to 7 inches thick. When dry, the soil material is brown, pale brown, grayish brown, or light brownish gray in hue of 10YR. It is fine sandy loam or loam that is very cobbly, very stony, or extremely stony. The structure is weak platy or moderate subangular blocky, or the material is massive. Consistence is soft, slightly hard, or hard. Reaction is neutral or slightly acid.

The B horizon is 7 to 11 inches thick. It is brown or dark brown in hue of 7.5YR and 5YR. It is clay loam or heavy clay loam in the upper part and heavy clay loam or clay in the lower part. It has weak subangular blocky to moderate angular blocky structure. The texture control zone on the average is 30 to 35 percent clay. Consistence is hard or very hard and friable or firm. Reaction is neutral or slightly acid.

The Csim horizon is massive, or it has thin continuous opal laminar layers in the upper part.

192—Thoms-Exel complex. This complex is nearly level to gently sloping and is on mounded terraces north of Russell Slough and east of the intersection of U.S. Highways 299 and 395. The Thoms soil makes up about 50 percent of the complex and is between mounds. The Exel soil makes up about 40 percent of the complex and is on the mounds. The mounds are 1 to 3 feet high and 20 to 60 feet in diameter. These soils have the profile described as representative of their respective series.

Included with these soils in mapping and making up about 5 percent of the acreage is Bieber gravelly loam, 0 to 9 percent slopes. About 3 percent of the acreage consists of a soil that is on mounds and does not have a hardpan; 2 percent is Barnard cobbly loam, 0 to 9 percent slopes.

Runoff is very slow on the Thoms soil and medium on the Exel soil. The hazard of erosion is slight.

This complex is used for range. Capability unit VIIs–1 (dryland); Storie Index 8; Thoms soil is Hardpan Terrace range site, Exel soil in Dry Loamy range site.

Tuff Outcrop

Tuff outcrop consists of nearly barren areas of exposed bedrock that is made up of massive pumice lapilli tuff, light colored ashy sandstone, and welded tuff. The tuff is black or gray. Tuff outcrop is in areas southwest of the town of Alturas.

Vegetation is sparse; juniper and annual grasses grow in cracks in the outcrops.

Tuff outcrop is used mainly for watershed and recreation. It is mapped only in complex with Casuse soils.

193—Tuff outcrop-Casuse, eroded complex, 2 to 15 percent slopes. This complex is undulating to rolling and is on terraces southwest of Alturas. The pattern of occurrence of Tuff reflects the parent material but is not geographically predictable. The Tuff outcrop is scattered throughout the areas where the bedrock is hard and has not been weathered. It makes up 55 percent of the complex. It consists of nearly barren areas of exposed bedrock that is made up of massive pumice lapilli tuff, light colored ashy sandstone, and welded tuff. Casuse sandy loam makes up 35 percent of the complex. It has the profile described as representative of the Casuse series.

Included with this complex in mapping and making up about 7 percent of the acreage is Daphnedale cobbly

loam, 9 to 30 percent slopes; and 3 percent is Ladd sandy loam, 2 to 9 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. The Casuse soil has an available water capacity of 1.5 to 3.5 inches and an effective rooting depth of 8 to 20 inches.

This complex is used for range, wildlife habitat, and recreation. In small areas it is used for dryland cereal rye and wheatgrass. Capability unit VIIs–1 (dryland); Tuff outcrop part not placed in a range site; Casuse part in Shallow Loamy range site; Storie Index 5.

194—Tuff outcrop-Casuse, eroded complex, 30 to 50 percent slopes. This complex is on steep upland escarpments southwest of Alturas. Tuff outcrop makes up 60 percent of the complex and is mainly on the upper part of the escarpments. It consists of nearly barren areas of exposed bedrock that is made up of massive pumice lapilli tuff, light colored ashy sandstone, and welded tuff. Casuse cobbly sandy loam makes up 30 percent of the complex and is on the lower part of the escarpments. It has a profile similar to the one described as representative of the series, except that cobbles make up about 20 percent of the surface layer. Shallow gullies dissect areas of the Casuse soil.

Included with this unit in mapping and making up about 6 percent of the acreage is Casuse sandy loam, 2 to 9 percent slopes; making up 4 percent is Daphnedale stony loam, 30 to 50 percent slopes.

Runoff is rapid. The hazard of erosion is high on the Casuse soil and slight on the Tuff outcrop. The available water capacity is 1.5 to 3.5 inches. The effective rooting depth is 8 to 20 inches.

This complex is used for range, wildlife habitat, and recreation. Capability unit VIIs–1 (dryland); Tuff outcrop part not placed in a range site; Casuse part in Shallow Loamy range site; Storie Index 2.

Tulana Series

The Tulana series consists of deep, poorly drained soils in concave basins and flat lake bottoms. The soils formed in lake sediment, mostly diatoms and volcanic ash. The slope ranges from 0 to 2 percent. The elevation ranges from 4,350 to 4,400 feet. Annual rainfall is 10 to 14 inches, annual snowfall is 24 to 36 inches, average annual air temperature is 47° to 49° F, and the frost-free period is 80 to 100 days. Vegetation in partially drained areas is water-tolerant grasses including bluegrass, rushes, sedges, reed canarygrass, creeping meadow foxtail, and timothy. Vegetation in undrained areas consists of cattail, tules, bulrushes, and sedges.

In a representative profile, the surface layer is dark gray, slightly acid, mucky loam about 13 inches thick. The underlying material, to a depth of 23 inches, is light gray, neutral loam. Below this, to a depth of 60 inches or more, it is very dark grayish brown, slightly acid silty clay loam.

Permeability is moderate, and the available water capacity is 12 to 18 inches. The effective rooting depth is 60 inches.

Tulana soils are used for irrigated meadow pasture, hay, and small grain, and a small acreage of irrigated alfalfa is grown in the better drained areas of these soils.

Representative profile of Tulana mucky loam, drained, in a nearly level basin about 4 miles northwest of the town of Likely, or 50 feet north of gate and 30 feet east of farm road that is 0.3 mile north of County Road 60 in NW¼SW¼ sec. 24, T. 40 N., R. 12 E.

Ap1—0 to 8 inches; dark gray (10YR 4/1) mucky loam, black (10YR 2/1) moist, and black (N 2/0) rubbed; about 15 percent fibers, 2 percent rubbed; weak coarse granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots and fine roots; slightly acid (pH 6.1); abrupt wavy boundary.

Ap2—8 to 13 inches; dark gray (10YR 4/1) mucky loam, black (10YR 2/1) moist, and black (N 2/0) rubbed; about 3 percent fibers; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; slightly acid (pH 6.3); abrupt wavy boundary.

C1—13 to 16 inches; light gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist and rubbed; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine and fine tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

C2—16 to 23 inches; light gray (10YR 7/1) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine and fine tubular pores; neutral (pH 7.0); abrupt smooth boundary.

C3—23 to 31 inches; very dark grayish brown (10YR 3/2) silty clay loam, black (10YR 2/1) moist; common medium distinct grayish brown (2.5Y 5/2) mottles; massive; hard, friable, sticky and slightly plastic; very few very fine roots; common very fine tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

IIIC4—31 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam, black (10YR 2/1) moist; common medium distinct grayish brown (2.5Y 5/2) mottles; massive; hard, friable, sticky and slightly plastic; very few very fine roots; common very fine tubular pores; strata of light brownish gray (10YR 6/2) silt loam 1 inch thick; thin strata that are 20 percent fiber; slightly acid (pH 6.5).

The A horizon ranges from 11 to 20 inches in thickness. It is gray or dark gray in hue of 10YR or in neutral hue. It is mucky loam, mucky silty clay loam, or mucky silty clay. Reaction is slightly acid or neutral.

The C horizon is light gray to very dark gray or grayish brown to very dark grayish brown in hue of 10YR or in neutral hue. It is loam, silt loam, or silty clay loam. Diatoms and glass shards are present in the

sand fraction. Reaction is slightly acid or neutral. Thin ash layers are in the profile.

195—Tulana mucky loam, partially drained. This is a nearly level soil in basins on the west side of the Likely Valley. It has a profile similar to the one described as representative of the series, except that the water table is at a depth of 24 to 36 inches. This soil is subject to frequent overflows for brief periods in spring. The surface layer is 11 to 16 inches thick.

Included with this soil in mapping and making up about 5 percent of the acreage is Tulana mucky loam, drained; 3 percent is Pasquetti silty clay loam, partially drained; 2 percent is Pit silty clay loam, 0 to 2 percent slopes; and about 1 percent is areas of mound vegetation over the water table.

Runoff is very slow, and there is no hazard of erosion. The water table limits the rooting depth of water-sensitive crops.

This soil is used for irrigated meadow, hay, and meadow pasture. Capability unit IIIw–2 (irrigated); not placed in a range site; Storie Index 30.

196—Tulana mucky loam, drained. This is a nearly level soil in basins throughout the Likely Valley. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 6 percent of the acreage is Pasquetti silty clay loam, drained; 5 percent is a soil that has a surface layer more than 20 inches thick that has a high content of organic matter; 2 percent is Tulana mucky loam, partially drained; 2 percent is Pit silty clay loam, 0 to 2 percent slopes; 1 percent is Balman loam, wet; and 1 percent is Pineal silt loam.

Runoff is very slow, and there is no hazard of erosion. The water table is at a depth of more than 60 inches. The water table fluctuates depending on the irrigation practices that are used.

This soil is used for irrigated hay, pasture, and grain and, in small areas, for irrigated alfalfa. Capability unit IIIc–1 (irrigated); not placed in a range site; Storie Index 30.

Typic Xerorthents

197—Typic Xerorthents. This map unit is on the east side of Goose Lake adjacent to Willow Creek and the Lakeshore Ranch headquarters. The soils formed in stratified sandy, gravelly, or cobbly lakeshore deposits. They have variable texture and are stratified. Horizon development is minimal. Vegetation is sparse.

Included with these soils in mapping and making up about 10 percent of the acreage is Donica gravelly clay loam, 2 to 9 percent slopes; 3 percent is Xerofluvents, occasionally flooded.

Runoff is slow, and the hazard of erosion is slight. The effective rooting depth is more than 60 inches.

These soils are used as a source of sand and gravel. They also provide limited winter feeding for wildlife. Capability unit VIIIs–1 (dryland); not placed in a range site; Storie Index 10.

Woodcock Series

The Woodcock series consists of well drained soils on upland ridges and slopes. The soils formed in colluvium derived from andesite and basalt. They are underlain by hard basalt or andesite. The slope ranges from 2 to 50 percent. The elevation ranges from 4,800 to 5,400 feet. Annual precipitation is 16 to 20 inches, average annual air temperature is 42° to 44° F, and the frost-free period is 60 to 80 days. Vegetation is ponderosa pine, juniper, and mountainmahogany and an understory of bitterbrush, wild plum, Idaho fescue, and Nevada bluegrass.

In a representative profile, the surface layer is dark brown, slightly acid stony loam about 6 inches thick. The subsoil is reddish brown, slightly acid very cobbly clay loam about 40 inches thick. Basalt is at a depth of 46 inches.

Permeability is moderate, and the available water capacity is 1 to 3 inches. The effective rooting depth is 40 to 60 inches or more.

Woodcock soils are used for woodland, wildlife habitat, and recreation and, in small areas, for grazing.

Representative profile of Woodcock stony loam, 30 to 50 percent slopes, 50 feet north of a dirt road that is 0.2 mile northeast from road to Briles Reservoir and 0.4 mile on Briles Reservoir Road east of U.S. Highway 395 in NE¼SW¼ sec. 33, T. 46 N., R. 14 E.

O1—1 inch to 0; loose mat of pine needles; 45 percent stones and cobbles on surface, by volume; abrupt smooth boundary.

A1—0 to 6 inches; dark brown (7.5YR 4/2) stony loam, dark brown (7.5YR 3.2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine and medium and few fine roots; many very fine interstitial pores and common very fine tubular pores; 20 percent stones and cobbles and 5 percent gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

B1—6 to 12 inches; reddish brown (5YR 4/4) cobbly clay loam; dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; hard, very friable, sticky and slightly plastic; common very fine roots, fine roots, and medium roots; few very fine interstitial and tubular pores; 20 percent cobbles and gravel, by volume; slightly acid (pH 6.5); clear smooth boundary.

B2t—12 to 46 inches; reddish brown (5YR 4/4) very cobbly light clay loam, dark reddish brown (5YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; very few very fine interstitial pores and few very fine and fine tubular pores; 85 percent cobbles and stones, by volume; slightly acid (pH 6.3); clear smooth boundary.

R—46 inches; fractured basalt.

Depth to bedrock and the thickness of the solum range from 40 to 60 inches.

The A horizon ranges from 6 to 12 inches in thickness. It is dark brown, brown, reddish brown, or dark reddish brown in hue of 7.5YR and 5YR. It is stony loam or stony clay loam that has granular or subangular blocky structure. Reaction is slightly acid to neu-

tral. Stones and cobbles make up 5 to 45 percent of the A horizon.

The B horizon ranges from 35 to 48 inches in thickness. It is brown, dark brown, reddish brown, or dark reddish brown in hue of 5YR and 7.5YR. It is sandy clay loam or clay loam and is 55 to 90 percent coarse fragments, by volume. Reaction is slightly acid to neutral.

Woodcock soils in this survey area are a taxadjunct to the Woodcock series because they have a summer temperature higher than 59° F in areas that do not have an O horizon and a summer temperature higher than 47° where an O horizon is present. Although these soils are a few degrees warmer than the defined range for the series, the difference does not alter their use or behavior.

198—Woodcock stony loam, 2 to 30 percent slopes. This gently sloping to moderately steep soil is on uplands west of Rocky Prairie. It has a profile similar to the one described as representative of the series, except it does not have a thin organic surface layer in places where there is no forest vegetation.

Included with this soil in mapping and making up about 5 percent of the acreage is Karcal cobbly clay loam, 0 to 9 percent slopes; 3 percent is Ninekar cobbly loam, 0 to 9 percent slopes; 3 percent is Deven very stony clay loam, 2 to 30 percent slopes; and 2 percent is Rock outcrop.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for woodland, wildlife habitat, recreation, and limited grazing. If it is used to grow ponderosa pine, the site index is 72. Equipment limitations, plant competition, and the hazard of windthrow are slight. Seedling mortality is moderate. Species to favor in existing stands are ponderosa pine, Jeffrey pine, and incense-cedar. Species to recommend for planting are ponderosa pine and Jeffrey pine. Capability unit VIe–1 (dryland) ; not placed in a range site; Storie Index 36.

199—Woodcock stony loam, 30 to 50 percent slopes. This steep soil is on faulted, extrusive igneous uplands. It has the profile described as representative of the series.

Included with this soil in mapping and making up about 5 percent of the acreage is Deven very stony clay loam, 30 to 50 percent slopes; 3 percent is Kinkel loam, 30 to 50 percent slopes; and 3 percent is a soil that is similar to this Woodcock soil but that is 20 to 40 inches deep to bedrock.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for woodland, wildlife habitat, recreation, and limited grazing. If it is used to grow ponderosa pine, the site index is 72. Plant competition and hazard of windthrow are slight. Equipment limitations and seedling mortality are moderate. Species to favor in existing stands are ponderosa pine, Jeffrey pine, and incense-cedar. Species to recommend for planting are ponderosa pine and Jeffrey pine. Capability unit VIe–1 (dryland) ; not placed in a range site; Storie Index 11.

Xerofluvents, Occasionally Flooded

200—Xerofluvents, occasionally flooded. This map unit is in and along channels of perennial and intermittent streams. The soils consist of highly stratified, unconsolidated, sandy and gravelly alluvium. They are variable in texture. These soils are subject to flooding at least once in every 2 or 3 years. This flooding results in scouring and deposition. The soils are, however, sufficiently stable that vegetation can be established. The vegetation consists of perennial grasses, brush, and willows.

Included with these soils in mapping and making up about 5 percent of the acreage is Pit silty clay loam, 0 to 2 percent slopes; 3 percent is Buntingville clay loam, 0 to 2 percent slopes; and 2 percent is Typic Xerorthents.

Runoff is slow, and there is no hazard of erosion. The effective rooting depth is more than 60 inches.

These soils are used for wildlife habitat. Capability unit VIIIw–1 (dryland) ; not placed in a range site; Storie Index 10.

Use and Management of the Soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bed-

rock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Use of the Soils for Crops and Pasture[1]

Soils in the Alturas area are used for various irrigated and dryland crops. Because of the short growing season, mostly forage crops are grown. Irrigated crops include alfalfa grown for hay, grass and legume mixtures grown for both hay and pasture, and wheat and barley. Dryland crops are mostly drought resistant and include various wheatgrasses, grass-legume mixtures grown for hay and pasture, and wheat and barley cereal grain. Native meadow grasses are discussed in the section "Use of the Soils for Range." Soils in some areas are planted to rye crops.

The major cropland areas are in Goose Lake Valley and in Pit River Valley near Likely, Alturas, and Canby. Soils that have drainage problems are used for irrigated grass-legume hay and pasture. The deep, nearly level and gently sloping, well drained soils are used for irrigated alfalfa and grain or, where water is not available, for dryland pasture, hay, and grain. Some areas are used for hay production and as grazing land. Much of the cropland supplements livestock enterprises in areas of public rangeland.

In the following pages, the system of capability grouping used by the Soil Conservation Service is explained, and management is suggested for each capability unit. Then, the Storie Index ratings are defined, and the estimated average acre yields of the main irrigated and dryland crops are given along with the management required to obtain these yields.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most common crops. The groups are made according to the limitations of the soils when used for common crops, the risk of damage when used, and the way the soils respond to conservation practices. The grouping does not take into account major landforming that would change slope, depth, or other characteristics of the soils; does not consider major reclamation projects; and does not apply to rice, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show the suitability, hazards, or limitations of groups of soils for range and wildlife, for forest trees, for recreation, or for engineering uses.

In the capability system, all soil map units are grouped at three levels: capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

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

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

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

Because of the severe climatic conditions in the Alturas Area, no soils are placed in Class I or Class II. In accordance with criteria used in California, the choice of crops is severely limited in areas that have fewer than 100 consecutive frost-free days during the growing season. Soils in these areas, therefore, are placed in Class III or higher. Frost is common in the Alturas area even in summer.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk or erosion; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, clayey, or stony; and *c* shows that the chief limitation is a climate that is too cold or too dry for common crops.

Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

The acreage of soils in each capability class and subclass is indicated in table 2. All soils in the survey area, except those named at a level higher than the series, are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use. Data in this table can be used to determine the farming potential of such soils.

[1] By RICHARD C. PYLE, district conservationist, Soil Conservation Service.

TABLE 2.—*Capability classes and subclasses*

[Miscellaneous areas are excluded. Dashes mean that no soils are placed in that class or subclass]

Class	Total acreage	Major management concerns			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
	Acres	*Acres*	*Acres*	*Acres*	*Acres*
Class I:					
Dryland	---	---	---	---	---
Irrigated	---	---	---	---	---
Class II:					
Dryland	---	---	---	---	---
Irrigated	---	---	---	---	---
Class III:					
Dryland	14,739	4,267	4,577	5,895	---
Irrigated	92,807	42,271	35,690	1,606	8,240
Class IV:					
Dryland	57,251	45,958	11,293	---	---
Irrigated	63,631	62,596	1,035	---	---
Class V:					
Dryland	237	---	237	---	---
Irrigated	---	---	---	---	---
Class VI:					
Dryland	152,934	83,372	1,988	67,574	---
Irrigated	---	---	---	---	---
Class VII:					
Dryland	105,373	11,942	2,913	90,518	---
Irrigated	---	---	---	---	---
Class VIII:					
Dryland	1,527	---	81	1,446	---
Irrigated	---	---	---	---	---

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils.

In California, capability units are identified by Arabic numbers that indicate the major soil limitation responsible for placing the soil in a given capability class or subclass. For this reason, some of the units within the subclasses are not numbered consecutively. The numerals used to designate capability units in classes III and IV indicate soil limitations as follows:

0. Sand and gravel in the substratum limit the depth of root penetration.
1. Erosion is an actual or potential hazard.
2. Poor soil drainage or flooding results in excessive soil wetness.
3. Permeability is slow or very slow in the subsoil or substratum.
4. Soil texture is too coarse, or excessive amounts of gravel are in the profile.
5. Texture of the surface layer is fine or very fine.
6. Excessive amounts of salts or alkali are in the profile.
7. Excessive amounts of cobbles, stones, or rocks are in the profile.
8. Nearly impervious bedrock or a hardpan is within the effective rooting depth.
9. The soil has low fertility or includes material toxic to plants.

For classes V through VIII only the nonconnotative number 1 is used. The limitations of soils in these classes for use as range or woodland are discussed in more detail in the sections "Use of the Soils for Range" and "Woodland."

Management by capability units

Utilization of crop residue, minimum tillage, proper grazing use, pasture and hayland management, and fertilization are common management practices in the Alturas Area. Disking or plowing under stubble and straw provides organic matter and reduces soil loss from erosion. The addition of organic matter to the soil increases fertility, aeration, and moisture penetration and maintains or improves soil structure. Minimum tillage maintains soil structure and reduces compaction, thus influencing air and water movement through the soil. Proper timing of tillage operations is important. All tilling should be done when moisture conditions are such that compaction can be kept to a minimum. Proper grazing management maintains stands and the desired composition of pasture and range vegetation and thus provides for maximum yield of desired vegetation. Pasture and hayland management maintains stands and provides for maximum erosion control and yields. Fertilization is generally needed to maintain or increase soil productivity. The kinds and amounts of fertilizer needed vary with the cropping history, the soil, and the crop grown. Nearly all crops respond to applications of nitrogen, and legumes respond readily to phosphorus. Crops on some soils respond to sulfur.

Irrigation water is available in much of the area but is lacking in certain areas. Where a cultivatable map unit is in both areas with available irrigation water and areas without available irrigation water, two capability units are given—one for irrigation and one for dryland farming. Only one capability unit is given otherwise.

The capability units in the Alturas Area are described on the following pages and suggestions for use and management of the soils are given. Soil series names are mentioned in each capability unit, but this does not mean that all units of the series are in that particular capability unit. To determine the capability unit in which a soil is placed, refer to the "Guide to Map Units" at the back of this survey.

In the following descriptions of the capability units, the available water capacity applies to the effective rooting depth, which is the depth that roots of plants common to this area generally penetrate.

CAPABILITY UNIT IIIe-1 (IRRIGATED)

This unit consists of sandy loam, loam, clay loam, and silty clay loam soils of the Buntingville, Calimus,

Drews, Jenny, Ladd, and Lakeview series. Some areas are gravelly. These soils are well drained, except for the Lakeview soils, which are moderately well drained, and the Buntingville soils, which are somewhat poorly drained. The soils are in basins and on basin rims, lake terraces, or alluvial fans. The slope ranges from 0 to 9 percent. The annual rainfall is 12 to 18 inches, and the frost-free period is 80 to 100 days. Permeability is moderate or slow. Runoff is slow or medium, and the hazard of erosion is slight. Available water capacity is 7 to 12 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for alfalfa, for grass and legume mixtures grown for hay or pasture, and for wheat and barley.

The soils with a low available water capacity need more frequent irrigation. In places, land leveling or smoothing is needed on lesser slopes. Sprinkler or contour irrigation is suited to the steeper slopes.

CAPABILITY UNIT IIIe–3 (IRRIGATED)

This unit consists of sandy loam, gravelly loam, and very fine sandy loam soils of the Barnard, Modoc, and Salisbury series. These soils are well drained. They are on alluvial fans or terraces. The slope ranges from 0 to 9 percent. The annual rainfall is 10 to 20 inches, and the frost-free period is 70 to 110 days. Permeability is slow or moderately slow above the nearly impervious hardpan. Runoff is slow or medium, and the hazard of erosion is slight or moderate. Available water capacity is 3 to 7 inches. Roots penetrate to a depth of 20 to 40 inches and are restricted by the hardpan.

These soils are used for alfalfa, for grass and legume mixtures grown for hay or pasture, and for wheat and barley.

Land leveling or smoothing is practical on the lesser slopes, but extreme care is needed to avoid deep cuts that expose the hardpan. Sprinkler and contour flooding irrigation are suited to the steeper slopes. The application rate of irrigation water should be adjusted to the water intake rate of the soil. It should also coincide with the available water capacity of the soil, because over-irrigation can cause a perched water table immediately above the hardpan. Deep rooted crops such as alfalfa are affected by the presence of hardpans and perched water tables. Careful irrigation management is needed to maintain stands and production of alfalfa on these soils.

CAPABILITY UNIT IIIe–3 (DRYLAND)

This unit consists of loam, very fine sandy loam, very cobbly loam, and gravelly loam soils of the Reba and Salisbury series. These soils are well drained. They are on lake terraces. The slope ranges from 0 to 9 percent. The annual rainfall is 10 to 20 inches, and the frost-free period is 80 to 110 days. Permeability is slow or moderately slow over the nearly impervious hardpan. Runoff is medium, and the hazard of erosion is slight or moderate. Available water capacity is 3 to 12 inches. Roots penetrate to a depth of 20 to 59 inches to a hardpan.

These soils are used for pasture. Drought-tolerant wheatgrass is suited to this unit.

Tillage operations should be across the slope or on the contour to reduce runoff and erosion. Crop residues should be returned to the soil to maintain or improve tilth, the water infiltration rate, and the water penetration into the soil.

CAPABILITY UNIT IIIe–4 (IRRIGATED)

This unit consists of Donica gravelly clay loam. This soil is somewhat excessively drained and is on alluvial fans. The slope ranges from 2 to 9 percent. The annual rainfall is 16 to 20 inches, and the frost-free period is 80 to 90 days. Permeability is moderately rapid. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 3 to 5 inches. Roots penetrate to a depth of 60 inches or more.

This soil is used for alfalfa, for grass and legume mixtures grown for hay or pasture, and for wheat and barley.

Frequent irrigation is needed because of the low available water capacity. Sprinkler irrigation is suited to this soil. Tillage operations should be on the contour or across the slope to slow runoff and to reduce erosion. Tillage is affected by gravel in the surface layer. Deep land leveling or smoothing should be avoided because deep cuts expose the gravelly and sandy substrata.

CAPABILITY UNIT IIIe–5 (IRRIGATED)

This unit consists of silty clay and clay soils of the Ager and Jenny series. Ager soils are well drained, and Jenny soils are moderately well drained. These soils are in basins or on terraces. The slope ranges from 0 to 15 percent. The annual rainfall is 10 to 15 inches, and the frost-free period is 70 to 90 days. Permeability is slow. Runoff is slow or medium, and the hazard of erosion is none to moderate. Available water capacity is 6 to 11 inches. Roots penetrate to a depth of 40 to more than 60 inches. The shallower soils are underlain by soft lake sediments.

These soils are used for alfalfa, for grass and legume mixtures grown for hay or pasture, and for wheat and barley.

The soils should be planted and plowed at the proper moisture content because of their high clay content. If the soils are tilled when too dry, large hard clods form. If they are tilled when too moist, the soil structure is destroyed, the surface seals, and root and water penetration are reduced. Land leveling or smoothing is practical on the lesser slopes. Sprinkler or contour flooding irrigation is suited to the steeper slopes. Because of the slow water intake rate and slow permeability, irrigation water should be applied slowly to these soils.

CAPABILITY UNIT IIIw–2 (IRRIGATED)

This unit consists of mucky loam, silt loam, clay loam, and silty clay loam soils of the Buntingville, Drews, Goose Lake, Pasquetti, and Tulana series. Drew soils are well drained but are subject to some flooding in spring. Buntingville soils are somewhat poorly drained. Goose Lake and Pasquetti soils are poorly drained and have a fluctuating water table. Tulana soils are poorly drained. These soils are in basins and on low lake terraces and alluvial fans. The slope ranges from 0 to 2 percent. The annual rainfall is 10 to 16 inches, and the frost-free period is 70 to 100 days. Permeability is moderate to slow. Runoff is very slow to medium, and the hazard of erosion is none to moderate.

Available water capacity is 9 to 15 inches. A seasonal water table is at a depth of 24 to 60 inches or more. Roots penetrate to a depth of 60 inches.

These soils are used for grass and legume mixtures grown for hay or pasture. Only water-tolerant plants should be planted on these soils, except for the Drews soil, which is suited to alfalfa. Wheat or barley can be grown on these soils, except for the Tulana soils. Small grain can be planted in spring after floodwaters have receded and the water table has lowered.

Careful irrigation is needed to prevent a rise in the water table which affects rooted crops. Contour or border irrigation is well suited to these soils. Land leveling or smoothing is needed in many areas to obtain good distribution of irrigation water. Deep cuts should not be made in the Goose Lake soil because they would expose the silty clay subsoil in places.

CAPABILITY UNIT IIIw–5 (IRRIGATED)

This unit consists of silty clay loam and clay soils of the Pit series. These soils are somewhat poorly drained and are on flood plains and in basins. The slope ranges from 0 to 5 percent. The annual rainfall is 10 to 14 inches, and the frost-free period is 80 to 90 days. Permeability is slow. Runoff is slow, and the hazard of erosion is none or slight. Available water capacity is 9 to 11 inches. A seasonal water table is at a depth of 36 to 40 inches.

These soils are used for grass and legume mixtures grown for hay or pasture and for wheat and barley. Wheat or barley should be planted after the hazard of spring floods has passed.

Land leveling or smoothing is needed on the lesser slopes in places to provide good distribution of irrigation water. Contour flooding irrigation is suited to the steeper slopes. Planting and plowing these soils at the proper moisture content is important. Irrigation water needs to be applied carefully to prevent drowning crops, because the soils have slow permeability and a seasonal high water table.

CAPABILITY UNIT IIIw–6 (IRRIGATED)

This unit consists of loam soils of the Alturas series. These soils are moderately well drained. They are in basins and on low terraces. The slope ranges from 0 to 2 percent. The annual rainfall is 8 to 15 inches, and the frost-free period is 80 to 130 days. Permeability is slow. Runoff is slow, and the hazard of erosion is slight. Available water capacity is 9 to 10 inches. A seasonal water table is at a depth of about 30 inches, and the soil is subject to ponding in wet weather. Roots penetrate to a depth of 60 inches or more.

These soils are used for grass and legume mixtures grown for hay or pasture. Saline- and alkali-tolerant plants can be grown. Wheat or barley can also be grown and should be planted in fall or after spring floods.

Contour flooding irrigation is suited to this soil. Limited land leveling or smoothing is needed in places to provide good distribution of irrigation water. Irrigation water should be applied carefully to avoid drowning crops, because the soils have slow permeability and a seasonal high water table. Removal of alkali and saline salts is needed to grow crops with low tolerance to salts.

CAPABILITY UNIT IIIw–6 (DRYLAND)

This unit consists of loam soils of the Alturas and Balman series. Alturas soils are moderately well drained and have a water table at a depth of about 30 inches. Balman soils are somewhat poorly drained and poorly drained and have a fluctuating water table at a depth of 24 to 72 inches. These soils are on low lake terraces and in basins. The slope is 0 to 2 percent. These soils are strongly saline in the upper few inches. The frost-free period is 80 to 130 days. Permeability is slow or moderately slow. Runoff is very slow or slow, and the hazard of erosion is none or slight. Available water capacity is 7 to 10 inches. Roots penetrate to a depth of 60 inches or more and are restricted by a water table.

These soils are used for pasture. Only saline- or alkali-tolerant grasses should be planted if the salts are not removed. Water-tolerant grasses that can withstand a high water table and flooding should be grown.

Saline and alkali salts need to be removed from these soils to grow crops sensitive to salt. Adequate drainage is needed for salt reclamation and lowering of the water table. Spring planting is desirable because salt concentration is lowest in the surface soil in spring. Later in summer and early in fall salts move upward with capillary water and concentrate at the surface.

CAPABILITY UNIT IIIs–3 (IRRIGATED)

This unit consists of silty clay loam soils of the Pasquetti series. These soils formed under poor drainage conditions but are now drained, and the water table is no longer a problem. These soils are in basins. The slope ranges from 0 to 2 percent. The annual rainfall is 10 to 12 inches, and the frost-free period is 80 to 90 days. Permeability is slow. Runoff is very slow, and there is no hazard of erosion. Available water capacity is 8 to 11 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for grass and legume mixtures grown for hay or pasture, and they are used for wheat and barley.

Land leveling or smoothing, or both, is needed in places to obtain good distribution of water. Contour flood irrigation is suited to these soils, but water needs to be applied carefully to avoid drowning crops. The slow permeability and the potential rise of the water table affect crop production.

CAPABILITY UNIT IIIs–6 (DRYLAND)

This unit consists of loam soils of the Rumbo series. These soils are moderately well drained. They are on low terraces and in basins. The slope ranges from 0 to 5 percent. These soils are nonsaline to strongly saline and are slightly to moderately affected by alkali salts. The annual rainfall is 10 to 14 inches, and the frost-free period is 80 to 100 days. Permeability is slow. Runoff is slow, and the hazard of erosion is slight or moderate. Available water capacity is 7.5 to 9 inches. In places a water table is below a depth of 50 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for pasture. Salt-tolerant grasses and legumes should be grown.

Rumbo soils have a leached surface layer and can be planted either in fall or spring. In summer and fall capillary water and salts move upward in the soil and concentrate near the surface. Tillage of the steeper soils should be across the slope to control erosion.

CAPABILITY UNIT IIIe–1 (IRRIGATED)

This unit consists of mucky loam, sandy loam, loam, and clay loam soils of the Calimus, Ladd, Lakeview, and Tulana series. The Calimus and Ladd soils are well drained; the Lakeview soils are moderately well drained; and the Tulana soils, which were poorly drained, are now drained. These soils are on alluvial fans or in basins. The slope is 0 to 2 percent. The annual rainfall is 10 to 18 inches, and the frost-free period is 80 to 100 days. Permeability is moderate or moderately slow. Runoff is slow or very slow, and the hazard of erosion is none or slight. Available water capacity is 8 to 15 inches. Roots penetrate to a depth of 60 inches or more.

These soils are used for alfalfa, for grass and legume mixtures grown for hay or pasture, and for wheat and barley. Varieties of shallow-rooted alfalfa are suited to the Tulana soils.

Contour flood irrigation is suited to these soils. Land smoothing or leveling is needed on some soils. Open drain ditches help to maintain the water level of the Tulana soils. Micronutrient deficiencies have been observed on some Tulana soils where management is intense.

CAPABILITY UNIT IVe–1 (IRRIGATED)

This unit consists of loam and cobbly loam soils of the Daphnedale and Delma series. These soils are well drained. They are on lake terraces. The slope ranges from 0 to 9 percent. The annual rainfall is 10 to 16 inches, and the frost-free period is 80 to 100 days. Permeability is moderately slow or slow. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 2 to 6 inches. Roots penetrate to a depth of 11 to 35 inches and are restricted by soft lake sediments and soft tuff.

These soils are used for irrigated pasture.

Sprinkler or contour flooding irrigation is suited to these soils. These soils need frequent applications of irrigation water because of their low water capacity. The shallow Delma soils are best suited to shallow-rooted crops. Land leveling is not practical on the Delma soil because of the shallow soil depth. As much vegetative cover as possible should be maintained on these soils.

CAPABILITY UNIT IVe–1 (DRYLAND)

This unit consists of gravelly loam, loam, clay loam, silty clay loam, and sandy loam soils of the Buntingville, Daphnedale, Drews, Gleason, Jenny, Kinkel, and Ladd series. These soils are well drained or moderately well drained, except for the Buntingville soils, which are somewhat poorly drained. These soils are on lake terraces, terrace escarpments, alluvial fans, and uplands. The slope ranges from 2 to 30 percent. The annual rainfall is 10 to 20 inches, and the frost-free period is 70 to 100 days. Permeability is moderately rapid to slow. Runoff is slow or medium, and the hazard of erosion is slight or moderate. Available water capacity is 3 to 12 inches. Roots penetrate to a depth of 25 to 60 inches or more. The shallower Daphnedale soils are underlain by soft lake sediments. Gleason soils are 40 to 60 inches deep over hard tuff. Kinkel soils are 45 to 60 inches deep over welded tuff.

These soils are used for range, pasture, wheat, and barley. They are also used for recreation and wildlife habitat.

Fall or spring planting of grain is suitable. All tillage operations should be on the contour to prevent erosion. The Drews soils that have 15 to 30 percent slopes should be maintained in permanent vegetation for as much of the time as is practical. Drews soils are suitable for legume and grass pasture. Because of the annual rainfall of 12 to 16 inches, only grass should be planted on the Daphnedale, Jenny, and Ladd soils. Firebreaks are desirable on the soils used for range.

CAPABILITY UNIT IVe–3 (IRRIGATED)

This unit consists of clay loam and gravelly loam soils of the Barnard and Bieber series. These soils are well drained and are on terraces. The slope ranges from 0 to 15 percent. The annual rainfall is 10 to 14 inches, and the frost-free period is 70 to 80 days. Permeability is slow. Runoff is slow or medium, and the hazard of erosion is slight or moderate. Available water capacity is 1 to 6 inches. Roots penetrate to a depth of 8 to 40 inches and are restricted at this depth by a hardpan.

These soils are suited to grass and legume mixtures grown for hay or pasture. Wheat or barley can also be grown.

Sprinkler irrigation is suited to these soils. Land leveling is not practical because of shallow soil depth. Applications of irrigation water should be frequent, but should not exceed the water intake rate and available water capacity of these soils. A maximum vegetative cover should be maintained for as much of the time as is practical.

CAPABILITY UNIT IVe–3 (DRYLAND)

This unit consists of sandy loam, gravelly loam, silt loam, and clay loam soils of the Barnard, Lovejoy, Modoc, and Salisbury series and the Daphnedale variant. These soils are well drained or moderately well drained. They are on alluvial fans and terraces. The slope ranges from 0 to 15 percent. The annual rainfall is 10 to 20 inches, and the frost-free period is 70 to 110 days. Permeability is moderately slow to very slow. Runoff is medium or slow, and the hazard of erosion is slight or moderate. Available water capacity is 3 to 11 inches. Roots penetrate to a depth of 20 to 60 inches or more. The shallower soils are restricted by a hardpan.

These soils are used for pasture and for wheat and barley. Annual rainfall on the Salisbury soils is sufficient to grow a grass and legume pasture. The other soils do not have enough rainfall to grow legumes, and they should be seeded to drought-tolerant wheatgrass. The steeper slopes should be tilled on the contour. The Lovejoy soils should be maintained in permanent vegetative cover for as much of the time as is practical.

The areas of lower rainfall need to be summer fallowed in order to grow wheat and barley.

CAPABILITY UNIT IVe–5 (DRYLAND)

This unit consists of clay and silty clay soils of the Ager and Jenny series. These soils are well drained and moderately well drained and are on terraces and in basins. The slope ranges from 0 to 15 percent. The annual rainfall is 10 to 15 inches, and the frost-free period is 70 to 90 days. Permeability is slow. Runoff is rapid, and the hazard of erosion is moderate. Available water capacity is 6 to 12 inches. Roots penetrate to a depth of 40 to 60 inches or more and are restricted at this depth by siltstone and mudstone.

These soils are used for pasture and for wheat and barley. The amount of annual rainfall makes them best suited to grasses. Drought-tolerant wheatgrasses should be planted. Summer fallow in combination with good crop management is needed if small grain is grown.

Good seedbeds are difficult to maintain because of the clay and silty clay surface soil. Fall planting is desirable because the soils dry out too late in spring for planting. Soil moisture is critical for tillage, which should be minimal and across the slope to prevent erosion.

CAPABILITY UNIT IVe–7 (IRRIGATED)

The only soil in this unit is Daphnedale cobbly loam, 9 to 30 percent slopes. It is well drained and is underlain by soft sedimentary tuff. The annual rainfall is 10 to 15 inches, and the frost-free period is 80 to 100 days. Permeability is slow. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 5 to 6 inches. Roots penetrate to a depth of 25 to 30 inches.

This soil is used for irrigated pasture.

Tillage should be minimal because of the surface cobbles, and it should be on the contour or across the slopes. Because this soil is steep and is only 25 to 30 inches deep, it is best suited to sprinkler irrigation, and land leveling is not practical.

CAPABILITY UNIT IVe–7 (DRYLAND)

This unit consists of cobbly clay and cobbly loam soils of the Ager and Daphnedale series. They are well drained and are on terraces and toe slopes. The slope ranges from 2 to 30 percent. The annual rainfall is 10 to 15 inches, and the frost-free period is 70 to 100 days. Permeability is slow. Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 5 to 9 inches. Roots penetrate to a depth of 25 to 50 inches to siltstone, mudstone, and sedimentary tuff.

These soils are used for pasture. Areas with annual rainfall of about 14 inches are suitable for mixtures of grass and legumes. Areas with annual rainfall of about 11 inches are suitable for drought-resistant wheatgrass. This is especially true if the available water capacity of the soil is low.

Tillage should be minimal and should be on the contour or across the slope. The Daphnedale soil is suitable for fall or spring seeding. The Ager soil is better suited to fall seeding because of the cobbly clay surface.

CAPABILITY UNIT Vw–1 (DRYLAND)

This unit consists of Pit clay, seeped, 0 to 2 percent slopes. In many places a thick mat of roots covers the mineral soil. This soil formed in basins. It is somewhat poorly drained and is affected by seepage from higher areas. The annual rainfall is 10 to 14 inches, and the frost-free period is 80 to 90 days. Permeability is slow. Runoff is very slow, and there is no hazard of erosion. Roots penetrate to a depth of 60 inches or more. A seasonal high water table is at a depth of 20 to 30 inches. The total available water capacity is 9.5 to 11 inches.

This soil is suited only to grazing. It is too wet to be cultivated, and only water-tolerant plants grow on it.

Management is mainly limited to keeping cattle off the soil when it is very wet and fencing areas of bog as needed. Open ditches can be used to drain these areas if outlets are available. Diversions are also practical in some places.

CAPABILITY UNIT VIe–1 (DRYLAND)

This unit consists of cobbly clay loam, cobbly clay, gravelly loam, stony loam, cobbly loam, loam, sandy loam, loamy fine sand, and clay loam soils of the Ager, Bieber, Casuse, Daphnedale, Delma, Deven, Gleason, Kinkel, Lorella, Lyonman, McQuarrie, Tandy, and Woodcock series. These soils are well drained, except for Tandy soils, which are somewhat poorly drained. They are on lava plateau escarpments, terraces, mountainous uplands, pediments, and toe slopes. The slope ranges from 0 to 50 percent. The annual rainfall is 8 to 22 inches, and the frost-free period is 50 to 100 days. Permeability is slow to moderately rapid. Runoff is slow to rapid, and the hazard of erosion is slight to high. Available water capacity is 1 to 10 inches. Roots penetrate to a depth of 8 to 60 inches and are restricted by hard basalt, rhyolite, soft lake sediment, soft tuff, tuff agglomerate, welded tuff, andesite, or a hardpan.

These soils are used for range, wildlife habitat, and recreation. Gleason, Kinkel, Lyonman, and Woodcock soils are used also for woodland.

Range seeding is practical on these soils. Plants selected for seeding should be suited to the soils, climate, and objectives of land managers. Cover is needed to help control erosion. Grazing management, range seeding, woodland management, and fire protection help to maintain good cover on these soils.

CAPABILITY UNIT VIs–1 (DRYLAND)

This unit consists of cobbly loam, very cobbly loam, very stony silt loam, silt loam, and very cobbly clay soils of the Barnard, Karcal, Ninekar, Pineal, and Salisbury series and the Daphnedale variant. These soils are well drained, except for Pineal soils, which are moderately well drained. Karcal and Ninekar soils are on lava plateaus, and the other soils are on old lake bottoms, fans, and terraces. The slope ranges from 0 to 50 percent. The annual rainfall is 10 to 20 inches, and the length of the frost-free period ranges from 70 to 110 days. Permeability is slow or very slow. Runoff is very slow to medium, and the hazard of erosion is none to moderate. Available water capacity is 1 to 11 inches. Roots penetrate to a depth of 10 to more than 60 inches. The shallower soils are underlain by hard andesite, basalt, or tuff or have a hardpan.

These soils are used for range and wildlife habitat. Range seeding is possible.

Although range seeding is difficult on very stony or

cobbly soils, it is practical on all soils in this capability unit. Plants selected for seeding should be suited to the soils, climate, and management objectives. Cover is needed to help control erosion. Proper grazing management, range seeding, and fire protection are needed to maintain or improve cover.

CAPABILITY UNIT VIIe–1 (DRYLAND)

This unit consists of loam, cobbly loam, gravelly clay loam, and cobbly clay loam soils of the Bieber, Delma, Donica, Lorella, Lyonman, and McQuarrie series. These soils are well drained, except for Donica soils, which are somewhat excessively drained. They are on lake terraces, pediments, and mountainous uplands. The slope ranges from 2 to 50 percent. The annual rainfall is 10 to 20 inches, and the frost-free period is 70 to 100 days. Permeability is moderately rapid to slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Available water capacity is 1 to 5 inches. Roots penetrate to a depth of 8 to 60 inches, except in the Donica soils, which are more than 60 inches deep. The more shallow soils are underlain by hard andesite, basalt, rhyolite, soft tuff, or they have hardpans.

These soils are used for range and wildlife habitat. Range seeding is not practical because of the shallow soil depth and low available water capacity. Adequate vegetative cover is needed to help control erosion. Proper grazing management is needed to maintain and improve vegetative cover. Fire protection is needed.

CAPABILITY UNIT VIIw–1 (DRYLAND)

This unit consists of Lolak clay loam and the variably textured Fluvaquents. These soils are poorly drained or very poorly drained. They are on basin edges next to lakes. The slope ranges from 0 to 2 percent. The annual rainfall is 12 to 15 inches, and the frost-free period is 70 to 90 days. Permeability is very slow in the Lolak soils and variable in Fluvaquents. Available water capacity is 9 to 10 inches. Roots penetrate to a depth of 60 inches or more but those of many plants are restricted by the seasonal water table, which is at a depth of 4 to 36 inches. These soils are strongly affected by saline or alkali salts or both.

This unit is used for range and wildlife habitat. Range seeding is not practical.

Maintenance of adequate plant cover is an important management practice. Grazing should be deferred until late in spring when the soils are not wet enough to be compacted by the animals.

CAPABILITY UNIT VIIs–1 (DRYLAND)

This unit consists of very cobbly loam, cobbly loam, gravelly loam, cobbly clay loam, stony loam, extremely stony clay loam, very stony clay loam, sandy loam, and loam soils. These soils are of the Casuse, Deven, Ditchcamp, Exel, Packwood, Puls, and Thoms series and the Lorella variant. These soils are well drained and are on lake terraces, lava plateaus, and mountainous uplands. The slope ranges from 0 to 50 percent. The annual rainfall is 8 to 20 inches, and the frost-free period is 70 to 100 days. Permeability is moderate to very slow. Runoff is rapid to very slow, and the hazard of erosion is slight to high. Available water capacity is 1 to 6 inches. Roots penetrate to a depth of 6 to 40 inches. These soils are underlain by hard rhyolite, basalt, andesite, tuff, or they have hardpans.

These soils are used for range and wildlife habitat. Range seeding is not practical because of the low precipitation or the low available water capacity or both.

Adequate vegetative cover is needed to help control erosion in many areas. Proper grazing management is needed to maintain and improve the vegetative cover. Fire protection is needed.

CAPABILITY UNIT VIIIw–1 (DRYLAND)

This unit consists of Xerofluvents, occasionally flooded. These are highly stratified, variably textured accumulations of sand and gravel along stream channels. They flood on an average of once every two years. The vegetation of perennial grasses, willows, and brush is sparse. These soils are excessively drained. Available water capacity is 2 to 4 inches.

Xerofluvents are used for wildlife habitat and limited grazing. A few areas are used as a source of sand.

CAPABILITY UNIT VIIIs–1 (DRYLAND)

This unit consists of Gravel pits, Rock outcrop, Rubble land, Lithic Xerorthents, and Typic Xerorthents. These miscellaneous areas and soils are along lake shores and on alluvial fans, and they occur as lava flows, lava escarpments, or chimney rocks. The slope ranges from 0 to 50 percent. Typic Xerorthents are subject to erosion.

These miscellaneous areas and soils are used for watershed and wildlife habitat. A few gravel pits are in the Xerorthents. The agricultural value of this unit is low.

Storie Index ratings[2]

The map units of the survey area are listed in the "Guide to Map Units" at the back of this survey and are rated according to the Storie Index (*16, 17*).[3] This Index expresses numerically the relative degree of suitability of a soil for general intensive agriculture. The rating is based only on soil properties and characteristics. Other factors, such as availability of irrigation water, climate, and distance from markets, which might determine the desirability of growing certain plants in a given locality, are not considered; therefore, the Index in itself should not be considered a direct indicator of land value. Where economic factors are known to the user, however, the Storie Index provides additional objective information for land tract value comparisons.

Four general factors are considered in the Index rating. These factors are (A) the characteristics of the soil profile and soil depth; (B) the texture of the surface soil; (C) the dominant slope of the soil body; and (X) other factors more readily subject to management or modification, such as drainage, salinity and alkalinity, general nutrient level of the soil, erosion, and microtopography. For some soils more than one X factor may be involved. Each of the four general factors is evaluated on the basis of 100 percent. A rating

[2] Prepared by MICHAEL J. SINGER, assistant professor, University of California, Davis.

[3] Italic numbers in parentheses refer to References, p. 152.

of 100 expresses the most favorable or ideal condition for crop production, and lower ratings express conditions that are less favorable. Factor ratings are prepared from data and observations that relate soil properties to plant growth and crop yield (*15*).

The Index rating for a soil is obtained by multiplying the A, B, C, and one or more X factors; thus any factor may control the final rating. For example, a soil such as Buntingville clay loam has a deep, slowly permeable profile formed on alluvial fans, which warrants a rating of 85 percent for factor A; a clay loam surface texture warrants a rating of 95 percent for factor B; a smooth, nearly level surface justifies 100 percent for factor C; and the somewhat poor drainage warrants a rating of 80 percent for factor X. Multiplying these four factors gives an Index rating of 64 percent for this soil, rounded to the nearest whole number. If the drainage problem eventually is corrected, the Storie Index should be reevaluated by assigning a value of 100 to the X factor to reflect the changed conditions.

Soil complexes mapped in this area, such as Deven-Rock outcrop complex, are rated according to the dominant soils in each unit. In the same manner, tracts or fields containing several different soil mapping units can be rated by acreage weighted averaging of the Storie Index values of the different soils present.

Soils are placed in grades according to their suitability for general intensive agriculture as shown by their Storie Index ratings. The six grades and their range in Index ratings are:

	Index rating
Grade 1	80 to 100
Grade 2	60 to 79
Grade 3	40 to 59
Grade 4	20 to 39
Grade 5	10 to 19
Grade 6	less than 10

Soils in Grade 1 are excellent and well suited to general intensive agriculture. Grade 2 soils are good and well suited to general agriculture, but are not as desirable as soils in Grade 1. Grade 3 soils are only fairly well suited, Grade 4 soils are poorly suited, and Grade 5 soils are very poorly suited. Grade 6 consists of soils and land types that are not suited to agriculture.

Estimated yields and soil management practices[4]

The estimated yields for irrigated and dryland crops listed in table 3 are based on the observations of the soil scientists who surveyed the Alturas Area, information from farmers, the Agricultural Commissioner's annual report for Modoc County, and on suggestions from the Agricultural Extension Service and Soil Conservation Service crop specialists. Federal and county census records and crop data were also reviewed. More information was available for some soils than for others. When little or no yield information was available for a particular soil, or if the specified crop is not grown on the soil, yield estimates were made by comparison with similar soils.

[4] By RICHARD C. PYLE, district conservationist, Soil Conservation Service, and JOHN P. ROBISON, farm advisor, Extension Service.

Yields of crops, listed in table 3, are averages that can be expected over a period of years under a high level of management. A high level of management is that combination of practices which experience, field trials, and research indicate provides the highest production at the present time.

When using the yield estimates, some important limitations should be kept in mind: (1) yield figures listed are averages, and yields can be higher or lower in any given year; (2) soils have considerable variation in depth to which plant roots are effective, in available water capacity, and in drainage—variations which were considered in the evaluations; and (3) new crop varieties and improved management will increase yields over those listed.

Yield estimates are not given for miscellaneous areas or for soils that are considered not suitable for cropping. Yield information for soils used for range and timber production is contained in the sections "Use of the Soils for Range" and "Woodland."

The estimated yields listed in table 3 are useful provided the management through which such yields were obtained is described. The management used is described in the following paragraphs for each crop listed in table 3.

IRRIGATED HAY CROPS

Alfalfa and mixed grass and legume hay are climatically adapted to the Alturas and Goose Lake Valleys in the survey area.

Alfalfa typically is grown for 4 to 6 years followed by 2 years of small grain. It is seeded in the spring or early in summer. Grass and legume hay is also grown for 4 to 6 years followed by 2 years of small grain. It is seeded in spring. Grasses and legumes alternate in rows.

Weeds are controlled by clipping when seedlings are 4 to 6 inches thick.

Border and sprinkler methods are suitable for irrigation. Sprinkler irrigation is equally suited to both smooth and undulating areas. Water should be applied at a frequency, rate, and length of run that is in accordance with the water intake rate and available water capacity of the soil and with crop needs.

Where border irrigation is planned, the field should be land-planed to a smooth surface; should be plowed or disked, harrowed, and dragged; and irrigation borders should be provided. Where sprinkler irrigation is planned, plowing or disking and harrowing are needed. Good seedbeds are essential to good stands of hay.

Fertilizers should be applied in accordance with results of soil or plant tissue tests, needs of the hay crop grown, and with recent Extension Service and Soil Conservation Service recommendations. Grasses respond readily to applications of nitrogen fertilizer, and legumes respond to applications of phosphorus and sulfur fertilizers. Through the application of varying amounts of fertilizer, the proportionate amounts of grass to legumes for forage or hay can be manipulated and a desirable balance maintained.

Alfalfa hay is harvested two to three times during the growing season. This should be done when the alfalfa is in about one-tenth bloom stage. Grass-legume hay is also harvested two to three times during the

TABLE 3.—*Yields per acre of crops and pasture*

[All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the soil is not suitable for cropping]

Soil name and map symbol	Alfalfa hay (Irrigated)	Barley		Wheat		Grass-legume hay (Irrigated)	Pasture	
		N	I	N	I		N	I
	Tons	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*AUM* [1]	*AUM* [1]
Ager:								
100, 101	4.6	37	67	34	54	4.5	2.3	11.3
Alturas:								
103			45		36	3.5	1.0	9.0
Balman:								
104							1.3	
105							1.5	
Barnard:								
106	4.8	37	75	34	60	4.8	2.3	11.5
108	4.7	32	75	30	60	4.8	2.0	10.0
Bieber:								
109, 110			50		50	3.6		9.0
Buntingville:								
112			80		55	4.5		11.3
113	4.4	50	83	36	60	4.5	3.0	11.5
Calimus:								
114, 117	6.0		75		60	5.3		14.0
115, 116	5.5		75		60	5.3		13.0
Daphnedale:								
119	5.3	37	75	34	60	4.8	2.3	12.0
120							2.0	10.0
122	4.2	23	60	31	48	3.9	2.1	10.8
Delma:								
128							1.6	9.0
Donica:								
133	4.8		66		48	4.0	1.0	10.0
Drews:								
134, 135, 137	5.7		75		60	5.0		13.0
136							2.0	
Goose Lake:								
142			50		40	3.0		10.0
Jenny:								
144, 145	4.1	28	56	22	45	4.5	1.0	11.3
Ladd:								
150, 151	5.3		75		60	5.0		13.0
Lakeview:								
152, 153	4.6		60		48	4.0		7.5
Lovejoy:								
162							0.5	
163						1.9		
Modoc:								
168, 169	4.8	27	75	20	60	4.5	1.0	11.3
Pasquetti:								
173			80		70	4.0		10.0
174			85		80	5.5		12.5
Pit:								
176, 177			64		42	5.2		13.0

TABLE 3.—*Yields per acre of crops and pasture*—Continued

Soil name and map symbol	Alfalfa hay (Irrigated)	Barley		Wheat		Grass-legume hay (Irrigated)	Pasture	
		N	I	N	I		N	I
	Tons	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*AUM* [1]	*AUM* [1]
Rumbo:								
185							0.8	
186							0.5	
Salisbury:								
187, 188	4.8	30	75	22	60	4.5	1.5	11.5
Tandy:								
191							0.6	
Tulana:								
195						4.0		10.0
196	4.8		83		75	5.0		12.5

[1] Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

growing season. This should be done when the grasses are in full bloom or at the soft dough stage.

IRRIGATED PASTURE

Irrigated pasture is suited to the Goose Lake and Alturas Valleys in the survey area. Irrigated pastures are simple mixtures of perennial grasses and legumes. Pasture mixtures consist of one or two grasses and a legume. They produce good forage for grazing, are sometimes cut for hay, and provide good plant cover.

Soil features affecting the selection of a pasture mixture are drainage, texture, tilth, slope, available water capacity, water intake rate, and presence of saline or alkali salts or both.

Border and sprinkler methods are suitable for irrigation. Where border irrigation is planned, the land should be planed to a smooth surface; plowed or disked and harrowed; and irrigation borders provided in fall. Seeding is completed the following spring or early in summer. Where sprinkler irrigation is planned, plowing or disking and harrowing are needed in fall and seeding is completed the following spring or early in summer.

Irrigation water should be applied at a frequency, rate, amount, and length of run that is in accordance with the water intake rate and available water capacity of the soil and with pasture needs. Irrigated pastures on moderately well drained and somewhat poorly drained soils, such as the Buntingville soils, need very careful irrigation to prevent the water table from rising and reducing forage production.

Weeds are controlled by clipping while the pasture is being established.

Fertilizer applications are needed for a sustained high production of forage. Applications should be in accordance with soil or tissue tests, pasture needs, and the latest recommendations of the Extension Service or Soil Conservation Service. Grasses respond readily to applications of nitrogen fertilizer, and legumes respond to applications of phosphorus fertilizer, and in some areas to sulfur fertilizer. Through the application of varying amounts of fertilizers, the proportionate amounts of grass to legumes produced in a pasture for herbage can be manipulated and a desirable balance maintained.

IRRIGATED SMALL GRAINS

Small grains, such as wheat and barley, are climatically adapted to the Alturas and Goose Lake Valleys. These grains typically follow alfalfa or grass and legume hay or pasture in the crop rotation system and are grown for two years. Spring seeding, which should be completed before June 15, provides additional help in weed control, although fall seeding is also useful. Grain is harvested about September 1.

Border and sprinkler methods are suitable for irrigation. Where border irrigation is planned, the surface should be smoothed; should be plowed or disked and harrowed; and borders should be provided in fall. Soils that have a sandy loam, loam, and silt loam surface layer can be disked before planting; but soils that have a silty clay loam, clay loam, or clay surface layer should be spring-tooth harrowed at the correct moisture content.

High grain yields are generally sustained by nitrogen fertilizers, but some areas may require other types of fertilizer. Fertilizers should be applied in accordance with soil or tissue tests or both, crop needs and the latest recommendations of the Extension Service or Soil Conservation Service.

Irrigation water should be applied at a frequency, rate, amount, and length of run that is in accordance with the water intake rate and available water capacity of the soil and with crop needs. Excess irrigation on soils that have a water table, such as the Goose Lake soils, raises the water table and reduces yields. Careful irrigation practices are especially needed on moderately deep soils to prevent a water table from perching over hardpan or bedrock.

DRYLAND PASTURE

Grass and mixed grass and legume dryland pastures are important in the survey area. Grass and legume pastures are mostly confined to areas that receive 16 or more inches of annual precipitation; this generally includes most of Goose Lake Valley. Grass pastures are planted throughout the Alturas Valley.

Dryland pastures should be planted early in spring and should not be grazed during the first year. The grazing potential for the second growing season depends on stand density and plant vigor.

Cultural practices used in seedbed preparation include fall disking and spring harrowing or disking to destroy weeds. Fall plowing and leaving the surface rough followed by disking in spring is also a suitable practice. These operations are followed by harrowing, ring packing, and drilling. Seed is covered by a packing wheel or by chaining. If a grass and legume mixture is seeded, the grass or legume seeds should be placed in alternate rows.

A suitable grazing system should be implemented and geared to the needs of livestock enterprises.

DRYLAND GRAINS

Dryland wheat and barley can be produced throughout the survey area. Areas with slopes of more than 9 percent should be seeded and maintained in perennial grasses, but not in small grain.

Both fall and spring plantings are made in the area, although fall planting is the more common. Practices used in fall planting are plowing or disking early in spring, weed control in summer, and harrowing and planting early in fall. Summer weed control is important for good yields of fall-planted grains. Where the annual rainfall is between 10 and 16 inches, soils are generally summer fallowed; and where it is 16 or more inches, soils are cropped each year.

Use of the Soils for Range [5]

Throughout the survey area domestic livestock and numerous wildlife species are closely associated on range. Range includes natural grasslands, brushlands, and wetlands which supply suitable grazing for domestic livestock or food and habitat for wildlife (*19*). The plant cover on range is dominated by mixtures of grasses, grasslike plants, forbs, and shrubs. Trees such as the western juniper often exist naturally or have invaded range areas. Range has many land uses including watershed, animal grazing, wildlife habitat, and recreation.

Livestock is one of the primary agricultural enterprises in the Alturas Area. Soils suitable for range make up 380,000 acres, which is about 80 percent of the survey area. Some areas have been planted to pasture, hay, and crops. Federal and private land ownership is about equal.

The range included in the Alturas Area is on the Modoc Plateau (*5*) immediately west of the Warner Mountains, which form the western boundary of the Great Basin province.

The range consists of three broad plant communities: the meadow-salt shrub, the sagebrush scrub (*12*), and the northern juniper woodland. On the Tulana, Pasquetti, Pit, Buntingville, Goose Lake, Lolak, Tandy, Rumbo, Alturas, and Pineal soils, the meadow-salt shrub community is dominant; on the Bieber, Thoms, Lovejoy, Ladd, Salisbury, Calimus, Daphnedale, Modoc, Reba, Casuse, Delma, McQuarrie, Ager, Karcal, Ninekar, and Jenny soils and the Daphnedale variant, the sagebrush scrub community is dominant; and on the Puls, Packwood, Lorella, and Deven soils, the northern juniper woodland community is dominant.

Range sites

Soils that have the capacity to produce the same kinds, amounts, and proportions of range plants are grouped into range sites. A range site is the product of all environmental factors responsible for its development.

A plant community existing within a range site that has not undergone abnormal disturbance, is the potential, or climax, plant community, for that site. Climax plant communities are not precise or fixed in their composition but vary, within reasonable limits, from year to year and from place to place.

Abnormal disturbance such as overuse by livestock, excessive burning, erosion, or plowing results in changes in the climax plant community or even complete destruction if disturbance is drastic enough. When the range site has not deteriorated significantly under such disturbance, secondary plant succession progresses in the direction of the natural potential or climax plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is less than 25.

When changes occur in the climax plant community due to use by livestock or disturbance, some plant species will increase, others will decrease. Species increasing or decreasing depends upon the grazing animal, season of use, and the degree of utilization. By comparing the composition of the present plant community to the potential plant community, it is possible to see how individual species have increased while others decreased. Plants not present in the climax community which show up in the present plant community are invaders for the site.

The composition of climax and present plant communities together with other range site information, provides the basis for selecting range management systems.

Management programs on rangeland usually try to increase desirable plants and restore rangeland to as near climax conditions as possible. Some programs are designed to create or maintain plant communities somewhat removed from the climax to fit specific needs in the grazing program, to provide for wildlife habitat,

[5] By JAMES E. PRESTON, State range conservationist, and BARRY K. WALLACE, range conservationist, Soil Conservation Service.

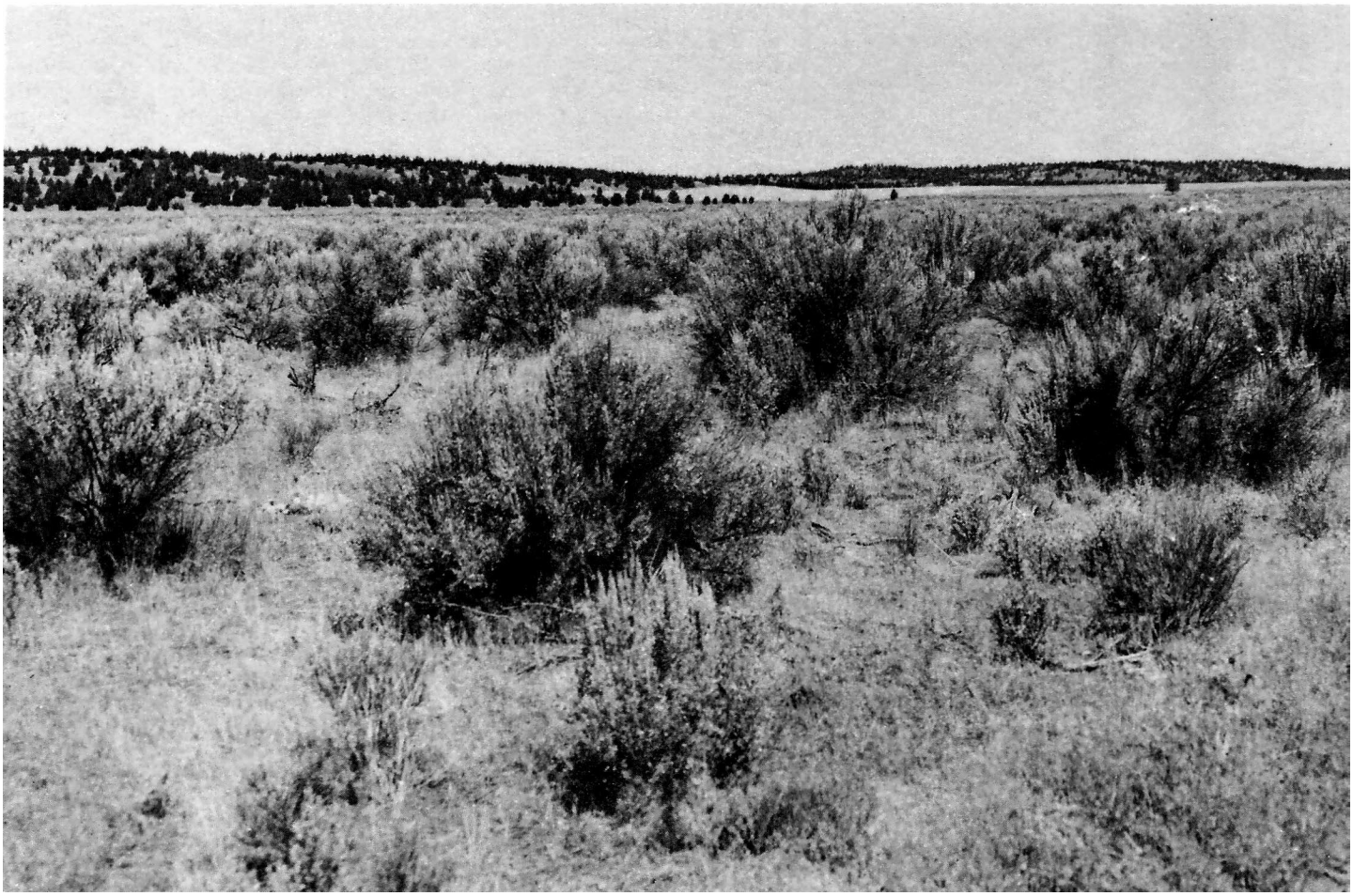

Figure 9.—**This area of Modoc gravelly loam, 0 to 9 percent slopes, is in Loamy range site. The vegetation consists of big sagebrush, rabbitbrush, bluebunch wheatgrass, and cheatgrass.**

or for other benefits. Any management objective should be compatible with conservation objectives.

In the following pages, the 10 range sites that occur in the Alturas Area are briefly described and the climax plants and principal invaders on the sites are named. An estimate is also given of the total annual production of range in excellent condition, for favorable and unfavorable seasons. Production is given as the normal high and low rather than the extremes and is expressed in pounds of air-dry herbage per acre, which includes the current year's growth of leaves, stems, twigs, and fruit of all plants on the site. Not all of this herbage is usable by livestock. The soils on each site can be determined by referring to the "Guide to Map Units" at the back of this soil survey.

SITE 1: LOAMY RANGE SITE

This range site covers about 58,000 acres in valleys. It is on alluvial fans, terraces, and slopes of foothills. The elevation ranges from 4,300 to 5,300 feet. The average annual precipitation is 15 to 20 inches. Topography is nearly level to steep. Slopes range from 0 to 50 percent.

The Drews, Ladd, Salisbury, Daphnedale, Modoc, and Reba soils and the Daphnedale variant are on this site (fig. 9). Generally these soils have a surface layer of sandy loam, loam, or clay loam, some of which contain gravel, stones, or cobbles. The soils are 24 to 60 inches or more deep to hardpan or bedrock. Most of these soils are well drained. The available water capacity is 3 to 12 inches, and permeability is slow to moderate. Runoff is very slow to rapid.

The potential plant community on this site consists of about 60 to 75 percent grasses and grasslike plants, 15 to 20 percent forbs, and 20 percent shrubs. Of the grasses and grasslike plants, bluebunch wheatgrass makes up 15 percent of the total plant community; Idaho fescue, western or streambank wheatgrass, and Thurber needlegrass, 10 percent each; and Nevada bluegrass, basin wildrye, and native bluegrass, 5 percent each. Forbs include 3 percent or less each of mulesear wyethia, vetch, tapertip hawksbeard, arrowleaf balsamroot, buckwheat, lupine, and yarrow. Shrubs include big sagebrush, 15 percent; rabbitbrush and snowberry, 5 percent each; bitterbrush, 3 percent; and squaw apple, 3 percent or less.

Some species of sagebrush, rabbitbrush, and bitterbrush are very important food and cover plants for deer, antelope, and sage grouse, especially in winter.

Because the soils of this range site are important

for use as watersheds, plant cover should be maintained. The total annual yield per acre is 1,200 pounds in favorable years and 600 pounds in unfavorable years.

SITE 2. DRY LOAMY RANGE SITE

This range site covers approximately 22,000 acres throughout the survey area. The elevation ranges from 4,300 to 5,400 feet. Average annual precipitation is 10 to 16 inches. Topography is nearly level to steep. Slopes range from 0 to 50 percent.

The Barnard, Exel, and Ditchcamp soils and the Lorella deep variant are on this site. Generally the soils have a surface layer of loam or clay loam. Some have gravel, cobbles, or stones in the surface layer, and others do not. The soils are 21 to 40 inches deep over hardpan bedrock. They are well drained. Available water capacity is 3 to 6 inches, and permeability is slow. Runoff is medium to rapid depending on slope.

The potential plant community on this site consists of approximately 50 to 60 percent grass and grasslike plants, 15 to 20 percent forbs, and 20 to 30 percent shrubs. Of the grasses and grasslike plants, bluebunch wheatgrass makes up 15 percent of the plant community; native needlegrass, native bluegrass, and streambank wheatgrass, 10 percent each; and junegrass, 5 percent. Forbs include vetch, tapertip hawksbeard, and lupine, 3 percent each; and low phlox, pussytoes, buckwheat, stonecrop, and fringed sagebrush, 10 percent. Shrubs include big sagebrush, which makes up 15 percent of the plant community; snowberry, 5 percent; and smaller amounts of bitterbrush, rabbitbrush, and serviceberry.

Some species of sagebrush, rabbitbrush, bitterbrush, and snowberry are very important food and cover plants for deer, antelope, and sage grouse, especially in winter.

The estimated total annual yield per acre is 800 pounds in favorable years and 450 pounds in unfavorable years.

SITE 3. SHALLOW LOAMY RANGE SITE

This range site covers about 64,000 acres on terraces, terrace escarpments, and uplands. The elevation ranges from 4,300 to 5,900 feet. Average annual precipitation is 10 to 20 inches. Topography is nearly level to steep. Slopes range from 0 to 50 percent.

The Casuse, Delma, and McQuarrie soils are on this site. Generally these soils have a surface layer of sandy loam, loam, cobbly loam, and stony loam. The soils are 8 to 20 inches deep over bedrock. They are well drained. The available water capacity is 1 to 3 inches, and permeability is moderate to moderately slow. Runoff is medium or rapid.

The potential plant community on this site consists of 40 to 50 percent shrubs, 35 to 45 percent grass and grasslike plants, and 20 to 30 percent forbs. Of the shrubs, big sagebrush makes up 15 percent of the total plant community, rabbitbrush 5 percent, squaw apple 10 percent, bitterbrush 10 percent, serviceberry 5 percent, and snowberry 5 percent. Grasses and grasslike plants include onespike oatgrass, needlegrass, bluegrass and bluebunch wheatgrass, each 10 percent of the plant community, and junegrass, 5 percent. Forbs include tapertip hawksbeard, lupine, low phlox, fringed sage, buckwheat, stonecrop, and yarrow.

Some species of sagebrush, rabbitbrush, and snowberry are very important food and cover plants for deer, antelope, and sage grouse, especially during winter.

The total annual yield per acre is 700 pounds in favorable years and 375 pounds in unfavorable years.

SITE 4: SHALLOW STONY UPLANDS RANGE SITE

This range site covers about 58,000 acres on lava plateaus and uplands. The elevation ranges from 4,400 to 5,800 feet. Average annual precipitation is 10 to 18 inches. Topography is nearly level to steep. Slopes range from 0 to 50 percent.

The Puls, Packwood, Lorella, and Deven soils are on this site. Generally they have a surface layer of clay loam or loam with stones or cobbles. The soils are 6 to 20 inches deep to bedrock. They are well drained. The available water capacity is 1 to 4 inches, and permeability is slow or very slow. Runoff is slow to rapid, depending on slope.

Vegetation is dominantly scattered or clustered juniper trees. The potential plant community on this site consists of about 50 percent grasses and grasslike plants, 20 percent forbs, and 30 percent trees and shrubs. Of the grasses and grasslike plants, bluebunch wheatgrass makes up 15 percent of the plant community, native bluegrasses and needlegrass 20 percent, onespike oatgrass 10 percent, and junegrass and bottlebrush squirreltail each make up 5 percent. Forbs include lupine, western yarrow, buckwheat, and low phlox, each of which makes up 5 percent of the vegetation, and smaller amounts of tapertip hawksbeard and pentstemon. Junipers make up 10 percent of the plant community. Other trees and shrubs, each making up 5 percent, are bitterbrush, serviceberry, low sagebrush, mountainmahogany, and squaw apple.

The potential plant community on this site is susceptible to rapid deterioration, and the steep soil erodes readily. The chief management concern should be to maintain adequate plant cover for the protection of the watershed. The site produces little forage.

The estimated total annual yield per acre is 550 pounds in favorable years and 300 pounds in unfavorable years.

SITE 5: SANDY RANGE SITE

This range site covers about 2,000 acres on alluvial fans. The elevation ranges from 4,800 to 5,000 feet. Average annual precipitation is 16 to 20 inches. Topography is gently sloping to moderately sloping, and slopes range from 2 to 9 percent.

The site consists only of Donica gravelly clay loam, 2 to 9 percent slopes. Generally this soil has a gravelly clay loam surface layer. Soil depth is more than 60 inches. The soil is somewhat excessively drained. The available water capacity is 4 to 5 inches, and permeability is moderately rapid. Runoff is medium.

The potential plant community consists of about 50 percent grasses and grasslike plants, about 30 percent shrubs, and about 20 percent forbs. Of the grasses and grasslike plants, bluebunch wheatgrass makes up 15 percent of the plant community, needlegrass makes up 10 percent, and 5 percent each is Indian ricegrass,

junegrass, native bluegrass, sedges, native fescues and bromes, and basin wildrye. Shrubs include bitterbrush, 15 percent of the plant community; big sagebrush, which makes up 10 percent; and 3 percent or less of squaw apple, wild plum, rabbitbrush, serviceberry, and occasionally rose, ribes, and chokecherry, Forbs include arrowleaf, balsamroot, buckwheat, pussytoes, phlox, groundsel, hairy goldaster, and other showy plants.

The estimated total annual yield per acre is 800 pounds in favorable years and 350 pounds in unfavorable years.

Some species of sagebrush, rabbitbrush, bitterbrush, and serviceberry are very important food and cover plants for deer, antelope, and sage grouse.

SITE 6 CLAYEY SLOPES RANGE SITE

This range site covers about 69,000 acres and is on terraces, toe slopes, lake escarpments, lava plateaus, or in basins. The elevation ranges from 4,300 to 5,800 feet. Average annual precipitation is 10 to 16 inches. Topography is nearly level to steep. Slopes are 0 to 50 percent.

The Ager, Karcal, Ninekar, and Jenny soils are on this site. Generally these soils have a surface layer of silty clay loam, very cobbly clay, clay, and very stony silt loam. The soils are 20 to 60 inches deep to lake sediments, siltstone, or basalt. They are moderately well drained or well drained. Available water capacity is 2 to 11 inches, and permeability is slow. Runoff is rapid to very slow.

The potential plant community on this site consists of about 50 percent grasses and grasslike plants, about 35 percent shrubs, and about 15 percent forbs. Of the grasses and grasslike plants, bluebunch wheatgrass makes up 15 percent of the plant community; basin wildrye, bluegrass, onespike oatgrass, and streambank wheatgrass make up 5 percent each; needlegrass, 10 percent; and Idaho fescue and bottlebrush squirreltail, 3 percent or less. Shrubs include low sagebrush, which makes up 10 percent of the plant community, and serviceberry, bitterbrush, snowberry, gray horsebush, and rabbitbrush, 3 percent or less. Forbs include sticky geranium, mulesear wyethia, arrowleaf balsamroot, tapertip hawksbeard, skullcap, Indian paintbrush, and larkspur.

The estimated total annual production per acre is 650 pounds in favorable years and 350 pounds in unfavorable years.

The relatively large amount of low sagebrush on this site produces good antelope habitat. The other species of sagebrush, bitterbrush, and snowberry are valuable food and cover plants for deer and antelope.

SITE 7: ALKALI TERRACE RANGE SITE

This range site covers 13,000 acres and is in basins and on low lake terraces and other terraces. The elevation ranges from 4,100 to 4,900 feet. Average annual precipitation is 8 to 15 inches. Topography is nearly level to gently sloping. Slopes are 0 to 5 percent. This site is flooded or wet in winter and spring.

The Balman, Alturas, Rumbo, and Pineal soils are on this site. Generally these soils have a surface layer of loam or silt loam. They are affected by saline or alkali salts in some parts of the profile. The soils are 10 to over 60 inches deep. A water table is at a depth of 24 to 60 inches. The soils are moderately well drained to somewhat poorly drained. Permeability is moderately slow to slow. Available water capacity is 1 to 10 inches.

The potential plant community on this site consists of about 50 percent grasses and grasslike plants, about 30 percent shrubs, and about 20 percent forbs. Of the grasses and grasslike plants, basin wildrye, alkali sacaton, western wheatgrass, and saltgrass each make up 10 percent of the plant community; bluegrass 5 percent; and bottlebrush squirreltail, sedge, and Indian ricegrass make up 5 percent. Shrubs include greasewood, which makes up 10 percent of the plant community, and big sagebrush, spiny hapsage, shadscale, and four-wing saltbush, which make up the rest. Forbs include globe mallow, aster, buckwheat, loco, gilia, and evening primrose.

The estimated total annual production per acre is 800 pounds in favorable years and 450 pounds in unfavorable years.

SITE 8: HARDPAN TERRACE RANGE SITE

This range site covers about 37,000 acres and is on valley terraces. The elevation ranges from 4,300 to 5,300 feet. Average annual precipitation is 10 to 16 inches. Topography is nearly level to strongly sloping. Slopes are 0 to 15 percent.

The Bieber, Thoms, and Lovejoy soils are on this site. Generally these soils have a surface layer of gravelly loam, cobbly loam, loam, or silt loam. These soils are 8 to 24 inches deep to hardpan or bedrock. They are well drained or moderately well drained. Available water capacity is 2 to 4 inches, and permeability is slow or very slow. Runoff is slow or medium.

The potential plant community on this site consists of about 60 percent grasses and grasslike plants, about 30 percent shrubs, and about 10 percent forbs. Of the grasses and grasslike plants, bluebunch wheatgrass makes up 15 percent of the plant community; Idaho fescue, 5 percent; native bluegrasses, onespike oatgrass, and needlegrass, 25 percent; streambank wheatgrass, 10 percent; and junegrass and dryland sedge, 5 percent. Shrubs include low sagebrush, which makes up 20 percent of the plant community, rabbitbrush and gray horsebrush, which make up 5 percent each, and smaller amounts of snakeweed and big sagebrush. Forbs include balsam roots, lupine, pussytoes, wild carrot, western yarrow, buckwheat, mariposa lily, and low phlox.

The estimated total annual production per acre is 600 pounds in favorable years and 300 pounds in unfavorable years.

SITE 9. SALINE BOTTOM RANGE SITE

This range site covers about 13,000 acres and is in basins at the edge of Goose Lake. The elevation ranges from 4,650 to 4,725 feet. Average annual precipitation is 12 to 15 inches. Topography is nearly level. Slopes are 0 to 2 percent.

The Tandy and Lolak soils and Fluvaquents are on this site. Generally these soils have a surface layer of loamy fine sand or silty clay loam. The water table is at a depth of 4 to 40 inches. The soils are somewhat poorly drained to very poorly drained. They are affected

by saline or alkali salts or both. Available water capacity is 6 to 10 inches, and permeability is moderately rapid to very slow. Runoff is very slow.

The potential plant community on this site consists of 60 percent grasses and grasslike plants, 20 to 30 percent shrubs, and the rest is forbs. Of the grasses and grasslike plants, great basin wildrye makes up 25 percent of the plant community; Nuttall alkaligrass, creeping wildrye, native bluegrasses, western wheatgrass, and inland saltgrass, 5 percent each; and alkali sacaton 10 percent. Shrubs include greasewood, which makes up 10 percent of the plant community, and four-wing saltbush, shadscale, Douglas rabbitbrush, which make up 5 percent each. Forbs include western yarrow, bassia, globe mallow, asters, owlclover, buckwheat, loco, and gilia.

The estimated annual production per acre is 1,500 pounds in favorable years and 1,200 pounds in unfavorable years.

Some areas in this site are Type I wetlands (*21*) and are important for waterfowl habitat. Wetness depends on annual precipitation or management of irrigation or tail water.

SITE 10 WET MEADOW RANGE SITE

This range site covers about 200 acres and is one of the most productive sites in the area. It is on bottom lands and along the east side of Goose Lake in the lowest part of the flood plains in basins and depressions. The elevation ranges from 4,300 to 4,750 feet. Average annual precipitation is 10 to 14 inches, and additional moisture comes from surface and subsurface water sources. Topography is nearly level. Slopes are 0 to 2 percent.

Pit clay, seeped, 0 to 2 percent slopes, is on this site. This soil is poorly drained. The water table ranges from the surface to a depth of 30 inches. Available water capacity is 9 to 11 inches, and permeability is moderate to slow. Runoff is very slow to none.

The potential plant community on this site consists of about 70 percent grass and grasslike plants, about 30 percent forbs, and traces of shrubs. Of the grasses and grasslike plants, tufted hairgrass and meadow sedges make up 15 percent of the plant community; alpine timothy, 10 percent; bluegrasses, wheatgrasses, and bromes, 15 percent; redtop, 5 percent; and basin wildrye and creeping wildrye, 3 percent. Forbs include ligusticum, cow parsnip, and Baltic rush, which each make up 5 percent of the plant community, and smaller amounts of American bistort, monkshood saxifrage, tall larkspur, clover, shooting star, and herbaceous cinquefoil. Shrubs include willow, bog birch, stubby cinquefoil, and silver sagebrush.

The estimated total annual production per acre is 5,500 pounds in favorable years and 3,000 pounds in unfavorable years. Its availability for grazing varies, depending on extent and duration of flooding, ponding, and wetness.

This site may contain or can be developed into Type 2, 3, or 4 wetlands (*21*) for waterfowl habitat. Wetness depends on annual precipitation or on management of tail water from nearby irrigated areas, diversion of surface streams, or runoff.

Use of the Soils for Wildlife[6]

Wildlife and fish are important in the Alturas Area and contribute directly and indirectly to the area's economy. The Modoc National Wildlife Refuge provides feed, resting and nesting areas for migrating and resident waterfowl, as well as valuable recreation for bird watchers and hunters. The area is well suited to a variety of wildlife. The various kinds of wildlife are listed under the description of each habitat type. Wildlife includes antelope, sage grouse, mule deer, and the Great Basin Canada goose. Cold water fish, such as trout, and warm water fish, such as black bass, catfish, and sunfish, inhabit the lakes, rivers, streams, and ponds. The Modoc sucker, which has been placed on the list of rare fishes by the State of California Department of Fish and Game, is found in Dorris Reservoir just east of Alturas.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 4, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

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[6] DAVID W. PATTERSON, area biologist, Soil Conservation Service, prepared this section.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are rye, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, fescue, needlegrass, bluegrasses, wild mustard, lupine, wheatgrass, and buckwheat.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa and Jeffrey pine, white fir, incense cedar, and Western juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, Japanese millet, saltgrass, and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include valley quail, sage grouse, mourningdove, meadowlark, field sparrow, cottontail rabbit, antelope, and deer.

Woodland habitat consists of areas of conifers and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, sage grouse, mountain quail, valley quail, and deer.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, swans, cranes, geese, herons, shore birds, and muskrat.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, lark bunting, valley quail, and chuk.

Woodland [7]

Forests are of minor importance in the survey area, but they are a major renewable resource in the entire county. Harvesting for commercial production and for local domestic needs began about 1880. The timber harvest rose gradually and, with the coming of the railroad, it reached a peak in the 1940's. Most of the earlier harvest was from private land.

Approximately 3,700 acres, or 0.9 percent of the total survey area, are capable of supporting commercial forests. Trees grow on most of the soils, but commercial conifers grow only on specific kinds of soils. The most widespread species of commercial conifers is ponderosa pine. Other trees of commercial importance are Jeffrey pine, white fir, and incense-cedar. Western juniper is also a major tree species in the survey area. Water birch, Utah juniper, whitebark pine, lodgepole pine, western white pine, Washoe pine, quaking aspen, and black cottonwood are also found in varying amounts (*9*).

Forests in the Alturas Area produce varying amounts of grazable understory vegetation. The amount is largely dependent on the density of the overstory canopy. In cutover stands and in open stands with less than 20 percent canopy, the understory vegetation, by weight, consists of about 50 percent grasses, about 25 to 35 percent shrubs, and about 15 to 25 percent forbs. Of the grasses, Idaho fescue makes up 20 percent of the plant community, bluebunch wheatgrass 15 percent, bluegrass and needlegrass 5 percent each, mountain brome 3 percent, and junegrass 2 percent. Shrubs include bitterbrush, which makes up 10 percent of the plant community; ponderosa pine, which makes up 5 percent; and big sagebrush, mountainmahogany, and serviceberry, which combined make up as much as 10 to 20 percent. Forbs include arrowleaf, balsamroot,

[7] By SHERMAN J. FINCH, woodland specialist, Soil Conservation Service.

TABLE 4.—*Wildlife*

[See text for definitions of "good," "fair," "poor," and "very

Soil name and map symbol	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Ager:				
100, 101	Fair	Fair	Fair	Fair
102	Very poor	Very poor	Poor	Fair
Alturas: 103	Poor	Fair	Fair	
Balman: 104, 105	Fair	Fair	Fair	Very poor
Barnard:				
106	Fair	Good	Fair	
107, 108	Poor	Poor	Fair	
Bieber:				
109, 110	Poor	Fair	Fair	Poor
111	Very poor	Very poor	Poor	Poor
Buntingville:				
112	Fair	Fair	Good	Very poor
113	Fair	Good	Good	Very poor
Calimus:				
114, 116, 117	Fair	Good	Good	
115	Fair	Good	Good	
Casuse: 118	Poor	Fair	Fair	Poor
Daphnedale: 119, 120, 122	Fair	Good	Good	
Delma part of 122	Poor	Poor	Good	
121	Poor	Poor	Fair	Poor
Daphnedale variant:				
123, 124	Poor	Poor	Good	Good
125	Fair	Good	Good	Good
Delma:				
126	Very poor	Very poor	Poor	Poor
127	Very poor	Very poor	Poor	Very poor
128	Poor	Fair	Fair	Poor
129	Very poor	Poor	Poor	Very poor
Deven:				
130	Poor	Fair	Fair	
131, 132	Very poor	Very poor	Fair	
Rock outcrop part of 132 not rated.				
Donica: 133	Fair	Fair	Good	
Drews:				
134, 135, 137	Fair	Good	Good	
136	Poor	Fair	Good	
138	Fair	Fair	Good	
Fluvaquents: 139	Very poor	Very poor	Very poor	
Gleason:				
140	Poor	Fair	Good	Good
141	Very poor	Very poor	Good	Good
Goose Lake: 142	Fair	Fair	Fair	
Jenny: 144, 145	Fair	Fair	Good	
Karcal: 146, 147 (Karcal part)	Poor	Poor	Poor	
147 Ninekar part of 147	Poor	Poor	Good	

habitat potentials

poor." Absence of an entry indicates the soil was not rated]

Potential for habitat elements—Cont.			Potential as—			
Shrubs	Wetland plants	Shallow-water areas	Openland habitat	Woodland habitat	Wetland habitat	Rangeland habitat
Poor	Very poor	Very poor	Fair	Fair	Very poor	Poor.
Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Poor	Fair	Good	Fair		Fair	Poor.
Very poor	Poor	Poor	Fair	Very poor	Poor	Poor.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Poor	Poor	Very poor	Fair	Poor	Very poor	Poor.
Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Good	Good	Good	Fair	Very poor	Good	Good.
Good	Poor	Poor	Good	Very poor	Poor	Good.
Good	Fair	Very poor	Good		Poor	Good.
Good	Very poor	Very poor	Good		Very poor	Good.
Poor	Poor	Very poor	Fair	Poor	Very poor	Poor.
Fair	Very poor	Very poor	Good		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Good.
Poor	Very poor	Very poor	Poor	Poor	Very poor	Poor.
Fair	Very poor	Very poor	Fair	Good	Very poor	Fair.
Fair	Very poor	Very poor	Good	Good	Very poor	Fair.
Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor.
Poor	Very poor	Very poor	Fair	Poor	Very poor	Poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor	Poor.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Good	Very poor	Very poor	Fair		Very poor	Good.
Good	Poor	Very poor	Good		Very poor	Good.
Good	Very poor	Very poor	Fair		Very poor	Good.
Good	Good	Good	Fair		Very poor	Good.
Poor	Good	Good	Very poor		Good	Very poor.
Fair	Very poor	Very poor	Fair	Good	Very poor	Fair.
Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair.
Fair	Good	Good	Fair		Good	
Poor	Poor	Very poor	Fair		Very poor	Fair.
Poor	Poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Fair		Very poor	Fair.

TABLE 4.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Kinkel:				
148	Fair	Good	Good	Good
149	Poor	Fair	Good	Good
Ladd:				
150	Fair	Fair	Good	
151	Fair	Fair	Good	
Lakeview:				
152	Fair	Fair	Good	
153	Fair	Fair	Good	
Lolak: 154	Very poor	Very poor	Very poor	
Lorella:				
155, 158	Poor	Poor	Fair	
156, 157, 159, 160	Very poor	Very poor	Fair	
Lorella variant: 161	Very poor	Very poor	Good	
Rubble land part not rated.				
Lovejoy:				
162, 163	Poor	Poor	Fair	
Reba part of 163	Fair	Good	Good	
Lyonman:				
164	Poor	Fair	Good	Good
165	Very poor	Very poor	Good	Good
McQuarrie:				
166	Poor	Fair	Fair	
167	Very poor	Very poor	Good	Very poor
Modoc: 168, 169	Fair	Good	Poor	
Ninekar: 170	Poor	Poor	Good	
Packwood: 171, 172	Very poor	Very poor	Fair	
Ditchcamp part of 171	Very poor	Very poor	Fair	
Puls part of 171	Very poor	Very poor	Poor	
Rock outcrop part of 172 not rated.				
Ditchcamp part of 172	Very poor	Very poor	Fair	
Pasquetti: 173, 174	Fair	Fair	Fair	
Pineal: 175	Poor	Poor	Fair	
Pit:				
176	Fair	Fair	Good	
177	Fair	Fair	Good	
178	Very poor	Poor	Poor	
Puls: 179, 180, 181	Very poor	Very poor	Poor	
Ninekar part of 180	Poor	Poor	Good	
Rock outcrop part of 181 not rated.				
Reba:				
182	Fair	Good	Good	
Rock outcrop: 183				
Rock outcrop part not rated.				
Lithic Xerorthents part	Very poor	Very poor	Poor	
Rumbo:				
185	Fair	Fair	Good	
186	Fair	Fair	Good	
Salisbury:				
187, 188, 190	Fair	Fair	Good	
189	Poor	Fair	Good	

potentials—Continued

Potential for habitat elements—Cont.			Potential as—			
Shrubs	Wetland plants	Shallow-water areas	Openland habitat	Woodland habitat	Wetland habitat	Rangeland habitat
Fair	Very poor	Very poor	Good	Good	Very poor	Fair.
Fair	Very poor	Very poor	Fair	Good	Very poor	Fair.
Good	Good	Good	Fair		Good	Good.
Good	Poor	Very poor	Good		Very poor	Good.
Fair	Fair	Fair	Good		Fair	Fair.
Fair	Poor	Very poor	Good		Very poor	Fair.
Very poor	Good	Fair	Very poor		Fair	Very poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Very poor	Very poor	Very poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Fair	Very poor	Poor		Poor	Fair.
Fair	Very poor	Very poor	Good		Very poor	Fair.
Fair	Very poor	Very poor	Fair	Good	Very poor	Fair.
Fair	Very poor	Very poor	Very poor	Good	Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Fair	Very poor	Very poor	Good		Very poor	Fair.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Very poor		Very poor	Fair.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Poor	Very poor	Very poor	Fair		Very poor	Poor.
Good	Good	Good	Fair		Good	Good.
Fair	Good	Good	Fair		Fair	Fair.
Fair	Good	Good	Poor		Good	Fair.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Good		Very poor	Fair.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Fair	Fair	Fair		Fair	Fair.
Fair	Poor	Very poor	Fair		Very poor	Fair.
Good	Very poor	Very poor	Fair		Very poor	Good.
Good	Very poor	Very poor	Fair		Very poor	Good.

TABLE 4.—*Wildlife habitat*

Soil name and map symbol	Potential for habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants
Tandy: 191	Poor	Fair	Good	
Thoms: 192	Very poor	Very poor	Fair	
Exel part	Poor	Poor	Fair	
Tuff outcrop: 193, 194				
Tuff outcrop part not rated.				
Casuse part of 193	Poor	Fair	Fair	
Casuse part of 194	Very poor	Very poor	Fair	
Tulana: 195, 196	Fair	Fair	Fair	
Typic Xerorthents: 197	Very poor	Very poor	Fair	
Woodcock: 198, 199	Poor	Fair	Good	Good
Xerofluvents: 200	Very poor	Very poor	Fair	

Hooker balsamroot, phlox, pussytoes, and tapertip hawksbeard.

Total estimated annual production per acre of this understory vegetation is 1,100 pounds in favorable years and 700 pounds in unfavorable years. As the density of the overstory canopy increases to about 70 percent, the grazable understory vegetation decreases to nearly zero pounds per acre. The understory vegetation also gradually changes to shade-tolerant plants, and the grazing value is greatly reduced.

Each soil suitable for growing commercial forest has been evaluated as to its performance if used for woodland production. These interpretations are listed with each map unit description.

Site quality is a measure of *productivity* of the soil for growing trees and is expressed as a site index rating. It is determined by measuring the height and determining the age of the dominant and co-dominant trees in the stand and relating this to a standard age of 100 years. Figures 10 and 11 show the yields in board feet for ponderosa pine (*11*) and white fir (*10*).

Engineering [8]

This section provides information about the use of soils for building sites, sanitary facilities, construction materials, and water management. Among those who can benefit from this section are engineers, landowners, community decision makers and planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in tables in this section are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by the soil survey and used in determining the rat-

[8] JACK H. GASSEL, civil engineer, Soil Conservation Service, helped with this section.

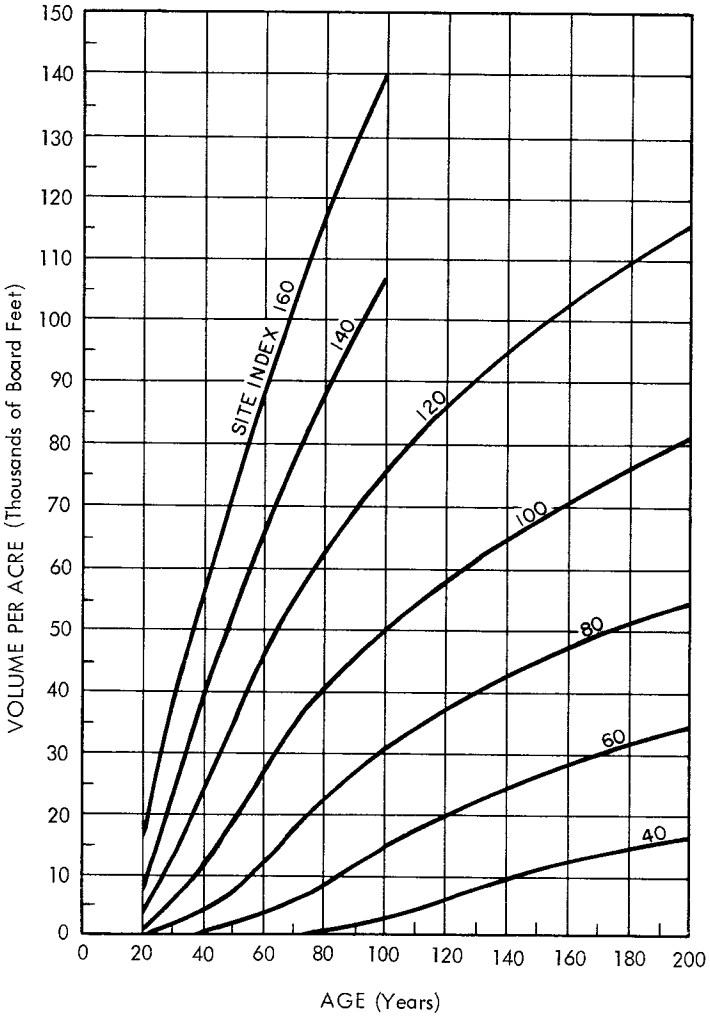

***Figure 10.*—Yields (in board-foot volume per acre) of unmanaged, fully stocked stands of ponderosa pine by various site indexes (*11*). Yields are for trees that have a minimum breast-high diameter of 6.6 inches.**

potentials—Continued

Potential for habitat elements—Cont.			Potential as—			
Shrubs	Wetland plants	Shallow-water areas	Openland habitat	Woodland habitat	Wetland habitat	Rangeland habitat
Good	Fair	Very poor	Fair		Poor	Good.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Poor	Very poor	Poor		Very poor	Fair.
Poor	Poor	Very poor	Fair		Very poor	Poor.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Good	Good	Fair		Good	Fair.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Fair	Very poor	Very poor	Fair	Good	Very poor	Fair.
Good	Fair	Fair	Poor		Fair	Fair.

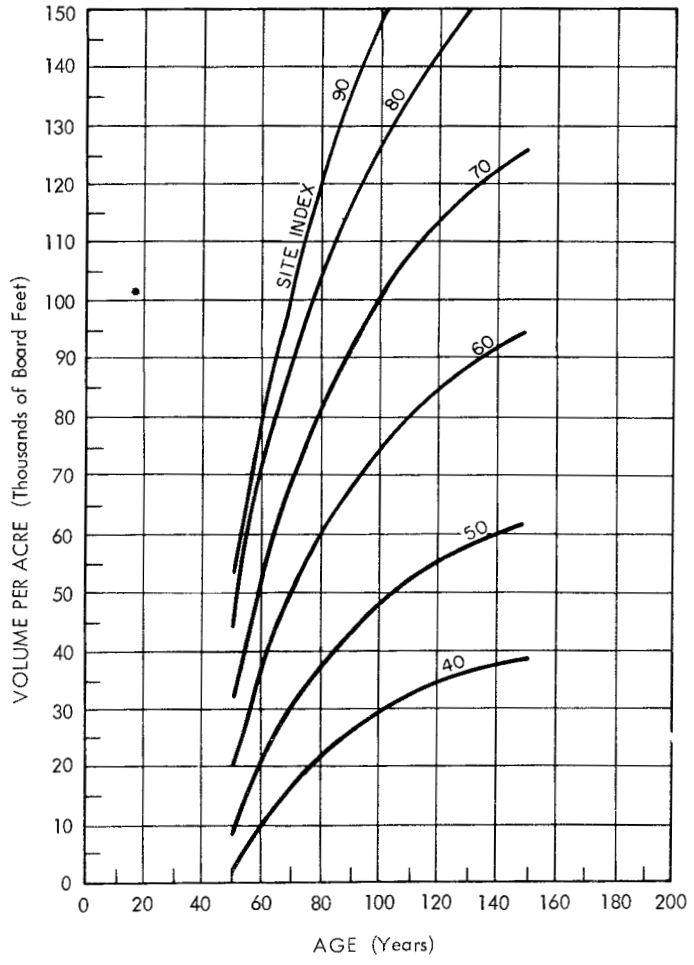

***Figure 11.*—Yields (in board-foot volume per acre) of unmanaged, fully stocked stands of white fir by various site indexes (*10*). Yields are for trees that have a minimum breast-high diameter of 8 inches.**

ings in this section are grain-size distribution, liquid limit, plasticity index, soil reaction, depth to and hardness of bedrock within 5 to 6 feet of the surface, soil wetness characteristics, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values may be estimated for erodibility, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values may be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to—(1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternate routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternate sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations and testing.

The information is presented mainly in tables. Table 5 shows, for each kind of soil, ratings of the degree and kind of limitations for building site development; table 6, for sanitary facilities; and table 8, for water management. Table 7 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have different meanings in soil science and in engineering; the Glossary defines many of these terms.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 5. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by the soil wetness of a high seasonal water table, the texture and consistence of soils, the tendency of soils to cave in or slough, and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and small commercial buildings referred to in table 5 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation do not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 5 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones, all of which affect stability and ease of excavation, were also considered.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 6 shows the degree and kind of limitations of each soil for these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight*, soils are favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance are required.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 to 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect the absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to

TABLE 5.—*Building site development*

[Some of the terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ager: 100, 101	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
102	Severe: slope; too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
Alturas: 103	Severe: too clayey.	Severe: shrink-swell, floods.	Severe: shrink-swell, floods.	Severe: shrink-swell, floods.	Severe: shrink-swell, low strength.
Balman: 104, 105	Severe: floods, wetness.	Severe: floods	Severe: floods, wetness.	Severe: floods	Severe: low strength, floods.
Barnard: 106, 107	Severe: too clayey, cemented pan.	Severe: shrink-swell, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
108	Severe: cemented pan, too clayey.	Severe: low strength, shrink-swell.	Severe: cemented pan, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.	Severe: low strength, shrink-swell.
Bieber: 109, 110, 111	Severe: cemented pan.	Severe: cemented pan, shrink-swell.	Severe: shrink-swell, cemented pan.	Severe: shrink-swell, cemented pan.	Severe: low strength, shrink-swell.
Buntingville: 112, 113	Severe: wetness, floods.	Severe: floods	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, low strength, frost action.
Calimus: 114, 116, 117	Moderate: small stones.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
115	Moderate: small stones.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength.
Casuse: 118	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Daphnedale: 119	Moderate: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Moderate: slope, depth to rock, low strength.	Severe: low strength, shrink-swell.
120, 121	Severe: slope.	Severe: slope, shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, low strength, shrink-swell.
122[1] Daphnedale part	Moderate: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Delma part	Severe: depth to rock.	Severe: shrink-swell, low strength, depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: shrink-swell, low strength, depth to rock.	Severe: depth to rock, low strength, shrink-swell.

TABLE 5.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Daphnedale variant:					
123	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
124	Severe: slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
125	Moderate: slope, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
Delma:					
126, 127, 129	Severe: slope, depth to rock.	Severe: slope, shrink-swell, low strength.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: slope, depth to rock, low strength.
128	Severe: depth to rock.	Severe: shrink-swell, low strength.	Severe: depth to rock, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: depth to rock, low strength, shrink-swell.
Deven:					
130	Severe: depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, shrink-swell, low strength.
131, 132	Severe: slope, depth to rock.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, low strength.
Rock outcrop part of 132 not rated.					
Donica: 133	Severe: small stones.	Moderate: slope	Slight	Moderate: slope	Moderate: slope, frost action.
Drews:					
134, 137	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, frost action, low strength.
135	Moderate: small stones, too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Moderate: shrink-swell, frost action, low strength.
136	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
138	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Fluvaquents: 139	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Gleason: 140, 141	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Goose Lake: 142	Severe: floods, too clayey, wetness.	Severe: floods, low strength, wetness.	Severe: floods, low strength, wetness.	Severe: floods, low strength, wetness.	Severe: floods, low strength, wetness.
Gravel pits: 143 Not rated.					
Jenny: 144, 145	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.

TABLE 5.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Karcal: 146, 147[1]	Severe: depth to rock, too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell, depth to rock.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Ninekar part of 147	Severe: depth to rock.	Severe: shrink-swell, low strength.	Severe: depth to rock, low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Kinkel: 148	Severe: small stones.	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope, low strength, frost action.
149	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Ladd: 150	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell, low strength.
151	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, shrink-swell, low strength.
Lakeview: 152, 153	Severe: floods	Severe: floods. low strength.	Severe: floods, low strength wetness.	Severe: floods, low strength.	Severe: floods, low strength.
Lolak: 154	Severe: wetness, too clayey.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, shrink-swell, low strength.
Lorella: 155, 156, 157, 158, 159, 160	Severe: slope, depth to rock, small stones.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: slope, depth to rock, low strength.
Lorella variant: 161	Severe: depth to rock, slope, large stones.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope, low strength.
Rubble land part not rated.					
Deven part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Lovejoy: 162	Severe: cemented pan.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: low strength, shrink-swell.
163[1]. Lovejoy part	Severe: cemented pan.	Severe: shrink-swell, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Reba part	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Lyonman: 164, 165	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.

TABLE 5.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
McQuarrie: 166, 167	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Modoc: 168, 169	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan, low strength.	Moderate: cemented pan, frost action.
Ninekar: 170	Severe: depth to rock.	Severe: shrink-swell, low strength.	Severe: depth to rock, low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Packwood: 171[1]:					
Packwood part	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, cemented pan, low strength.
Ditchcamp part	Severe: cemented pan, depth to rock.	Severe: shrink-swell.	Severe: cemented pan, depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Puls part	Severe: large stones, cemented pan, too clayey.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Moderate: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, low strength, cemented pan.
172	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, large stones, cemented pan.	Severe: depth to rock, large stones.	Severe: depth to rock, cemented pan, low strength.
Rock outcrop part not rated.					
Ditchcamp part	Severe: cemented pan, depth to rock.	Severe: shrink-swell.	Severe: cemented pan, depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Pasquetti: 173	Moderate: wetness, too clayey.	Moderate: low strength, shrink-swell, wetness.	Severe: wetness	Moderate: low strength, shrink-swell, wetness.	Severe: frost action, low strength.
174	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: frost action, low strength.
Pineal: 175	Moderate: cemented pan.	Severe: floods; shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: shrink-swell, cemented pan, low strength.
Pit: 176, 177	Severe: floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: wetness, floods, low strength.	Severe: floods, low strength.	Severe: floods, low strength, shrink-swell.
178	Severe: wetness, floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: wetness, floods, low strength.	Severe: floods, low strength.	Severe: floods, low strength, shrink-swell.
Puls: 179, 180, 181[1]	Severe: large stones, cemented pan, too clayey.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, low strength, cemented pan.

TABLE 5.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Puls part of 180 and 181	Severe: large stones, cemented pan, too clayey.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, cemented pan, low strength.	Severe: shrink-swell, low strength, cemented pan.
Ninekar part of 180	Severe: depth to rock.	Severe: shrink-swell, low strength.	Severe: depth to rock, low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Rock outcrop part of 181 not rated.					
Reba: 182	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: depth to rock, slope.	Severe: shrink-swell, low strength.
Rock outcrop: 183[1] Rock outcrop part not rated.					
Lithic Xerorthents part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: low strength, shrink-swell.	Severe: depth to rock, slope.
Rubble land: 184 not rated.					
Rumbo: 185, 186	Moderate: too clayey, wetness.	Severe: low strength, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Salisbury: 187, 188, 189	Severe: cemented pan.	Severe: shrink-swell.	Severe: shrink-swell, cemented pan.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
190	Severe: cemented pan.	Severe: shrink-swell.	Severe: shrink-swell, cemented pan.	Severe: slope, shrink-swell.	Severe: low strength, shrink-swell.
Tandy: 191	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Thoms: 192[1]	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan, low strength.
Exel part	Moderate: too clayey, cemented pan.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength, cemented pan.	Moderate: shrink-swell, low strength.	Severe: low strength.
Tuff outcrop: 193,[1] 194[1] Tuff outcrop part not rated.					
Casuse part of 193	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Casuse part of 194	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Tulana: 195	Severe: wetness	Severe: floods, low strength.	Severe: floods, low strength, wetness.	Severe: floods, low strength.	Severe: frost action, floods, low strength.
196	Moderate: wetness.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: frost action, low strength.

TABLE 5.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Typic Xerorthents: 197. Not rated.					
Woodcock: 198, 199	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Xerofluvents: 200	Severe: floods, wetness.	Severe: floods	Severe: floods, wetness.	Severe: floods	Severe: floods.

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

flooding. Stones, boulders, and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and as a result ground water supplies in the area may be contaminated. Soils having a hazard of inadequate filtration are indicated by footnotes in table 6.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet. Impervious soil at least 4 feet thick for the lagoon floor and sides is required to minimize seepage and contamination of local ground water. Soils that are very high in organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table 6 apply only to soil properties and features within a depth of about 6 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for sanitary landfills should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation

TABLE 6.—*Sanitary facilities*

[Some of the terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ager: 100, 101	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey.
102	Severe: slope, percs slowly.	Severe: slope	Severe: slope, too clayey.	Severe: slope	Poor: slope, too clayey.
Alturas: 103	Severe: percs slowly, wetness.	Severe: wetness	Severe: too clayey, wetness.	Severe: wetness	Poor: too clayey.
Balman: 104	Severe: percs slowly, floods.	Severe: floods	Severe: floods, wetness.	Severe: floods	Good.
105	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Barnard: 106, 107	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan, too clayey.	Slight	Poor: too clayey, area reclaim.
108	Severe: percs slowly, cemented pan.	Severe: slope, cemented pan.	Severe: cemented pan, too clayey.	Moderate: slope	Poor: too clayey, area reclaim.
Bieber: 109	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan.	Slight	Poor: too clayey, thin layer, area reclaim.
110, 111	Severe: cemented pan, percs slowly.	Severe: slope, cemented pan.	Severe: cemented pan.	Moderate: slope	Poor: too clayey, thin layer, area reclaim.
Buntingville: 112, 113	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: too clayey.
Calimus: 114, 115, 116, 117	Moderate: percs slowly.	Severe: seepage	Severe: seepage	Severe: seepage	Good.
Casuse: 118	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Daphnedale: 119	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: thin layer, too clayey, area reclaim.
Daphnedale: 120	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope.
121	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
122.[1] Daphnedale part	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Fair: large stones, thin layer.
Delma part	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, too clayey, area reclaim.

TABLE 6.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Daphnedale variant:					
123	Severe: percs slowly.	Severe: slope, small stones.	Severe: too clayey.	Moderate: slope	Poor: small stones, too clayey.
124	Severe: percs slowly, slope.	Severe: slope, small stones.	Severe: slope, too clayey.	Severe: slope	Poor: slope, small stones, too clayey.
125	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Moderate: slope	Poor: too clayey.
Delma:					
126, 129	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, too clayey.
127	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, too clayey.
128	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, too clayey, small stones.
Deven:					
130	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer.
131	Severe: depth to rock, percs slowly, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope	Poor: thin layer, slope, area reclaim.
132[1]:	Severe: depth to rock, percs slowly, slope.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: thin layer, slope, area reclaim.
Rock outcrop part of 132 not rated.					
Donica: 133	Slight	Severe: seepage, small stones.	Severe: seepage	Severe: seepage	Poor: small stones.
Drews:					
134, 135, 137	Severe: percs slowly.	Moderate: seepage, small stones.	Slight	Slight	Fair: small stones, too clayey.
136	Severe: slope, percs slowly.	Severe: slope	Moderate: slope	Severe: slope	Poor: slope.
138	Severe: floods, percs slowly.	Severe: floods	Severe: floods	Severe: floods	Fair: too clayey, small stones.
Fluvaquents: 139	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Gleason:					
140	Severe: slope	Severe: slope, seepage.	Severe: depth to rock, seepage.	Severe: slope, seepage.	Poor: slope.
141	Severe: slope	Severe: slope, seepage.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage.	Poor: slope.
Goose Lake: 142	Severe: floods, percs slowly, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Gravel pits: 143 Not rated.					

TABLE 6.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Jenny: 144, 145	Severe: percs slowly.	Moderate: slope	Severe: too clayey.	Slight	Poor: too clayey.
Karcal: 146	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: too clayey, thin layer, area reclaim.
147[1]. Karcal part	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: too clayey.
Ninekar part	Severe: percs slowly, depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock.	Slight	Fair: thin layer, large stones, too clayey.
Kinkel: 148	Severe: percs slowly.	Severe: slope	Slight	Moderate: slope	Poor: small stones.
149	Severe: slope, percs slowly.	Severe: slope	Severe: slope	Severe: slope	Poor: slope, small stones.
Ladd: 150	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
151	Severe: percs slowly.	Moderate: slope	Moderate: too clayey.	Slight	Fair: too clayey.
Lakeview: 152, 153	Severe: percs slowly, floods.	Severe: floods	Severe: floods, wetness.	Severe: floods	Fair: too clayey.
Lolak: 154	Severe: wetness, percs slowly, floods.	Severe: floods	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: wetness, too clayey.
Lorella: 155, 156, 157, 158, 159, 160	Severe: percs slowly, slope, depth to rock.	Severe: depth to rock, slope, small stones.	Severe: depth to rock, slope, too clayey.	Severe: slope	Poor: slope, thin layer, small stones.
Lorella variant: 161	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.	Severe: slope	Poor: large stones, slope, area reclaim.
Rubble land part not rated.					
Deven part	Severe: depth to rock, slope, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: thin layer, slope, area reclaim.
Lovejoy: 162	Severe: percs slowly, cemented pan.	Moderate: slope	Severe: cemented pan.	Slight	Poor: thin layer.
163[1] Lovejoy part	Severe: percs slowly, cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Poor: thin layer, area reclaim.
Reba part	Severe: percs slowly.	Moderate: slope	Severe: too clayey.	Slight	Poor: too clayey.
Lyonman: 164	Severe: slope, percs slowly.	Severe: slope	Severe: depth to rock.	Severe: slope	Poor: slope.

TABLE 6.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
165	Severe: slope, percs slowly.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
McQuarrie: 166	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
167	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Modoc: 168, 169	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan.	Slight	Fair: thin layer, slope, area reclaim.
Ninekar: 170	Severe: percs slowly, depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock.	Slight	Fair: thin layer, large stones, too clayey.
Packwood: 171[1].					
Packwood part	Severe: percs slowly, cemented pan, depth to rock.	Severe: cemented pan, depth to rock.	Severe: cemented pan, depth to rock.	Slight	Poor: thin layer, area reclaim.
Ditchcamp part	Severe: percs slowly, cemented pan, depth to rock.	Severe: cemented pan, depth to rock.	Severe: cemented pan, depth to rock.	Slight	Fair: thin layer, too clayey, area reclaim.
Puls part	Severe: cemented pan, percs slowly, large stones.	Severe: large stones, cemented pan.	Severe: large stones, cemented pan, too clayey.	Slight	Poor: thin layer, too clayey, large stones.
172[1]:	Severe: percs slowly, cemented pan, depth to rock.	Severe: large stones, cemented pan, depth to rock.	Severe: cemented pan, depth to rock, large stones.	Slight	Poor: thin layer, area reclaim, large stones.
Rock outcrop part not rated.					
Ditchcamp part	Severe: percs slowly, cemented pan, depth to rock.	Severe: cemented pan, depth to rock.	Severe: cemented pan, depth to rock.	Slight	Fair: thin layer, too clayey, area reclaim.
Pasquetti: 173	Severe: wetness, percs slowly.	Moderate: wetness.	Severe: wetness	Moderate: wetness.	Fair: too clayey, wetness.
174	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Pineal: 175	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: wetness	Moderate: floods	Poor: thin layer, area reclaim.
Pit: 176, 177, 178	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey.
Puls: 179, 180[1], 181	Severe: cemented pan, percs slowly, large stones.	Severe: large stones, cemented pan.	Severe: large stones, cemented pan, too clayey.	Slight	Poor: thin layer, too clayey, large stones.

TABLE 6.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ninekar part	Severe: percs slowly, depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock.	Slight	Fair: thin layer, large stones, too clayey.
Rock outcrop part of 181 not rated.					
Reba: 182	Severe: percs slowly.	Moderate: slope	Severe: too clayey.	Slight	Poor: too clayey.
Rock outcrop: 183[1]					
Rock outcrop part not rated.					
Lithic Xerorthents part	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.		Poor: thin layer, area reclaim.
Rubble land: 184					
Not rated.					
Rumbo: 185	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
186	Severe: percs slowly.	Moderate: slope	Severe: too clayey.	Slight	Poor: too clayey.
Salisbury: 187, 188, 189	Severe: percs slowly, cemented pan.	Severe: cemented pan.	Severe: too clayey, cemented pan.	Slight	Poor: too clayey, area reclaim.
190	Severe: percs slowly, cemented pan.	Severe: slope, cemented pan.	Severe: too clayey, cemented pan.	Moderate: slope	Poor: too clayey, area reclaim.
Tandy: 191	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Good.
Thoms: 192[1]	Severe: cemented pan, percs slowly.	Severe: small stones, cemented pan.	Severe: cemented pan.	Slight	Poor: thin layer, small stones, area reclaim.
Exel part	Severe: percs slowly, cemented pan.	Severe: cemented pan, small stones.	Severe: cemented pan.	Slight	Fair: too clayey, thin layer, small stones.
Tuff outcrop: 193[1], 194[1]					
Tuff outcrop part not rated.					
Casuse part of 193	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope	Poor: thin layer, area reclaim.
Casuse part of 194	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Tulana: 195	Severe: floods, percs slowly, wetness.	Severe: excess humus, floods, wetness.	Severe: excess humus, floods, wetness.	Severe: floods, wetness.	Poor: excess humus, wetness.
196	Moderate: percs slowly.	Moderate: seepage, excess humus.	Severe: wetness	Slight	Good.

TABLE 6.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Typic Xerorthents: 197. Not rated.					
Woodcock:					
198	Severe: slope	Severe: slope, small stones.	Severe: depth to rock.	Severe: slope	Poor: slope, small stones.
199	Severe: slope	Severe: slope, small stones.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, small stones.
Xerofluvents: 200	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	

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

of the borrow areas, such as slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 7 by ratings of good, fair, or poor. The texture, thickness, and organic matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Roadfill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

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

According to the Unified soil classification system, soils rated *good* have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness, or many stones. If the thickness of the suitable material is less than 3 feet, the entire soil is rated *poor,* regardless of the quality of the suitable material.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

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

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

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

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

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

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is much preferred for topsoil because of its organic matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter. Consequently, careful preservation and use of material from these horizons is desirable.

TABLE 7.—*Construction materials*

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

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ager:				
100	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
101	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, small stones.
102	Poor: slope, shrink-swell, low strength.	Unsuited	Unsuited	Poor: slope, small stones, too clayey.
Alturas: 103	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: excess salt.
Balman:				
104	Fair: low strength	Unsuited	Unsuited	Poor: excess salt, excess sodium.
105	Fair: wetness, low strength.	Unsuited	Unsuited	Poor: excess sodium, excess salt.
Barnard:				
106, 107	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Poor: too clayey, small stones.
108	Poor: low strength, thin layer, shrink-swell.	Unsuited	Unsuited	Poor: too clayey.
Bieber: 109, 110, 111	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, small stones.
Buntingville: 112, 113	Poor: low strength, frost action.	Unsuited	Unsuited	Fair: too clayey.
Calimus:				
114, 115	Poor: low strength	Unsuited	Unsuited	Good.
116	Poor: low strength	Unsuited	Unsuited	Poor: small stones.
117	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
Casuse: 118	Poor: thin layer, area reclaim, low strength.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Daphnedale:				
119	Poor: thin layer, low strength.	Unsuited	Unsuited	Fair: too clayey.
120	Poor: thin layer, low strength.	Unsuited	Unsuited	Poor: slope, small stones.
121	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: slope, large stones.
122[1]:				
Daphnedale part	Poor: thin layer, low strength.	Unsuited	Unsuited	Poor: large stones.
Delma part of 122	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Daphnedale variant:				
123	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Poor: small stones.
124	Poor: slope, low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, small stones.

TABLE 7.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
125	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Fair: too clayey, slope.
Delma:				
126	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: slope, thin layer, area reclaim.
127	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: slope, thin layer, area reclaim.
128	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: thin layer, small stones, area reclaim.
129	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: slope, thin layer, small stones.
Deven:				
130	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: thin layer, too clayey, area reclaim.
131	Poor: slope, thin layer, shrink-swell.	Unsuited	Unsuited	Poor: slope, large stones, thin layer.
132	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Poor: slope, large stones, thin layer.
Rock outcrop part not rated.				
Donica: 133	Good	Good	Good	Poor: small stones.
Drews:				
134, 137, 138	Poor: low strength	Unsuited	Unsuited	Fair: too clayey, small stones.
135	Poor: low strength	Unsuited	Unsuited	Poor: small stones.
136	Poor: low strength	Unsuited	Unsuited	Poor: slope, small stones.
Fluvaquents: 139. Not rated.				
Gleason:				
140	Fair: slope, frost action.	Poor: excess fines	Unsuited	Poor: slope.
141	Poor: slope	Poor: excess fines	Unsuited	Poor: slope, small stones.
Goose Lake: 142	Poor: low strength, shrink-swell, wetness.	Unsuited	Unsuited	Good.
Gravel pits: 143 Not rated.				
Jenny:				
144	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey.
145	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
Karcal: 146, 147[1]	Poor: thin layer, low strength, shrink-swell.	Unsuited	Unsuited	Poor: small stones, too clayey.

TABLE 7.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ninekar part of 147	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: large stones.
Kinkel:				
148	Fair: low strength	Unsuited	Unsuited	Poor: small stones.
149	Poor: slope	Unsuited	Unsuited	Poor: slope, small stones.
Ladd:				
150, 151	Fair: frost action, shrink-swell, low strength.	Unsuited	Unsuited	Good.
Lakeview:				
152	Fair: shrink-swell, low strength.	Unsuited	Unsuited	Good.
153	Fair: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey.
Lolak:				
154	Poor: wetness, shrink-swell, low strength.	Unsuited	Unsuited	Poor: excess salt, excess sodium, too clayey.
Lorella:				
155, 156, 158	Poor: area reclaim, thin layer, low strength.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
157, 159, 160	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Lorella variant:				
161	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: slope, large stones.
Rubble land part not rated.				
Deven part	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: slope, thin layer, large stones.
Lovejoy: 162, 163[1]	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Poor: area reclaim, too clayey.
Reba part of 163	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey.
Lyonman:				
164	Poor: low strength	Unsuited	Unsuited	Poor: slope.
165	Poor: slope, low strength.	Unsuited	Unsuited	Poor: slope.
McQuarrie:				
166	Poor: thin layer	Unsuited	Unsuited	Poor: slope, area reclaim.
167	Poor: slope, thin layer.	Unsuited	Unsuited	Poor: slope, large stones, area reclaim.
Modoc:				
168	Poor: thin layer	Unsuited	Unsuited	Fair: too clayey.
169	Poor: thin layer	Unsuited	Unsuited	Poor: small stones.

TABLE 7.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ninekar: 170	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: large stones.
Packwood: 171 [1], 172 [1]	Poor: thin layer, area reclaim, low strength.	Unsuited	Unsuited	Poor: thin layer, large stones, area reclaim.
Ditchcamp part of 171 and 172	Poor: thin layer, low strength.	Unsuited	Unsuited	Fair: too clayey, small stones.
Rock outcrop part of 172 not rated.				
Pasquetti: 173, 174	Poor: frost action, low strength.	Unsuited	Unsuited	Fair: too clayey.
Pineal: 175	Poor: low strength	Unsuited	Unsuited	Fair: excess sodium, too clayey.
Pit: 176, 177, 178	Poor: frost action, low strength.	Unsuited	Unsuited	Poor: too clayey.
Puls: 179, 180 [1], 181	Poor: shrink-swell, low strength, thin layer.	Unsuited	Unsuited	Poor: too clayey, large stones.
Ninekar part of 180	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: large stones, too clayey.
Rock outcrop part of 181 not rated.				
Reba: 182	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Good.
Rock outcrop: 183 [1] Rock outcrop part not rated.				
Lithic Xerorthents part	Poor: thin layer, slope.	Unsuited	Unsuited	Poor: thin layer, slope.
Rubble land: 184 Not rated.				
Rumbo: 185, 186	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: excess sodium, excess salt.
Salisbury: 187, 190	Poor: thin layer, low strength, shrink-swell.	Unsuited	Unsuited	Poor: area reclaim.
188, 189	Poor: thin layer, low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Tandy: 191	Fair: low strength, wetness.	Poor: excess fines	Unsuited	Fair: excess sodium, too sandy.
Thoms: 192 [1]	Poor: thin layer, low strength.	Unsuited	Unsuited	Poor: small stones.
Exel part	Poor: thin layer, low strength.	Unsuited	Unsuited	Fair: small stones.

TABLE 7.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Tuff outcrop: 193[1], 194[1]				
Tuff outcrop part not rated.				
Casuse part of 193	Poor: thin layer, area reclaim, low strength.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Casuse part of 194	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: thin layer, slope, area reclaim.
Tulana:				
195	Poor: frost action, wetness, low strength.	Unsuited	Unsuited	Good.
196	Poor: low strength, frost action, excess humus.	Unsuited	Unsuited	Good.
Typic Xerorthents:				
197				
Not rated.				
Woodcock:				
198	Fair: slope	Unsuited	Unsuited: large stones.	Poor: slope, small stones, large stones.
199	Poor: slope	Unsuited	Unsuited: large stones.	Poor: slope, small stones, large stones.
Xerofluvents: 200.				
Not rated.				

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

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 8 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

An *aquifer-fed excavated pond* is a body of water created by excavating a pit or dugout into a groundwater aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 8 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability, texture, structure, depth to claypan or other layers that influence rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

TABLE 8.—*Water management*

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

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
Ager: 100, 101, 102	Slope	Shrink-swell, compressible, low strength.	No water	Slope, percs slowly, depth to rock.	Slope, slow intake, percs slowly.	Percs slowly, slope.
Alturas: 103	Favorable	Low strength, hard to pack, compressible.	Percs slowly	Wetness, percs slowly, excess sodium.	Wetness, percs slowly, excess salt.	Percs slowly, wetness.
Balman:						
104	Seepage	Low strength, piping, hard to pack.	Deep to water	Excess sodium, floods, wetness.	Excess sodium, excess salt, wetness.	Piping.
105	Seepage	Low strength, piping, hard to pack.	Favorable	Excess sodium, wetness, floods.	Wetness, excess sodium, floods.	Wetness.
Barnard:						
106, 107	Cemented pan	Shrink-swell, thin layer, low strength.	No water	Cemented pan, percs slowly, slope.	Rooting depth, percs slowly, slope.	Cemented pan, percs slowly.
108	Cemented pan, slope.	Low strength, shrink-swell, low strength.	No water	Slope, cemented pan, percs slowly.	Rooting depth, slope, percs slowly.	Slope, cemented pan, percs slowly.
Bieber: 109, 110, 111	Slope, cemented pan.	Low strength, thin layer, shrink-swell.	No water	Slope, cemented pan, percs slowly.	Slope, percs slowly, rooting depth.	Percs slowly, rooting depth, cemented pan.
Buntingville:						
112	Favorable	Shrink-swell, low strength.	Deep to water	Floods, percs slowly, frost action.	Wetness, percs slowly, floods.	Percs slowly, wetness.
113	Slope	Shrink-swell, low strength.	Deep to water	Floods, percs slowly, frost action.	Wetness, percs slowly, floods.	Percs slowly, wetness.
Calimus:						
114, 117	Seepage	Low strength, seepage, piping.	No water	Favorable	Droughty	Piping.
115, 116	Slope, seepage.	Low strength, seepage, piping.	No water	Slope	Slope, droughty.	Slope, piping.
Casuse: 118	Depth to rock, slope.	Piping, hard to pack, thin layer.	No water	Slope, depth to rock.	Slope, rooting depth, droughty.	Depth to rock, piping.
Daphnedale: 119, 120, 121, 122[1]	Slope, depth to rock.	Thin layer, shrink-swell, low strength.	No water	Slope, percs slowly, depth to rock.	Slope, percs slowly, droughty.	Slope, percs slowly, depth to rock.
Delma part of 122	Depth to rock	Thin layer, low strength, shrink-swell.	No water	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, percs slowly, depth to rock.
Daphnedale variant:						
123, 124, 125	Slope	Low strength, shrink-swell, compressible.	No water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Delma:						
126, 127, 129	Slope, depth to rock.	Shrink-swell, low strength, thin layer.	No water	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, percs slowly, depth to rock.

TABLE 8.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
128	Depth to rock	Shrink-swell, low strength, thin layer.	No water	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, percs slowly, depth to rock.
Deven: 130	Slope, depth to rock.	Low strength, shrink-swell, thin layer.	No water	Slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Depth to rock, percs slowly, slope.
131	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	No water	Slope, depth to rock, percs slowly.	Slope, rooting depth, large stones.	Slope, depth to rock, percs slowly.
132	Slope, depth to rock.	Low strength, thin layer, piping.	No water	Slope, depth to rock, percs slowly.	Slope, rooting depth, large stones.	Depth to rock, slope, percs slowly.
Rock outcrop part of 132 not rated.						
Donica: 133	Slope, seepage.	Seepage, piping.	No water	Slope, cutbanks cave.	Slope, droughty.	Slope, piping.
Drews: 134, 135, 137	Slope, seepage.	Hard to pack, piping, low strength.	No water	Slope, percs slowly.	Slope, erodes easily.	Percs slowly, erodes easily.
136	Slope, seepage.	Hard to pack, piping, low strength.	No water	Slope	Slope, erodes easily.	Slope, erodes easily.
138	Seepage	Low strength, hard to pack, piping.	No water	Floods	Floods	Percs slowly.
Fluvaquents: 139			Favorable	Wetness, floods.	Wetness, floods.	Wetness.
Gleason: 140, 141	Depth to rock, slope, seepage.	Low strength, piping.	No water	Slope, depth to rock.	Slope, seepage.	Slope, piping.
Goose Lake: 142	Favorable	Low strength, shrink-swell, compressible.	Slow refill	Floods, percs slowly, wetness.	Floods, percs slowly, wetness.	Percs slowly, wetness.
Gravel pits: 143 Not rated.						
Jenny: 144, 145	Slope	Low strength, compressible, shrink-swell.	No water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Karcal: 146, 147 [1]	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	No water	Slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Slope, depth to rock, percs slowly.
Ninekar part of 147	Slope, depth to rock.	Thin layer, shrink-swell, low strength.	No water	Slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Depth to rock, large stones, percs slowly.
Kinkel: 148, 149	Slope	Low strength	No water	Slope	Slope	Slope.
Ladd: 150	Seepage	Low strength, shrink-swell.	No water	Favorable	Favorable	Favorable.
151	Slope, seepage.	Low strength, shrink-swell.	No water	Slope	Slope	Favorable.

TABLE 8.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
Lakeview: 152	Favorable	Low strength, shrink-swell.	Slow refill	Floods, poor outlets, percs slowly.	Floods, wetness.	Percs slowly, wetness.
153	Slope	Low strength, shrink-swell.	Slow refill	Slope, poor outlets.	Floods, wetness, slope.	Wetness.
Lolak: 154	Favorable	Low strength, shrink-swell, compressible.	Slow refill	Percs slowly, poor outlets.	Excess alkali, excess sodium, wetness.	Wetness, poor outlets, percs slowly.
Lorella: 155, 156, 157, 158, 159, 160	Depth to rock, slope.	Low strength, thin layer, shrink-swell.	No water	Depth to rock, slope, percs slowly.	Rooting depth, slope, percs slowly.	Slope, depth to rock, percs slowly.
Lorella variant: 161	Slope, depth to rock.	Shrink-swell, low strength, large stones.	No water	Slope, depth to rock, percs slowly.	Rooting depth, slope, large stones.	Depth to rock, slope, percs slowly.
Rubble land part not rated.						
Lovejoy: 162, 163 [1]	Cemented pan, slope.	Shrink-swell, thin layer, low strength.	No water	Slope, percs slowly, cemented pan.	Slope, percs slowly, rooting depth.	Cemented pan, percs slowly.
Reba part of 163	Slope	Low strength, shrink-swell.	No water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Lyonman: 164, 165	Slope	Piping, hard to pack, low strength.	No water	Slope, depth to rock.	Slope	Slope, depth to rock.
McQuarrie: 166, 167	Slope, depth to rock.	Low strength, thin layer.	No water	Slope, depth to rock.	Slope, rooting depth, droughty.	Slope, depth to rock.
Modoc: 168, 169	Slope, cemented pan.	Low strength, thin layer.	No water	Slope, cemented pan.	Slope, rooting depth, droughty.	Slope, cemented pan.
Ninekar: 170	Slope, depth to rock.	Thin layer, shrink-swell, low strength.	No water	Slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Depth to rock, large stones, percs slowly.
Packwood: 171 [1], 172 [1]	Slope, cemented pan, depth to rock.	Low strength, thin layer, large stones.	No water	Depth to rock, cemented pan, slope.	Slope, rooting depth, percs slowly.	Slope, depth to rock, percs slowly.
Ditchcamp part of 171	Cemented pan, depth to rock, slope.	Thin layer, low strength.	No water	Depth to rock, percs slowly, slope.	Rooting depth, percs slowly, slope.	Cemented pan, depth to rock, slope.
Puls part of 171	Slope, cemented pan, depth to rock.	Low strength, shrink-swell, thin layer.	No water	Depth to rock, slope, cemented pan.	Rooting depth, slope, large stones.	Slope, depth to rock, large stones.
Rock outcrop part of 172 not rated.						
Ditchcamp part of 172	Slope, cemented pan, depth to rock.	Low strength, thin layer, large stones.	No water	Depth to rock, percs slowly, slope.	Rooting depth, percs slowly, slope.	Cemented pan, depth to rock, slope.

TABLE 8.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
Pasquetti: 173	Favorable	Low strength, hard to pack, piping.	Percs slowly	Frost action, percs slowly, wetness.	Percs slowly, wetness.	Percs slowly, piping.
174	Favorable	Low strength, hard to pack, piping.	Deep to water, percs slowly.	Frost action, percs slowly.	Percs slowly	Percs slowly, piping.
Pineal: 175	Cemented pan	Low strength, piping.	Slow refill, deep to water.	Cemented pan, percs slowly.	Cemented pan, rooting depth.	Cemented pan, percs slowly, rooting depth.
Pit: 176, 177, 178	Favorable	Low strength, shrink-swell, compressible.	Slow refill	Floods, percs slowly.	Percs slowly, wetness, floods.	Percs slowly, wetness.
Puls: 179	Slope, cemented pan, depth to rock.	Low strength, shrink-swell, thin layer.	No water	Slope, cemented pan, percs slowly.	Slope, rooting depth, percs slowly.	Cemented pan, percs slowly, rooting depth.
180[1]: Puls part	Slope, cemented pan, depth to rock.	Low strength, shrink-swell, thin layer.	No water	Slope, cemented pan, percs slowly.	Slope, rooting depth.	Cemented pan, percs slowly, rooting depth.
Ninekar part	Slope, depth to rock.	Thin layer, shrink-swell, low strength.	No water	Slope, depth to rock, percs slowly.	Slope, depth to rock, percs slowly.	Depth to rock, large stones, percs slowly.
181	Slope, cemented pan, depth to rock.	Low strength, shrink-swell, thin layer.	No water	Slope, depth to rock, cemented pan.	Slope, rooting depth, percs slowly.	Cemented pan, percs slowly, rooting depth.
Rock outcrop part not rated.						
Reba: 182	Slope	Low strength, shrink-swell.	No water	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Rock outcrop: 183[1] Rock outcrop part not rated.						
Lithic Xerorthents part	Slope, depth to rock.	Thin layer	No water	Depth to rock, slope.	Rooting depth, slope.	Depth to rock, slope.
Rubble land: 184 Not rated.						
Rumbo: 185, 186	Favorable	Shrink-swell, low strength, compressible.	Percs slowly	Wetness, excess sodium, percs slowly.	Excess salt, excess sodium, percs slowly.	Percs slowly.
Salisbury: 187, 188, 189	Slope, cemented pan.	Low strength, thin layer, shrink-swell.	No water	Slope, percs slowly, cemented pan.	Slope, rooting depth, percs slowly.	Cemented pan, percs slowly.
190	Slope, cemented pan.	Low strength, thin layer, shrink-swell.	No water	Slope, percs slowly, cemented pan.	Slope, rooting depth, percs slowly.	Slope, cemented pan, percs slowly.
Tandy: 191	Seepage	Piping, low strength, hard to pack.	Favorable	Excess sodium, poor outlets, floods.	Wetness, floods, excess sodium.	Wetness, poor outlets.

TABLE 8.—*Water management*—Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
Thoms: 192 [1]	Slope, cemented pan.	Low strength, thin layer.	No water	Cemented pan, percs slowly, slope.	Rooting depth, percs slowly, slope.	Cemented pan, complex slope, percs slowly.
Exel part	Slope, cemented pan.	Low strength, thin layer.	No water	Slope, cemented pan, percs slowly.	Slope, percs slowly, rooting depth.	Cemented pan, slope, percs slowly.
Tuff outcrop: 193 [1], 194 [1]						
Tuff outcrop part not rated.						
Casuse part	Depth to rock, slope.	Piping, hard to pack, thin layer.	No water	Slope, depth to rock.	Slope, rooting depth, droughty.	Depth to rock, piping.
Tulana:						
195	Seepage	Compressible, low strength, hard to pack.	Favorable	Poor outlets, wetness, floods.	Floods, wetness.	Wetness, poor outlets.
196	Seepage	Low strength, compressible, hard to pack.	Deep to water	Favorable	Favorable	Favorable.
Typic Xerorthents: 197.						
Not rated.						
Woodcock: 198, 199	Slope, seepage.	Seepage, piping.	No water	Slope, large stones.	Slope, large stones, droughty.	Slope, piping, large stones.
Xerofluvents: 200						
Not rated.						

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

Recreation

Outdoor recreation is an increasingly important factor in the Alturas Area. There are numerous recreational opportunities nearby, with the town of Alturas serving as a central service point. Some of the unique recreation activities include backpacking and hiking, hunting, fishing, camping and picnicking, skiing, visiting historical sites, horseback riding, rock hunting, and boating. Tourism is at present the third largest industry in the county.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreational use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreational facilities.

In table 9 the limitations of soils are rated as slight, moderate or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by additional information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 6, and interpretations for dwellings without basements and for local roads and streets, given in table 5.

Camp areas require such site preparation as shaping and leveling tent, small trailer, and parking areas; stabilizing roads and intensively used areas; and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes

TABLE 9.—*Recreational development*

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ager:				
100	Severe: too clayey, percs slowly.	Severe: too clayey	Severe: slope, too clayey, percs slowly.	Moderate: too clayey.
101	Severe: too clayey, percs slowly.	Severe: too clayey	Severe: slope, small stones, percs slowly.	Moderate: too clayey, small stones.
102	Severe: slope, too clayey, percs slowly.	Severe: slope, too clayey.	Severe: slope, small stones, percs slowly.	Severe: slope.
Alturas: 103	Moderate: wetness	Moderate: wetness	Moderate: wetness	Slight.
Balman:				
104	Severe: floods	Moderate: floods	Severe: floods	Slight.
105	Severe: wetness, floods.	Severe: wetness	Severe: wetness, floods.	Severe: wetness.
Barnard:				
106, 107	Moderate: small stones, percs slowly.	Moderate: small stones.	Severe: small stones	Moderate: small stones.
108	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey	Severe: slope	Moderate: too clayey.
Bieber:				
109	Moderate: small stones.	Moderate: small stones.	Severe: small stones, cemented pan.	Moderate: small stones.
110, 111	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, cemented pan.	Moderate: small stones.
Buntingville: 112, 113	Severe: wetness, floods.	Moderate: floods, too clayey, wetness.	Severe: wetness, floods.	Moderate: too clayey, floods.
Calimus:				
114	Slight	Slight	Slight	Slight.
115, 116	Slight	Slight	Moderate: slope	Slight.
117	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
Casuse: 118	Slight	Slight	Severe: depth to rock, depth to pan.	Slight.
Daphnedale:				
119	Moderate: percs slowly.	Slight	Moderate: percs slowly, depth to pan.	Slight.
120	Severe: slope	Severe: slope	Severe: small stones, slope.	Moderate: slope, small stones.
121	Severe: slope	Severe: slope	Severe: large stones, slope.	Severe: slope.
122 [1]	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope, depth to pan.	Slight.
Delma part of 122	Moderate: percs slowly.	Slight	Severe: depth to pan	Slight.
Daphnedale variant:				
123	Severe: small stones	Severe: small stones	Severe: slope, small stones.	Severe: small stones.
124	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones, slope.
125	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope	Moderate: too clayey.

TABLE 9.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Delma:				
126	Severe: slope	Severe: slope	Severe: slope, depth to pan.	Moderate: slope.
127	Severe: slope	Severe: slope	Severe: slope, depth to pan.	Severe: slope.
128	Moderate: small stones, percs slowly.	Moderate: small stones.	Severe: small stones, depth to pan.	Moderate: small stones.
129	Severe: slope	Severe: slope	Severe: slope, small stones, depth to pan.	Moderate: slope, small stones.
Deven:				
130	Moderate: too clayey	Moderate: too clayey	Severe: depth to rock	Moderate: too clayey.
131	Severe: slope	Severe: slope	Severe: slope, depth to rock, small stones.	Severe: slope.
132	Severe: slope	Severe: slope	Severe: slope, depth to rock, small stones.	Moderate: slope, small stones.
Rock outcrop part of 132 not rated.				
Donica: 133	Moderate: small stones.	Moderate: small stones.	Severe: small stones	Moderate: small stones.
Drews:				
134, 137	Slight	Slight	Moderate: slope	Slight.
135	Slight	Slight	Moderate: slope, small stones.	Slight.
136	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
138	Moderate: too clayey, floods.	Moderate: floods, too clayey.	Severe: floods	Moderate: floods, too clayey.
Fluvaquents: 139	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Gleason:				
140	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
141	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
Goose Lake: 142	Severe: wetness, dusty.	Severe: wetness, dusty.	Severe: floods, wetness, dusty.	Severe: wetness, dusty.
Gravel pits: 143. Not rated.				
Jenny:				
144	Moderate: too clayey	Moderate: too clayey	Moderate: slope, too clayey.	Moderate: too clayey.
145	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Karcal: 146, 147 [1]	Severe: too clayey	Severe: too clayey	Severe: too clayey, small stones.	Severe: too clayey.
Ninekar part of 147	Severe: percs slowly.	Severe: large stones	Severe: percs slowly, large stones.	Moderate: large stones.
Kinkel:				
148	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
149	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

TABLE 9.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ladd:				
150	Slight	Slight	Slight	Slight.
151	Slight	Slight	Moderate: slope	Slight.
Lakeview:				
152	Moderate: wetness, dusty, percs slowly.	Moderate: wetness, dusty.	Moderate: wetness, dusty, percs slowly.	Moderate: dusty.
153	Moderate: too clayey, wetness, excess humus.	Moderate: too clayey, wetness, excess humus.	Moderate: too clayey, wetness, excess humus.	Moderate: too clayey, excess humus.
Lolak: 154	Severe: wetness	Severe: wetness	Severe: wetness, percs slowly, too clayey.	Severe: wetness.
Lorella:				
155, 156	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
157, 159, 160	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
158	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: small stones, slope.
Lorella variant:				
161	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Rubble land part not rated.				
Deven part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Lovejoy: 162, 163[1]	Severe: percs slowly	Slight	Severe: percs slowly	Slight.
Reba part of 163	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Lyonman:				
164	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
165	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
McQuarrie:				
166	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
167	Severe: slope	Severe: slope	Severe: slope, depth to rock, large stones.	Severe: slope.
Modoc: 168, 169	Moderate: percs slowly.	Slight	Moderate: slope, small stones, percs slowly.	Slight.
Ninekar: 170	Severe: percs slowly	Moderate: large stones.	Severe: percs slowly, large stones.	Moderate: large stones.
Packwood: 171,[1] 172[1]	Severe: large stones	Moderate: large stones.	Severe: percs slowly, depth to rock, large stones.	Severe: large stones.
Ditchcamp part of 171 and 172	Moderate: percs slowly.	Slight	Moderate: slope, depth to rock.	Slight.
Puls part of 171	Severe: large stones, percs slowly.	Moderate: large stones.	Severe: large stones, cemented pan, depth to rock.	Severe: large stones.
Rock outcrop part of 172 not rated.				

TABLE 9.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Pasquetti:				
173	Moderate: percs slowly, too clayey.	Moderate: too clayey	Moderate: percs slowly, too clayey.	Moderate: too clayey.
174	Moderate: percs slowly, too clayey, wetness.	Moderate: too clayey, wetness.	Moderate: percs slowly, too clayey.	Moderate: too clayey.
Pineal: 175	Moderate: percs slowly, floods.	Slight	Moderate: percs slowly, floods.	Slight.
Pit:				
176	Severe: wetness, floods.	Moderate: wetness, too clayey.	Severe: floods, wetness.	Moderate: wetness, too clayey.
177, 178	Severe: wetness, floods, too clayey.	Severe: too clayey	Severe: floods, wetness, too clayey.	Severe: too clayey.
Puls: 179, 180,[1] 181	Severe: large stones, percs slowly.	Moderate: large stones.	Severe: cemented pan	Severe: large stones.
Ninekar part of 180	Severe: percs slowly	Moderate: large stones.	Severe: percs slowly, large stones.	Moderate: large stones.
Rock outcrop part of 181 not rated.				
Reba: 182	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Rock outcrop: 183[1]				
Rock outcrop part not rated.				
Lithic Xerorthents part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Rubble land: 184. Not rated.				
Rumbo:				
185	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
186	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
Salisbury:				
187	Moderate: percs slowly.	Slight	Severe: cemented pan	Slight.
188, 189	Moderate: percs slowly, small stones.	Moderate: small stones.	Severe: small stones, percs slowly, cemented pan.	Moderate: small stones.
190	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey.	Severe: slope, cemented pan.	Moderate: too clayey.
Tandy: 191	Severe: soil blowing, wetness.	Severe: soil blowing, wetness.	Severe: floods, soil blowing, wetness.	Severe: wetness, soil blowing.
Thoms: 192[1]	Moderate: small stones, percs slowly.	Moderate: small stones.	Severe: small stones, cemented pan.	Moderate: small stones.
Exel part	Slight	Slight	Moderate: slope, cemented pan.	Slight.
Tuff outcrop: 193,[1] 194[1].				
Tuff outcrop part not rated.				

TABLE 9.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Casuse part of 193	Moderate: slope	Moderate: slope	Severe: slope, depth to rock.	Slight.
Casuse part of 194	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Tulana:				
195	Severe: dusty, wetness, floods.	Severe: dusty, wetness.	Severe: dusty, wetness, floods.	Severe: dusty, wetness.
196	Severe: dusty	Severe: dusty	Severe: dusty	Severe: dusty.
Typic Xerorthents: 197 Not rated.				
Woodcock:				
198	Severe: slope, small stones, large stones.	Severe: slope, small stones, large stones.	Severe: slope, small stones, large stones.	Severe: small stones, large stones.
199	Severe: slope, small stones, large stones.	Severe: slope, small stones, large stones.	Severe: slope, small stones, large stones.	Severe: slope, small stones, large stones.
Xerofluvents: 200	Moderate: wetness, floods.	Moderate: floods, wetness.	Moderate: floods, wetness.	Moderate: wetness, floods.

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

and are not wet nor subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

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

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and not wet nor subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over rock should be sufficient to allow necessary grading.

The design and layout of *paths and trails* for walking, horseback riding, and bicycling should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Soil Properties[9]

Extensive data about soil properties collected during the soil survey are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of samples selected from representative soil profiles in the field.

When the soil scientists make soil borings during field mapping, they can identify several important soil properties. They note the seasonal soil moisture condition, or the presence of free water and its depth in the profile. For each horizon, they note the thickness of the soil and its color; the texture, or the amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in-place under the existing soil moisture conditions. They record the root depth of existing plants, determine the pH or reaction, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data, and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area. Also, pertinent soil and water features, engineering test data, and data obtained from laboratory analyses, both physical and chemical, are presented.

Engineering Properties

Table 10 gives estimates of engineering properties

[9] JACK H. GASSEL, civil engineer, Soil Conservation Service, helped with this section.

TABLE 10.—*Engineering properties*

[The symbol < means less than; > means more than. NP means

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Ager:				
100	0–39	Clay	MH, CH	A–7
	39–53	Clay loam, loam	CL	A–6
	53	Weathered bedrock.		
101, 102	0–39	Cobbly clay	MH, CH	A–7
	39–53	Clay loam, loam	CL	A–6
	53	Weathered bedrock.		
Alturas: 103	0–17	Loam	CL, CL–ML	A–4, A–6
	17–42	Clay loam, clay	CL	A–7
	42–60	Gravelly loam	GC, GM–GC	A–4, A–6
Balman:				
104	0–24	Loam	CL, ML, CL–ML	A–4, A–6
	24–60	Loam, fine sandy loam, sandy loam	CL–ML, ML	A–4
105	0–24	Loam	CL–ML, ML	A–4
	24–40	Fine sandy loam, loam, clay loam	CL, ML, CL–ML	A–4, A–6
	40–60	Stratified sandy loam to clay	SM–SC, SC, CL, CL–ML	A–2, A–4, A–6
Barnard:				
106	0–7	Gravelly loam	GM, SM	A–4
	7–36	Cobbly clay loam, clay, silty clay	CL, CH	A–7
	36	Indurated.		
107	0–7	Cobbly loam	GM, SM	A–4
	7–36	Cobbly clay loam, clay, silty clay	CL, CH	A–7
	36	Indurated.		
108	0–5	Clay loam	CL, CL–ML	A–4, A–6, A–7
	5–33	Silty clay loam, silty clay, clay	CL, CH	A–7
	33	Indurated.		
Bieber:				
109, 110	0–6	Gravelly loam	SM–SC, GM–GC	A–4
	6–18	Clay, clay loam	CH	A–7
	18	Indurated.		
111	0–4	Cobbly loam	CL–ML	A–4
	4–16	Clay, clay loam	CH	A–7
	16	Indurated.		
Buntingville: 112, 113	0–7	Clay loam	CL, CH	A–7
	7–60	Clay loam	CL, CH	A–7
Calimus:				
114, 115	0–9	Loam	ML, SM	A–2, A–4
	9–37	Loam, clay loam, sandy clay loam	CL	A–6
	37–60	Very gravelly loamy sand to gravelly clay loam.	GM–GC	A–4, A–2
116	0–9	Gravelly loam	GM–GC, SM–SC, SM, GM	A–4
	9–37	Loam, clay loam, sandy clay loam	CL	A–6
	37–60	Stratified very gravelly loamy sand to gravelly clay loam.	GM–GC	A–4, A–2
117	0–20	Clay loam	CL	A–6
	20–37	Loam, clay loam, sandy clay loam	CL	A–6
	37–60	Stratified very gravelly loamy sand to gravelly clay loam.	GM–GC	A–4, A–2
Casuse: 118, Casuse part of 193	0–2	Sandy loam	SM	A–2, A–4
	2–12	Clay loam, sandy clay loam	ML, CL	A–6, A–7
	12	Unweathered bedrock		

and classifications

nonplastic. Absence of an entry means data were not estimated]

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	95–100	90–95	90–115	50–70
0	95–100	95–100	85–100	60–80	25–40	10–20
25–40	100	100	95–100	90–95	90–115	50–70
0	95–100	95–100	85–100	60–80	25–40	10–20
0	100	100	85–95	60–70	25–30	5–15
0	100	100	90–100	70–80	40–50	15–25
0	65–75	65–75	55–65	40–50	20–30	5–15
0	100	100	75–100	50–75	15–40	NP–20
0	100	100	75–90	50–75	15–30	NP–10
0	100	100	75–100	50–75	15–30	NP–10
0	100	100	75–90	50–75	15–40	NP–20
0	100	90–100	60–100	30–70	20–30	5–15
0–5	55–80	55–75	50–65	40–50	20–35	NP–10
10–35	90–100	85–95	80–90	75–85	45–65	20–45
25–40	60–80	55–75	50–65	40–50	20–35	NP–10
10–35	90–100	85–95	80–90	75–85	45–65	20–45
0	95–100	90–100	80–100	65–80	25–45	5–20
0	95–100	90–100	85–100	80–95	20–25	20–30
0	65–75	50–60	40–50	35–45	40–55	5–10
0	100	95–100	80–95	65–90	50–70	25–40
25–35	100	100	85–95	60–75	20–25	5–10
0	100	95–100	80–95	65–90	50–70	25–40
0	100	95–100	90–100	65–80	40–55	15–30
0	100	100	95–100	75–80	40–55	15–30
0	95–100	80–100	55–95	30–75	25–35	NP–10
0	95–100	85–100	75–95	60–80	30–40	10–20
0	40–55	35–55	15–50	10–40	20–30	5–10
0	65–80	65–75	55–65	40–50	25–35	5–10
0	95–100	85–100	75–95	60–80	30–40	10–20
0	40–55	35–55	15–50	10–40	20–30	5–10
0	100	100	90–100	70–80	30–40	10–20
0	95–100	85–100	75–95	60–80	30–40	10–20
0	40–55	35–55	15–50	10–40	20–30	5–10
0	100	95–100	60–80	30–50	25–35	NP–10
0	100	95–100	80–90	50–60	35–45	10–20

TABLE 10.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Casuse part of 194	0–2	Cobbly sandy loam	SM	A–2, A–4
	2–12	Clay loam, sandy clay loam	ML, CL	A–6, A–7
	12	Unweathered bedrock.		
Daphnedale:				
119	0–12	Loam	CL, CL–ML	A–4, A–6
	12–25	Clay loam, clay	CL	A–6, A–7
	25–35	Clay loam, loam	ML, CL–ML	A–4, A–6, A–7
	35	Weathered bedrock.		
120	0–12	Cobbly loam	CL–ML, CL, SM–SC, SC	A–4, A–6
	12–25	Clay loam, clay	CL	A–6, A–7
	25–35	Clay loam, loam	ML, CL–ML	A–4, A–6, A–7
	35	Weathered bedrock.		
121	0–12	Stony loam	CL–ML, CL, SM–SC, SC	A–4, A–6
	12–25	Clay loam, clay	CL	A–6, A–7
	25–35	Clay loam, loam	ML, CL–ML	A–4, A–6, A–7
	35	Weathered bedrock.		
122[1]	0–12	Stony loam	CL–ML, CL, SM–SC, SC	A–4, A–6
For Delma part, see 126 in Delma series.	12–25	Clay loam, clay	CL	A–6, A–7
	25–35	Clay loam, loam	ML, CL–ML	A–4, A–6, A–7
	35	Weathered bedrock.		
Daphnedale variant:				
123, 124	0–11	Very cobbly loam	CL, ML	A–4, A–6
	11–60	Clay loam, clay	CL, CH	A–6, A–7
125	0–11	Clay loam	CL, ML	A–6, A–7
	11–60	Clay loam, clay	CL, CH	A–6, A–7
Delma:				
126, 127	0–9	Loam	CL–ML, CL	A–4, A–6
	9–14	Clay	CH	A–7
	14	Weathered bedrock.		
128, 129	0–13	Cobbly loam	CL–ML, CL	A–4, A–6
	13–18	Clay	CH	A–7
	18	Weathered bedrock.		
Deven:				
130	0–2	Clay loam	ML, CL	A–6
	2–16	Clay loam, clay	CL, CH	A–7
	16	Unweathered bedrock.		
131	0–2	Very stony clay loam	CL	A–6
	2–16	Clay, clay loam	CL, CH	A–6, A–7
	16	Unweathered bedrock.		
132	0–2	Very stony clay loam	CL	A–6
No estimates for Rock outcrop part.	2–16	Clay, clay loam	CL, CH	A–6, A–7
	16	Unweathered bedrock.		
Ditchcamp	0–9	Loam	ML, CL–ML	A–4
	9–31	Clay loam, clay, cobbly clay	CL, CH	A–6, A–7
	31–36	Indurated.		
	36	Unweathered bedrock.		
Donica: 133	0–14	Gravelly clay loam	GC	A–2, A–6
	14–33	Gravelly coarse sandy loam	GM	A–1
	33–60	Gravelly coarse sand, very gravelly coarse sand.	GP	A–1

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
20–40 0–10	100 100	95–100 95–100	60–80 80–90	30–50 50–60	20–35 35–45	NP–10 10–20
0–10 0–5 0–5	95–100 95–100 95–100	90–100 95–100 95–100	75–90 90–100 85–100	55–70 70–95 60–80	20–30 35–50 25–45	5–15 15–25 5–15
25–50	95–100	90–100	55–95	35–75	20–35	5–15
0–5 0–5	95–100 95–100	95–100 95–100	90–100 85–100	70–95 60–80	35–50 25–45	15–25 5–15
25–50	95–100	90–100	55–95	35–75	20–35	5–15
0–5 0–5	95–100 95–100	95–100 95–100	90–100 85–100	70–95 60–80	35–50 25–45	15–25 5–15
25–50	95–100	90–100	55–95	35–75	20–35	5–15
0–5 0–5	95–100 95–100	95–100 95–100	90–100 85–100	70–95 60–80	35–50 25–45	15–25 5–15
50–60 0–15	90–100 95–100	90–100 95–100	85–95 90–100	60–75 70–95	30–40 35–55	5–20 15–35
0–15 0–15	90–100 95–100	90–100 95–100	90–100 90–100	70–80 70–95	35–50 35–55	10–25 15–35
0 0	95–100 100	95–100 100	85–95 90–100	65–75 70–80	25–35 50–60	5–15 25–40
25–35 0	100 100	95–100 100	85–95 90–100	65–75 70–80	25–35 50–60	5–15 25–40
0 0–5	95–100 90–100	90–100 90–100	70–100 80–100	70–85 75–95	35–40 40–60	10–15 15–35
25–50 0	90–100 90–100	90–100 80–90	70–100 70–80	60–85 65–75	30–40 35–60	10–20 20–30
25–50 0	90–100 90–100	90–100 80–90	70–100 70–80	60–85 65–75	30–40 35–60	10–20 20–30
0–5 0–30	85–100 80–100	80–100 75–100	65–95 70–100	50–75 55–95	15–35 35–55	NP–10 15–30
0–5 5–10 5–10	55–65 30–45 30–40	50–60 25–40 25–35	40–50 5–15 15–20	30–45 10–20 0–5	30–40 ---------------- ----------------	10–15 NP NP

TABLE 10.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Drews:				
134	0–11	Loam	ML	A–4
	11–67	Clay loam, gravelly clay loam	GM, MH	A–7
135, 136	0–11	Gravelly loam	GM	A–4, A–2
	11–67	Clay loam, gravelly clay loam	GM, MH	A–7
137, 138	0–11	Clay loam	CL	A–6
	11–67	Clay loam, gravelly clay loam	GM, MH	A–7
Exel	0–11	Loam	CL–ML, CL	A–4, A–6
	11–35	Cobbly clay loam, cobbly sandy clay loam	SC, GC	A–2, A–6
	35	Indurated.		
Fluvaquents: 139	0–60	Variable		
Gleason:				
140	0–4	Loam	CL–ML, SM–SC	A–4
	4–22	Sandy loam	SM	A–2, A–4
	22–35	Gravelly sandy loam, gravelly loamy coarse sand.	SM	A–1, A–2
	35–50	Very gravelly coarse sand	SP	A–1
	50	Unweathered bedrock.		
141	0–4	Gravelly loam	SM–SC, GM–GC	A–2, A–4
	4–22	Sandy loam	SM	A–2, A–4
	22–35	Gravelly sandy loam, gravelly loamy coarse sand.	SM	A–1, A–2
	35–50	Very gravelly coarse sand	SP	A–1
	50	Unweathered bedrock.		
Goose Lake: 142	0–21	Silt loam	OL, MH, OH	A–5, A–7
	21–39	Silty clay, silty clay loam	CH	A–7
	39–67	Sandy clay loam, clay loam, loam	SC, CL, CL–ML, SM–SC	A–4, A–6
Gravel pits: 143 No estimates.				
Jenny:				
144	0–8	Silty clay loam	CL	A–6, A–7
	8–62	Clay, silty clay loam, silty clay	CH, CL	A–7
145	0–30	Silty clay	CH, CL	A–7
	16–60	Clay, silty clay loam, silty clay	CH, CL	A–7
Karcal:				
146	0–6	Very cobbly clay	GC, CL	A–7
	6–21	Clay, silty clay	CL, CH	A–7
	21	Unweathered bedrock.		
147[1]	0–6	Cobbly clay	GC, CL	A–7
	6–21	Clay, silty clay	CL, CH	A–7
	21	Unweathered bedrock.		
For Ninekar part, see Ninekar series.				
Kinkel: 148, 149	0–8	Loam	CL, CL–ML	A–4, A–6
	8–60	Very cobbly clay loam, cobbly clay loam	CL	A–6
Ladd: 150, 151	0–12	Sandy loam	SM–SC	A–4, A–2
	12–40	Clay loam, loam	CL	A–6
	40–60	Sandy loam, loam	SM, ML	A–4, A–2
Lakeview:				
152	0–31	Loam	CL–ML, ML	A–4
	31–60	Sandy clay loam, loam	SC, CL	A–6
153	0–31	Clay loam	CL, ML	A–6, A–7
	31–60	Sandy clay loam, loam	SC, CL	A–6

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	75–95	75–90	65–85	50–70		NP
0	55–95	50–90	45–90	35–70	50–55	20–25
0	55–95	50–75	40–65	30–55		NP
0	55–95	50–90	45–90	35–70	50–55	20–25
0	100	95–100	90–100	70–80	25–35	10–20
0	55–95	50–90	45–90	35–70	50–55	20–25
0	100	95–100	85–95	60–75	20–30	5–15
25–35	55–80	50–75	40–70	20–50	25–35	10–20
0	95–100	95–100	80–90	40–60	20–30	5–10
0	90–100	90–100	60–70	30–40		NP
0	75–85	60–75	30–50	15–35		NP
0	60–70	15–35	10–25	0–5		NP
0	65–80	50–75	40–70	30–45	20–30	5–10
0	90–100	90–100	60–70	30–40		NP
0	75–85	60–75	30–50	15–35		NP
0	60–70	15–35	10–25	0–5		NP
0	100	100	90–100	70–95	40–100	NP–30
0	100	100	95–100	85–95	60–95	30–65
0	100	100	80–100	35–75	20–35	5–20
0	100	100	95–100	85–95	30–50	15–25
0	100	100	95–100	80–95	40–60	20–30
0	100	100	95–100	80–95	40–60	20–30
0	100	100	95–100	80–95	40–60	20–30
50–75	65–70	60–70	50–55	45–55	45–50	20–25
0–25	75–90	75–85	65–70	50–60	45–55	20–30
25–50	65–70	60–70	50–55	45–55	45–50	20–25
0–25	75–90	75–85	65–70	50–60	45–55	20–30
0–5	90–100	85–95	75–95	55–75	20–30	5–15
50–65	90–100	90–100	90–100	70–80	30–40	10–20
0	90–100	90–100	60–70	30–40	20–25	5–10
0	75–100	75–100	70–100	50–80	25–40	10–15
0	90–100	90–95	60–700	30–60		NP
0	95–100	95–100	85–95	60–75	25–35	5–10
0	100	100	80–90	35–55	30–40	10–15
0–20	100	95–100	90–100	70–80	35–45	10–20
0	100	100	80–90	35–55	30–40	10–15

TABLE 10.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Lithic Xerorthents	0–8	Variable		
	8	Unweathered bedrock.		
Lolak: 154	0–15	Silty clay loam	CH, MH	A–7
	15–44	Stratified silt loam to clay	CH, MH	A–7
	44–60	Sand, gravelly sand	SP	A–1
Lorella:				
155, 156, 157	0–2	Loam	ML, CL–ML, SM, SM–SC	A–4
	2–10	Gravelly clay loam, cobbly clay loam	CL, GC	A–6
	10–19	Very gravelly clay, cobbly clay	CL, GC	A–6, A–7, A–2
	19	Unweathered bedrock.		
158, 159	0–2	Cobbly clay loam	CL	A–6
	2–10	Gravelly clay loam, cobbly clay loam	CL, GC	A–6
	10–19	Very gravelly clay, cobbly clay	CL, GC	A–6, A–7, A–2
	19	Unweathered bedrock.		
160	0–1	Cobbly clay loam	ML, CL–ML, SM, SM–SC	A–4
	1–10	Gravelly clay loam, cobbly clay loam	CL, GC	A–6
	10–19	Very gravelly clay, cobbly clay	CL, GC	A–6, A–7, A–2
	19	Unweathered bedrock.		
Lorella variant: 161	0–10	Very stony loam	CL–ML, CL	A–4, A–6
No estimates for Rubble land part.	10–40	Very cobbly clay loam, very stony clay	CL, ML	A–6, A–7
	40	Unweathered bedrock.		
For Deven part, see 131 in Deven series.				
Lovejoy:				
162	0–8	Silt loam	ML	A–4
	8–21	Clay, clay loam, sandy clay loam	CL, CH	A–7
	21	Indurated.		
163[1]	0–5	Silt loam	ML	A–4
	5–21	Clay, clay loam, sandy clay loam	CL, CH	A–7
	21	Indurated.		
Lyonman: 164, 165	0–11	Loam	ML, SM	A–4
	11–44	Cobbly clay loam, clay loam	ML, CL	A–6, A–7
	44	Unweathered bedrock.		
McQuarrie:				
166	0–3	Sandy loam	SM, ML, CL–ML, SM–SC	A–2, A–4
	3–13	Loam, clay loam	CL–ML, CL	A–4, A–6
	13	Unweathered bedrock.		
167	0–3	Stony loam	CL–ML	A–4
	3–13	Clay loam, loam	CL, CL–ML	A–4, A–6
	13	Unweathered bedrock.		
Modoc:				
168	0–12	Sandy loam	SM, SM–SC	A–2, A–4
	12–30	Sandy clay loam, clay loam, gravelly sandy clay loam.	SM–SC, SC, CL–ML, CL	A–6, A–7, A–4
	30	Indurated.		
169	0–7	Gravelly loam	ML, CL–ML	A–4
	7–30	Sandy clay loam, clay loam, gravelly sandy clay loam.	SM–SC, SC, CL–ML, CL	A–6, A–7, A–4
	30	Indurated.		
Ninekar: 170	0–3	Very stony silt loam	ML, CL–ML, CL	A–4, A–6
	3–28	Clay, clay loam, silty clay loam	CL, CH	A–6, A–7
	28	Unweathered bedrock.		

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	95–100	85–95	50–65	20–35
0	100	100	90–100	80–95	50–65	20–35
0	100	60–100	30–50	0–5		NP
0–10	75–95	70–90	60–85	40–70	25–35	5–10
5–40	55–90	50–90	45–90	35–70	25–35	10–20
15–50	35–95	30–90	25–85	20–85	35–50	15–25
20–35	75–95	65–90	60–90	50–70	25–40	10–20
5–40	55–90	50–90	45–90	35–70	25–35	10–20
15–50	35–95	30–90	25–85	20–85	35–50	15–25
15–25	75–95	70–90	60–85	40–70	25–35	5–10
5–40	55–90	50–90	45–90	35–70	25–35	10–20
15–50	35–95	30–90	25–85	20–85	35–50	15–25
50–60	95–100	95–100	85–95	60–75	20–30	5–15
50–65	95–100	95–100	90–100	70–80	35–50	10–25
0–5	95–100	80–95	55–65	50–60	10–15	NP–5
0–5	95–100	90–100	80–95	75–90	45–60	20–40
0–5	95–100	80–95	55–65	50–60	10–15	NP–5
0–5	95–100	90–100	80–95	75–90	45–60	20–40
0–5	95–100	85–100	60–85	40–60	25–40	NP–10
10–40	70–100	65–100	60–90	50–75	35–45	10–20
0–5	90–100	75–95	55–85	30–70	10–25	NP–10
0–5	95–100	90–100	85–95	60–80	20–35	5–15
25–50	90–100	75–95	65–85	50–70	20–30	5–10
0–5	85–95	80–90	65–80	50–65	20–35	5–15
0	80–100	75–100	50–85	30–50	10–25	NP–10
0	70–100	65–100	55–100	35–80	25–45	5–20
0–5	80–100	70–80	65–75	50–70	15–35	NP–10
0	70–100	65–100	55–100	35–80	25–45	5–20
40–85	75–100	75–100	70–100	50–95	20–35	NP–15
3–10	85–100	75–100	65–100	55–95	35–65	15–35

TABLE 10.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Packwood: 171,[1] 172[1]	0–5	Extremely stony loam	CL–ML, CL, SM–SC, SC	A–4, A–6
For Ditchcamp part, see Ditchcamp series. No estimates for Rock outcrop in 172 For Puls part of 171, see Puls series.	5–8	Clay loam, loam	CL	A–6
	8–22	Indurated.		
	22	Unweathered bedrock.		
Pasquetti: 173, 174	0–10	Silty clay loam	CL, CL–ML	A–4, A–6, A–7
	10–60	Stratified sandy loam to silty clay loam	CL	A–7, A–6
Pineal: 175	0–9	Silt loam	ML	A–4, A–6
	9–16	Clay loam, silty clay loam, clay	CL	A–7
	16–30	Cemented.		
	30–60	Clay loam	ML, CL	A–7
Pit:				
176	0–24	Silty clay loam	CH, MH	A–7
	24–60	Silt loam, silty clay loam, clay loam	ML, MH, CL	A–6, A–7
177, 178	0–24	Clay	CH, MH	A–7
	24–60	Silt loam, silty clay loam, clay loam	ML, MH, CL	A–6, A–7
Puls: 179, 180,[1] 181	0–5	Extremely stony clay loam	ML, CL	A–6, A–7
For Ninekar part of 180, see Ninekar series. No estimates for Rock outcrop part of 181	5–19	Clay, clay loam	CH, CL	A–7
	19–28	Indurated.		
	28	Unweathered bedrock.		
Reba:				
182	0–15	Loam	CL	A–6
	15–47	Clay, clay loam, silty clay	CL, CH	A–7
	47–50	Indurated.		
	50–60	Clay loam, loam, sandy loam	SC, CL, SM–SC, CL–ML	A–4, A–6, A–7
Reba part of 163	0–10	Loam	CL	A–6
	10–47	Clay, clay loam, silty clay	CL, CH	A–7
	10–47	Indurated.		
	47–50	Sandy loam, clay loam, loam	SC, SM–SC, CL, CL–ML	A–2, A–4, A–6, A–7
Rock outcrop: 183[1]				
No estimates for Rock outcrop part. For Lithic Xerorthents part, see that series.				
Rubble land: 184				
No estimates.				
Rumbo: 185, 186	0–6	Loam	CL–ML, ML	A–4
	6–40	Clay loam, silty clay loam, clay	CL	A–7
	40–60	Stratified loamy sand to very gravelly clay loam.	SM, GM	A–1, A–2
Salisbury:				
187	0–10	Very fine sandy loam	CL–ML	A–4
	10–27	Clay, gravelly clay	CL, CH, GC	A–7
	27	Indurated.		
188	0–10	Gravelly loam	CL–ML, CL, SC, SM–SC	A–6, A–4
	10–23	Clay, gravelly clay	CL, CH, GC	A–7
	23	Indurated.		
189	0–10	Very cobbly loam	CL, ML	A–6
	10–23	Clay, gravelly clay	CL, CH, GC	A–7
	23	Indurated.		

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
50–70	90–100	85–100	80–90	40–75	25–40	5–20
0	90–100	85–100	85–95	70–80	30–40	10–20
0	100	100	90–100	70–95	20–45	5–20
0	100	100	80–100	50–95	25–45	10–20
0	100	100	85–100	50–90	30–40	5–15
0	100	100	90–100	70–80	40–50	20–30
0	100	100	90–100	70–80	40–50	10–25
0	100	100	95–100	85–95	50–70	20–40
0	100	100	95–100	85–95	25–55	10–20
0	100	100	95–100	85–95	50–70	20–40
0	100	100	95–100	85–95	25–55	10–20
45–70	95–100	90–100	85–100	65–80	35–45	10–20
0–15	90–100	85–100	80–100	70–95	45–85	30–55
0–5	95–100	85–95	80–85	60–70	25–30	10–15
0–5	100	95–100	75–100	60–95	45–55	20–30
0	100	100	70–100	45–70	25–45	5–20
0–5	95–100	85–95	80–85	60–70	25–30	10–15
0–5	100	95–100	75–100	60–95	45–55	20–30
0–5	95–100	95–100	70–100	45–70	25–45	5–20
0	100	100	70–95	50–75	20–35	5–10
0	100	100	70–100	70–95	40–50	20–30
0	40–80	35–80	25–40	15–30	----------	NP
0–10	90–100	85–100	75–95	50–65	20–30	5–10
0–10	65–95	55–90	50–90	40–85	40–60	20–35
0–15	65–75	60–75	55–70	45–60	20–40	5–20
0–10	65–95	55–90	50–90	40–85	40–60	20–35
40–60	90–100	85–100	75–100	60–80	35–40	10–20
0–10	65–95	55–90	50–90	40–85	40–60	20–35

TABLE 10.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
190	0–10	Clay loam	CL, ML	A–6
	10–23	Clay, gravelly clay	CL, CH, GC	A–7
	23	Indurated.		
Tandy: 191	0–30	Loamy fine sand	SM, ML	A–2, A–4
	30–61	Silt loam, clay loam	ML, MH	A–4, A–5, A–6, A–7
	61–69	Loamy sand, loamy fine sand	SM	A–2, A–4
Thoms: 192[1]	0–6	Very cobbly loam	ML	A–4
For Exel part, see Exel series.	6–13	Loam, clay loam	CL	A–6
	13–42	Indurated.		
Tuff outcrop: 193,[1] 194[1]				
No estimates for Tuff outcrop part. For Casuse part, see Casuse series.				
Tulana:				
195	0–13	Mucky loam	OH	A–5
	13–60	Silt loam, silty clay loam	MH, OH	A–5
196	0–13	Mucky loam	OH	A–5
	13–60	Silt loam, silty clay loam	MH, OH	A–5
Typic Xerorthents:				
197	0–60	Variable.		
Woodcock: 198, 199	0–6	Stony loam	GM	A–1, A–2
	6–46	Very gravelly clay loam, very cobbly clay loam, very cobbly sandy clay loam.	GM	A–1, A–2
	46	Unweathered bedrock.		
Xerofluvents: 200	0–60	Variable.		

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

and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a typical profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in the section "Descriptions of the Soils."

Texture is described in table 10 in standard terms used by the United States Department of Agriculture (*18*). These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System unified (*4*) and the system used by the American Association of State Highway and Transportation Officials (AASHTO) (*2*). In table 10 soils in the survey area are classified according to both systems.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL–ML.

and classifications—Continued

Fragments > 3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–10	90–100	85–100	75–100	60–80	35–40	10–20
0–10	65–95	55–90	50–90	40–85	40–60	20–35
0	80–100	75–100	50–85	20–55	----------	NP
0	100	100	90–100	70–80	30–60	5–20
0	100	100	50–85	20–50	----------	NP
60–70	100	100	85–95	60–75	25–40	NP–10
0–5	95–100	90–100	90–100	70–80	30–40	10–20
0	100	100	95–100	80–100	100–120	NP–10
0	100	100	95–100	80–100	50–60	NP–10
0	100	100	95–100	80–100	100–120	NP–10
0	100	100	95–100	80–100	50–60	NP–10
25–50	25–60	20–60	15–50	10–35	----------	NP
70–85	25–60	20–60	15–50	10–35	----------	NP

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A–1 are coarse grained and low in content of fines. At the other extreme, in group A–7, are fine-grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection.

When laboratory data are available, the A–1, A–2, and A–7 groups are further classified as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 13. The estimated classification, without group index numbers, is given in table 10.

Also in table 10 the percentage, by weight, of cobbles or rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil. These indexes are used in both the USCS and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index is estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

All estimates in table 10 have been rounded to the nearest 5 percent. Thus the classification in the marginal zone has been omitted for ranges of gradation and Atterberg limits that extend 1 or 2 percentage points across classification boundaries.

Physical and Chemical Properties

Table 11 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25°C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is largely affected by the quality of the irrigation water and the irrigation practices. Hence, the salinity of individual fields can differ greatly from the value given in table 11. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table 11, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Soil and Water Features

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

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

Group D. Soils having a very slow infiltration rate

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

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding; and on information that relates the position of each soil on the landscape to historic floods.

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

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

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

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

Cemented pans are hard subsurface layers, within a depth of 5 or 6 feet, that are strongly compacted (indurated). Such pans cause difficulty in excavation. The hardness of pans is similar to that of bedrock. A rippable pan can be excavated, but a hard pan generally requires blasting.

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

Engineering Test Data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 13.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Descriptions of the Soils." The soil samples were analyzed by the California Division of Highways in accordance with procedures given in California Materials Manual for Testing and Control Procedures (*6*).

Formation and Morphology of the Soils

This section discusses the major factors of soil formation as they relate to the soils in the Alturas Area. It also describes the morphology of the soils and some of the soil-forming processes that occur.

Factors of Soil Formation

The properties of a soil depend on the interaction of five soil-forming factors: relief, parent material, climate, biological activity, and time. All five factors influence soil formation, but the relative importance of each factor varies from soil to soil. The many different soils in an area are the products of unique combinations of these soil-forming factors.

Relief

Relief, or the shape of the landscape, influences formation of soils through its effect on drainage, erosion, plant cover, and soil temperature. Soils in depressional areas or along the borders of the Pit River have increased amounts of water and are somewhat poorly drained. The higher areas within the valley lack this additional water and are better drained. The upland areas are either flat plateaus or mountainous uplands. The flat plateaus have less runoff than the mountainous areas and are less easily eroded. North-facing slopes receive less radiant energy from

TABLE 11.—*Physical and chemical*

[The symbol < means less than; > means more than. The erosion tolerance factor (T) is for

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Ager:				
100	0–39	0.06–0.2	0.17–0.19	7.4–8.4
	39–53	0.6–2.0	0.15–0.19	7.4–8.4
	53			
101, 102	0–39	0.06–0.2	0.16–0.18	7.4–8.4
	39–53	0.6–2.0	0.15–0.19	7.4–8.4
	53			
Alturas: 103	0–17	0.6–2.0	0.14–0.16	7.9–8.4
	17–42	0.06–0.2	0.16–0.18	7.9–9.0
	42–60	0.2–0.6	0.14–0.16	7.9–8.4
Balman:				
104	0–24	0.2–0.6	0.13–0.17	>7.8
	24–60	0.6–2.0	0.10–0.14	>7.8
105	0–24	0.2–0.6	0.13–0.17	>7.8
	24–40	0.6–2.0	0.13–0.15	>7.8
	40–60	0.06–0.2	0.08–0.17	6.6–8.4
Barnard:				
106	0–7	0.6–2.0	0.10–0.13	6.1–7.3
	7–36	0.06–0.2	0.10–0.14	6.6–7.8
	36			
107	0–7	0.6–2.0	0.06–0.09	6.1–7.3
	7–36	0.06–0.2	0.10–0.14	6.6–7.8
	36			
108	0–5	0.6–2.0	0.19–0.22	6.1–7.3
	5–33	0.06–0.2	0.15–0.17	6.6–7.8
	33			
Bieber:				
109, 110	0–6	0.6–2.0	0.09–0.11	6.1–7.3
	6–18	0.06–0.2	0.16–0.18	6.1–8.4
	18			
111	0–4	0.6–2.0	0.09–0.11	6.1–7.3
	4–16	0.06–0.2	0.16–0.18	6.1–8.4
	16			
Buntingville: 112, 113	0–7	0.2–0.6	0.17–0.19	6.1–7.8
	7–60	0.2–0.6	0.17–0.19	6.1–7.8
Calimus:				
114, 115	0–9	0.6–2.0	0.14–0.22	6.1–7.3
	9–37	0.6–2.0	0.16–0.18	6.1–7.8
	37–60	0.6–2.0	0.07–0.09	6.1–7.8
116	0–22	0.6–2.0	0.13–0.15	6.1–7.3
	22–37	0.6–2.0	0.16–0.18	6.1–7.8
	37–60	0.6–2.0	0.07–0.09	6.1–7.8
117	0–20	0.6–2.0	0.16–0.18	6.1–7.3
	20–37	0.6–2.0	0.16–0.18	6.1–7.8
	37–60	0.6–2.0	0.07–0.09	6.1–7.8
Casuse: 118	0–2	2.0–6.0	0.10–0.19	5.6–6.5
	2–12	0.6–2.0	0.16–0.17	6.1–7.3
	12			
Daphnedale:				
119	0–12	0.2–0.6	0.13–0.16	6.6–7.8
	12–25	0.06–0.2	0.15–0.18	6.6–7.8
	25–35	0.06–0.02	0.13–0.18	7.4–8.4

properties of soils

the entire profile. Absence of an entry means data were not available or were not estimated]

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	High	High	Low	0.24	3
<2	Moderate	High	Low	0.32	
<2	High	High	Low	0.20	3
<2	Moderate	High	Low	0.32	
2–8	Low	High	Low	0.43	5
<4	High	High	Low	0.32	
<2	Low	High	Low	0.37	
>2	Low	High	High	0.32	5
<2	Low	High	Moderate	0.32	
>4	Low	High	High	0.32	5
>4	Low	High	High	0.37	
<4	Low	High	Moderate	0.28	
<2	Low	Moderate	Low	0.37	2
<2	High	High	Low	0.28	
<2	Low	Moderate	Low	0.32	2
<2	High	High	Low	0.28	
<2	Low	Moderate	Low	0.32	2
<2	High	High	Low	0.32	
<2	Low	Moderate	Low	0.24	1
<2	High	High	Low	0.24	
<2	Low	Moderate	Low	0.17	1
<2	High	High	Low	0.24	
<2	Moderate	High	Low	0.28	5
<2	Moderate	High	Low	0.28	
<2	Low	Moderate	Low	0.24	4
<2	Moderate	High	Low	0.24	
<2	Low	Moderate	Low	0.17	
<2	Low	Moderate	Low	0.24	4
<2	Moderate	High	Low	0.24	
<2	Low	Moderate	Low	0.17	
<2	Moderate	High	Low	0.28	4
<2	Moderate	High	Low	0.24	
<2	Low	Moderate	Low	0.17	
<2	Low	Moderate	Moderate	0.24	1
<2	Moderate	Moderate	Low	0.32	
<2	Moderate	Moderate	Low	0.24	2
<2	High	High	Low	0.28	
<2	Moderate	High	Low	0.24	

TABLE 11.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
120, 121, 122 [1]	0–12	0.2–0.6	0.12–0.14	6 6–7.8
For Delma part of 122, see 126, 127 in Delma series.	12–25	0.06–0.2	0.15–0.18	6.6–7.8
	25–35	0.06–0.02	0.13–0.16	7.4–8.4
	35			
Daphnedale variant:				
123, 124	0–11	0.2–0.6	0.08–0.10	6.1–7.3
	11–60	0.06–0.2	0.16–0.19	6.1–7.3
125	0–11	0.06–0.2	0.17–0.19	6.1–7.3
	11–60	0.06–0.2	0.16–0.19	6.1–7.3
Delma:				
126, 127	0–9	0.6–2.0	0.14–0.16	5.6–7.3
	9–14	0.2–0.6	0.17–0.18	6.1–7.3
	14			
128, 129	0–13	0.6–2.0	0.13–0.15	5.6–7.3
	13–18	0.2–0.6	0.17–0.18	6.1–7.3
	18			
Deven:				
130	0–2	0.06–0.2	0.16–0.20	6.1–7.3
	2–16	0.06–0.2	0.18–0.21	6.1–7.3
	16			
131, 132	0–2	0.06–0.2	0.14–0.19	6.1–7.3
No estimates for Rock outcrop part of 132	2–16	0.06–0.2	0.14–0.16	7.4–7.8
	16			
Ditchcamp	0–9	0.6–2.0	0.11–0.15	6.1–7.3
	9–20	0.06–0.2	0.14–0.18	6.1–7.3
	20–31	0.06–0.2	0.10–0.20	6.1–7.3
	31–36			
	36			
Donica: 133	0–14	0.6–2.0	0.12–0.14	6.1–7.3
	14–30	2.0–6.0	0.05–0.09	6.1–7.3
	30–60	>6.0	0.04–0.06	6.1–7.3
Drews:				
134, 135, 136, 137	0–11	0.6–2.0	0.13–0.19	6.6–7.8
	11–33	0.2–0.6	0.15–0.22	6.6–7.8
	33–60	0.6–2.0	0.11–0.19	7.3–8.4
138	0–11	0.2–0.6	0.17–0.18	6.6–7.8
	11–33	0.2–0.6	0.16–0.18	7.4–8.4
	33–60	0.6–2.0	0.11–0.19	7.4–8.4
Exel	0–11	0.6–2.0	0.14–0.16	6.1–7.3
	11–30	0.06–0 2	0.15–0.17	6.1–7.3
Fluvaquents: 139	30–60			
Gleason:				
140	0–4	2.0–6.0	0.12–0.13	5.6–6.5
	4–22	2.0–6.0	0.08–0.10	5.6–6.5
	22–35	2.0–6.0	0.08–0.10	5.6–6.5
	35–50	6.0–20	0.03–0.04	5.6–6.5
	50			
141	0–4	2.0–6.0	0.11–0.12	5.6–6.5
	4–22	2.0–6.0	0.08–0.10	5.6–6.5
	22–35	2.0–6.0	0.08–0.10	5.6–6.5
	35–50	6.0–20	0.03–0.04	5.6–6.5
	50			

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Moderate	Moderate	Low	0.24	2
<2	High	High	Low	0.28	
<2	Moderate	High	Low	0.24	
<2	Moderate	Moderate	Low	0.24	5
<2	High	High	Low	0.32	
<2	Moderate	Moderate	Low	0.37	5
<2	High	High	Low	0.32	
<2	Moderate	Moderate	Low	0.24	1
<2	High	High	Low	0.24	
<2	Moderate	Moderate	Low	0.20	1
<2	High	High	Low	0.24	
<2	Moderate	Moderate	Low	0.28	1
<2	High	High	Low	0.28	
<2	Moderate	Moderate	Low	0.24	1
<2	High	High	Low	0.28	
<2	Low	Moderate			
<2	Moderate				
<2	High				
<2	Moderate	Moderate	Low	0.28	5
<2	Low	Moderate	Low	0.17	
<2	Low	Moderate	Low	0.10	
<2	Low	Moderate	Low	0.24	3
<2	Moderate	Moderate	Low	0.28	
<2	Low	High	Low	0.37	
<2	Moderate	Moderate	Low	0.28	5
<2	Moderate	High	Low	0.24	
<2	Low	High	Low	0.37	
<2	Low	Moderate	Low	0.32	2
<2	Moderate	Moderate	Low	0.32	
<2	Low	Moderate	Moderate	0.37	3
<2	Low	Moderate	Moderate	0.24	
<2	Low	Moderate	Moderate	0.24	
<2	Low	Moderate	Moderate	0.10	
<2	Low	Moderate	Moderate	0.32	3
<2	Low	Moderate	Moderate	0.24	
<2	Low	Moderate	Moderate	0.24	
<2	Low	Moderate	Moderate	0.10	

TABLE 11.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Goose Lake: 142	0–21	0.2–0.6	0.14–0.23	6.1–7.3
	21–39	0.06–0.2	0.16–0.20	6.6–8.4
	39–67	0.06–0.2	0.14–0.19	6.6–8.4
Gravel pits: 143. No estimates.				
Jenny:				
144	0–8	0.06–0.2	0.19–0.21	6.1–7.3
	8–60	0.06–0.2	0.16–0.18	7.3–8.4
145	0–16	0.06–0.2	0.14–0.17	6.1–7.3
	16–60	0.06–0.2	0.16–0.18	7.3–8.4
Karcal: 146, 147[1]	0–6	0.06–0.2	0.05–0.09	7.4–7.8
For Ninekar part of 147, see Ninekar series.	6–21	0.06–0.2	0.10–0.13	7.4–7.8
	21			
Kinkel: 148, 149	0–6	0.2–0.6	0.10–0.14	6.1–7.3
	6–60	0.2–0.6	0.10–0.14	5.6–6.5
Ladd: 150, 151	0–12	2.0–6.0	0.09–0.11	6.1–7.3
	12–40	0.2–0.6	0.19–0.21	6.1–7.3
	40–60	0.6–2.0	0.16–0.21	6.6–7.8
Lakeview:				
152	0–31	0.6–2.0	0.14–0.16	6.1–7.3
	31–60	0.2–0.6	0.15–0.18	6.1–7.3
153	0–31	0.6–2.0	0.17–0.18	6.1–7.3
	31–60	0.2–0.6	0.15–0.18	6.1–7.3
Lithic Xerorthents	0–8			
	8			
Lolak: 154	0–15	<0.06	0.16–0.17	>8.5
	15–60	<0.06	0.15–0.16	>8.5
Lorella:				
155, 156, 157, 160	0–2	0.6–2.0	0.15–0.19	6.1–7.8
	2–10	0.2–0.6	0.09–0.13	6.6–7.8
	10–15	0.06–0.2	0.05–0.13	6.6–7.8
	15			
158, 159	0–2	0.2–0.6	0.11–0.13	6.1–7.8
	2–10	0.2–0.6	0.09–0.13	6.6–7.8
	10–15	0.06–0.2	0.05–0.13	6.6–7.8
	15			
Lorella variant: 161	0–10	0.6–2.0	0.11–0.13	6.6–7.3
	10–40	0.06–0.2	0.13–0.15	6.1–7.3
	40			
No estimates for Rubble land part. For Deven part, see 130 in Deven series.				
Lovejoy:				
162	0–8	0.6–2.0	0.10–0.13	5.1–7.3
	8–21	<0.06	0.14–0.20	6.6–7.8
	21			
163[1]	0–8	0.6–2.0	0.10–0.13	6.1–7.3
	8–21	<0.06	0.14–0.20	6.6–7.9
	21			
For Reba part, see Reba series.	0–10	0.6–2.0	0.13–0.19	5.6–6.5
	10–47	0.06–0.2	0.14–0.20	6.6–7.8
	47–50			
	50–60	0.2–0.6		6.6–7.8

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Low	High	Low		
<2	High	High	Low		
<2	Moderate	High	Low		
<2	High	High	Low	0.37	5
<2	High	High	Low	0.32	
<2	High	High	Low	0.28	5
<2	High	High	Low	0.32	
<2	High	High	Low	0.28	2
<2	High	High	Low	0.28	
<2	Low	High	Moderate	0.28	1
<2	Low	Moderate	Moderate	0.28	
<2	Low	Moderate	Low	0.32	5
<2	Moderate	Moderate	Low	0.28	
<2	Moderate	Moderate	Low	0.32	
<2	Low	High	Low	0.24	5
<2	Moderate	High	Low	0.28	
<2	Moderate	High	Low	0.17	5
<2	Moderate	High	Low	0.28	
>8	High	High	High		
>8	High	High	High		
<2	Low	Moderate	Low	0.32	1
<2	Low	High	Low	0.37	
<2	High	High	Low	0.32	
<2	Low	High	Low	0.24	1
<2	Low	High	Low	0.37	
<2	High	High	Low	0.32	
<2	Low	Moderate	Low	0.32	2
<2	Moderate	High	Low	0.32	
<2	Low	Moderate	Low	0.37	1
<2	High	High	Low	0.24	
<2	Low	Moderate	Low	0.37	1
<2	High	High	Low	0.24	
<2	Moderate	Moderate	Low	0.20	4
<2	High	High	Low	0.17	
<2	Moderate	High	Low	0.20	

TABLE 11.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Lyonman: 164, 165	0–13	0.6–2.0	0.14–0.16	5.6–6.5
	13–48	0.2–0.6	0.13–0.18	5.6–6.5
	48			
McQuarrie:				
166	0–3	0.6–2.0	0.07–0.15	6.6–7.8
	3–13	0.6–2.0	0.16–0.18	6.6–7.8
	13			
167	0–3	0.6–2.0	0.07–0.14	6.6–7.8
	3–13	0.6–2.0	0.15–0.17	6.6–7.8
	13			
Modoc:				
168	0–12	0.6–2.0	0.10–0.12	6.1–7.3
	12–30	0.2–0.6	0.14–0.17	6.6–7.8
	30			
169	0–7	0.2–0.6	0.15–0.18	6.1–7.3
	7–30	0.2–0.6	0.14–0.17	6.6–7.8
	30			
Ninekar: 170	0–3	0.2–0.6	0.04–0.08	6.1–6.5
	3–28	<0.06	0.12–0.18	6.6–8.4
	28			
Packwood:				
171 [1]	0–5	0.6–2.0	0.13–0.15	6.1–7.3
	5–8	0.06–0.2	0.17–0.18	6.1–7.3
	8–22			
	22			
For Ditchcamp part, see Ditchcamp series. For Puls part, see Puls series.	0–9	0.6–2.0	0.11–0.15	6.1–7.3
	9–20	0.06–0.2	0.14–0.18	6.1–7.3
	20–31	0.06–0.2	0.10–0.20	6.1–7.3
	31–36			
	36			
172 [1]	0–5	0.6–2.0	0.13–0.15	6.1–7.3
	5–8	0.06–0.2	0.17–0.18	6.1–7.3
	8			
No estimates for Rock outcrop part. For Ditchcamp part, see Ditchcamp series.				
Pasquetti: 173, 174	0–10	0.06–0.2	0.14–0.20	6.6–8.4
	10–60	0.06–0.2	0.14–0.20	6.6–8.4
Pineal: 175	0–9	0.2–0.6	0.14–0.16	6.1–9.0
	9–16	0.06–0.2	0.17–0.18	>7.8
	16–30			
	30–60	0.06–0.2	0.17–0.18	>7.8
Pit: 176, 177, 178	0–24	0.06–0.2	0.17–0.19	6.6–7.8
	24–60	0.2–0.6	0.15–0.18	7.4–8.4
Puls: 179, 180,[1] 181	0–5	0.2–0.6	0.17–0.18	6.1–7.3
For Ninekar part of 180, see Ninekar series. No estimates for Rock outcrop part of 181	5–19	<0.06	0.16–0.18	6.1–7.3
	19–28			
	28			
Reba:				
182	0–15	0.6–2.0	0.13–0.19	5.6–6.5
	15–47	0.06–0.2	0.14–0.20	6.6–7.8
	47–50			7.4–8.4
	50–60	0.2–0.6		6.6–7.8

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Low	Moderate	Moderate	0.32	4
<2	Moderate	Moderate	Moderate	0.28	
<2	Low	High	Moderate	0.32	1
<2	Low	High	Moderate	0.37	
<2	Low	High	Moderate	0.20	1
<2	Low	High	Moderate	0.37	
<2	Low	Moderate	Moderate	0.32	2
<2	Moderate	Moderate	Low	0.28	
<2	Low	Moderate	Moderate	0.28	2
<2	Moderate	Moderate	Low	0.28	
<2	Low	Moderate	Low	0.32	1
<2	High	High	Low	0.28	
<2	Moderate	Moderate	Low	0.32	1
<2	Moderate	High	Low	0.28	
<2	Low	Moderate	Low	0.32	2
<2	Moderate	Moderate	Low	0.37	
<2	High	High	Low	0.32	
<2	Moderate	Moderate	Low	0.32	1
<2	Moderate	High	Low	0.28	
<2	Moderate	High	Low	0.37	5
<2	Moderate	High	Low	0.32	
2–4	Moderate	High	Low		
2–4	High	High	Low		
2–4	Moderate	High	Low		
<2	High	High	Low	0.20	5
<4	Moderate	High	Low	0.28	
<2	Moderate	Moderate	Low	0.28	1
<2	High	High	Moderate	0.32	
<2	Moderate	Moderate	Low	0.20	4
<2	High	High	Low	0.17	
<2	Moderate	High	Low	0.20	

TABLE 11.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Reba part of 163	0–10	0.6–2.0	0.13–0.19	5.6–6.5
	10–47	0.06–0.2	0.14–0.20	6.6–7.8
	47–50			
	50–60	0.2–0.6		6.6–7.8
Rock outcrop: 183 [1]				
No estimates for Rock outcrop part. For Lithic Xerorthents part, see Lithic Xerorthents.				
Rubble land: 184				
No estimates.				
Rumbo: 185, 186	0–6	0.6–2.0	0.12–0.16	6.1–7.8
	6–40	0.06–0.2	0.17–0.18	6.6–8.4
	40–60	0.06–0.2	0.03–0.08	7.9–8.4
Salisbury:				
187	0–10	0.6–2.0	0.09–0.11	6.6–7.8
	10–27	0.06–0.2	0.14–0.16	6.6–7.8
	27			
188	0–10	0.6–2.0	0.17–0.19	6.6–7.8
	10–23	0.06–0.2	0.14–0.16	6.6–7.8
	23			
189, 190	0–10	0.6–2.0	0.19–0.21	6.6–7.8
	20–23	0.06–0.2	0.14–0.16	6.6–7.8
	23			
Tandy: 191	0–30	2.0–6.0	0.09–0.17	7.9–9.0
	30–61	0.6–2.0	0.17–0.23	7.9–9.0
	61–69	2.0–6.0	0.09–0.17	7.9–9.0
Thoms: 192 [1]	0–6	0.6–2.0	0.14–0.16	6.1–7.3
	6–13	0.06–0.2	0.17–0.18	6.1–7.3
	13			
For Exel part, see Exel series.				
Tuff outcrop: 193, [1] 194 [1]				
No estimates for Tuff outcrop part. For Casuse part, see Casuse series.				
Tulana:				
195	0–13	0.6–2.0	0.40–0.55	6.1–7.3
	13–60	0.6–2.0	0.17–0.25	6.1–7.3
196	0–13	0.6–2.0	0.40–0.50	6.1–7.3
	13–60	0.6–2.0	0.17–0.25	6.1–7.3
Typic Xerorthents:				
197	0–60			
Woodcock: 198, 199	0–6	0.6–2.0	0.03–0.09	6.1–7.3
	6–46	0.6–2.0	0.01–0.06	6.1–7.3
	46			
Xerofluvents: 200	0–60			

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

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Moderate	Moderate	Low	0.20	
<2	High	High	Low	0.17	
<2	Moderate	High	Low	0.20	
<4	Low	High	Low	0.37	5
>4	High	High	Low	0.43	
>4	Low	High	Low	0.10	
<2	Low	Moderate	Low	0.32	2
<2	High	High	Low	0.28	
<2	Moderate	High	Low	0.20	2
<2	High	High	Low	0.28	
<2	Moderate	High	Low	0.24	2
<2	High	High	Low	0.28	
<4	Low	High	Low	0.32	
<4	Moderate	High	Low	0.37	
<4	Low	High	Low	0.32	
<2	Low	Moderate	Low	0.37	1
<2	Moderate	Moderate	Low	0.43	
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	Moderate	Low	0.10	3
<2	Low	Moderate	Low	0.10	

TABLE 12.—*Soil and*

[Absence of an entry means the map unit was not evaluated. Dashes indicate the feature is not a concern. See text for descriptions > means

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Ager: 100, 101, 102	D	None		
Alturas: 103	C	Rare		
Balman:				
104	B	Frequent	Long	Mar-May
105	B	Frequent	Long	Mar-May
Barnard:				
106, 107	C	None		
108	C	None		
Bieber: 109, 110, 111	D	None		
Buntingville: 112, 113	C	Frequent	Brief	Feb-May
Calmus: 114, 115, 116, 117	B	None		
Casuse: 118	D	None		
Daphnedale: 119, 120, 121, 122 [1]	C	None		
For Delma part of 122, see Delma series.				
Daphnedale deep variant: 123, 124, 125	C	None		
Delma: 126, 127, 128, 129	D	None		
Delma part of 122	D	None		
Deven:				
130, 132	D	None		
Rock outcrop part of 132 not rated.				
131	D	None		
Deven part of 161	D	None		
Ditchcamp	C	None		
Donica: 133	B	None		
Drews:				
134, 135, 136, 137	B	None		
138	B	Frequent	Brief	Feb-May
Exel	C	None		
Fluvaquents: 139	D	Frequent	Very long	Jan-Dec
Gleason: 140, 141	B	None		
Goose Lake: 142	D	Frequent	Long	Mar-May
Gravel pits: 143. Not rated.				
Jenny: 144, 145	D	None		

water features

of hydrologic groups. The Glossary, under "flooding," explains such terms as "rare" and "brief." The symbol < means less than; greater than]

High water table		Bedrock		Cemented pan		Potential frost action
Depth	Months	Depth	Hardness	Depth	Hardness	
Ft		*In*		*In*		
>6.0		40–60	Rippable			Moderate.
2.5–5.0	Dec-Jun	>60				Moderate.
4.0–6.0	Jan-Dec	>60				Moderate.
2.0–3.5	Jan-Dec	>60				Moderate.
>6.0		>60		26–40	Rippable	Moderate.
>6.0		>60		26–40	Rippable	Moderate.
>6.0		>60		8–20	Rippable	Moderate.
3.0–5.0	Feb-Jun	>60				High.
>6.0		>60				Moderate.
>6.0		8–20	Hard			Moderate.
>6.0		25–40	Rippable			Moderate.
>6.0		>60				Moderate.
>6.0		8–20	Rippable			Moderate.
>6.0		11–19	Rippable			Moderate.
>6.0		16–20	Hard			Moderate.
>6.0		13–20	Hard			Moderate.
>6.0		13–20	Hard			Low.
>6.0		25–40	Hard	21–35	Hard	Moderate.
>6.0		>60				Moderate.
>6.0		>40	Rippable	>40	Rippable	Moderate.
>6.0		>60				Moderate.
>6.0		>60		24–40	Rippable	Moderate.
0.5–1.0	Jan-Dec	>60				High.
>6.0		40–60	Hard			Moderate.
1.0–3.0	Mar-Jul	>60				Moderate.
>6.0		>60				Moderate.

TABLE 12.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Karcal: 146, 147 [1]	C	None		
For Ninekar part of 147, see Ninekar series.				
Kinkel: 148, 149	B	None		
Ladd: 150, 151	B	None		
Lakeview: 152, 153	B	Rare		
Lithic Xerorthents	D	None		
Lolak: 154	D	Rare		
Lorella: 155, 156, 157, 158 159, 160	D	None		
Lorella variant: 161 [1]	C	None		
Rubble land part not rated. For Deven part see Deven series.				
Lovejoy: 162, 163 [1]	C	None		
For Reba part of 163, see Reba series.				
Lyonman: 164, 165	C	None		
McQuarrie: 166, 167	D	None		
Modoc: 168, 169	C	None		
Ninekar: 170	C	None		
Ninekar part of 147, 180	C	None		
Packwood: 171 [1]	D	None		
For Ditchcamp part, see Ditchcamp series. For Puls part, see 179 in Puls series.				
172 [1]	D	None		
For Ditchcamp part see Ditchcamp series. Rock outcrop part not rated.				
Pasquetti: 173	D	None		
174	D	None		
Pineal: 175	D	Rare		
Pit: 176, 177	D	Frequent	Long	Dec-Mar
178	D	Frequent	Long	Dec-Mar
Puls: 179	D	None		

water features—Continued

High water table		Bedrock		Cemented pan		Potential frost action
Depth	Months	Depth	Hardness	Depth	Hardness	
Ft		*In*		*In*		
>6.0		20–30	Hard			Moderate.
>6.0		>60				Moderate.
>6.0		>60				Moderate.
4.0–5.0	Mar-Jul	>60				Moderate.
>6.0		1–10	Hard			
1.0–2.0	Mar-Jul	>60				Moderate.
>6.0		10–20	Hard			Moderate.
>6.0		30–40	Hard			Moderate.
>6.0		>60		20–30	Hard	Moderate.
>6.0		40–60	Hard			Moderate.
>6.0		10–16	Hard			Moderate.
>6.0		>60		24–40	Hard	Moderate.
>6.0		20–38	Hard			Moderate.
>6.0		20–40	Hard			Moderate.
>6.0		16–22	Hard	8–15	Rippable	Moderate.
>6.0		16–22	Hard	9–16	Rippable	Moderate.
3.0–5.0	Jan-Jun	>60				High
>6.0		>60				High.
5.0–6.0	Mar-Sep	>60		10–20	Rippable	Moderate.
3.0–4.0	Dec-Jul	>60				High.
1.5–2.5	Dec-Jul	>60				High.
>6.0		19–60	Hard	14–20	Rippable	Moderate.

TABLE 12.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
180,[1] 181	D	None		
For Ninekar part of 180, see Ninekar series.				
Rock outcrop part of 181 not rated.				
Reba: 182	C	None		
Rock outcrop: 183[1]				
Rock outcrop part not rated. For Lithic Xerorthents part, see Lithic Xerorthents.				
Rubble land: 184. Not rated.				
Rumbo: 185, 186	C	None		
Salisbury: 187, 188, 189, 190	C	None		
Tandy: 191	C	Common	Long	Mar-Jun
Thoms: 192[1]	D	None		
For Exel part, see Exel series.				
Tuff outcrop: 193,[1] 194[1]				
Tuff outcrop part not rated. For Casuse part, see Casuse series.				
Tulana:				
195	B/D	Frequent	Brief	Mar-May
196	B	None		
Typic Xerorthents: 197	A	None		
Woodcock: 198, 199	B	None		
Xerofluvents: 200	B	Occasional	Brief	Mar-Jun

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

the sun and are cooler than south-facing slopes. This affects the vegetation and frequently results in formation of a different soil. Microrelief in the form of mounds and intermounds is common in certain parts of the Alturas Area. These mounds occur at random on slopes of less than about 5 percent. There is marked orientation of the mounds up and down slopes that are much more than 15 percent.

Parent material

Generally, two types of rock, sedimentary and igneous, are dominant in the Alturas Area. The sedimentary formations are remnants of prehistoric lake sediments. Volcanic rocks commonly cap these sedimentary formations or have been uplifted to form plateaus and mountains.

Parent material exerts considerable influence on soil formation. The general location of parent materials in the Alturas Area is shown in figure 12. The influence of parent material is greatest in recently deposited materials and decreases with weathering and horizon differentiation. Recent alluvium, derived mostly from basalt, andesite, obsidian, and some pyroclastic rocks, is frequently stratified, is commonly poorly drained, is affected by saline or alkali salts, and has little or no horizon differentiation below the surface layer.

Old terraces and alluvial fan deposits, which are the older parts of the landscape, are derived from rocks

water features—Continued

High water table		Bedrock		Cemented pan		Potential frost action
Depth	Months	Depth	Hardness	Depth	Hardness	
Ft		*In*		*In*		
>6.0		11–60	Hard	14–20	Rippable	Moderate.
>6.0		>60		40–60	Rippable	Moderate.
3.5–5.0	Feb-Jun	>60				Moderate.
>6.0		>60		20–32	Rippable	Moderate.
1.5–4.0	Jan-Dec	>60				Moderate.
>6.0		>60		12–18	Rippable	Moderate.
2.0–3.0	Jan-Dec	>60				High.
>5.0	Jan-Dec	>60				High.
>6.0		>60				
>6.0		40–60	Hard			Moderate.
2.5–5.0	Mar-Jul	>60				

similar to those contributing to the recent alluvium. Soils that formed in these materials have a clay subsoil and indurated pans or carbonate accumulations. The influence of parent materials on these soils has been modified and lessened by soil genesis. The Alturas, Drews, Bieber, and Delma soils are examples of soils formed in these old alluvial materials.

The high uplands of the Alturas Area have been dissected, but remnants of old landscapes are still evident. In places where hard tuff bedrock is prominent, there are areas of Tuff outcrop and the shallow, relatively infertile and easily eroded Casuse soils. In other places where basalt bedrock is prominent, there are areas of Rock outcrop and the shallow, clayey Deven soil. In areas where older, more weathered basalt is prominent, the soils are deeper and have duripans and a clay subsoil. The Puls soils are an example of these deeper soils.

Climate

Climate—temperature and precipitation—strongly affects soil formation through its influence on biological activity. Heat and moisture control the kind and amount of vegetation that grows, the rate at which organic matter decomposes, and the rate at which minerals weather. Moisture controls the removal or accumulation of soil material in the different soil hori-

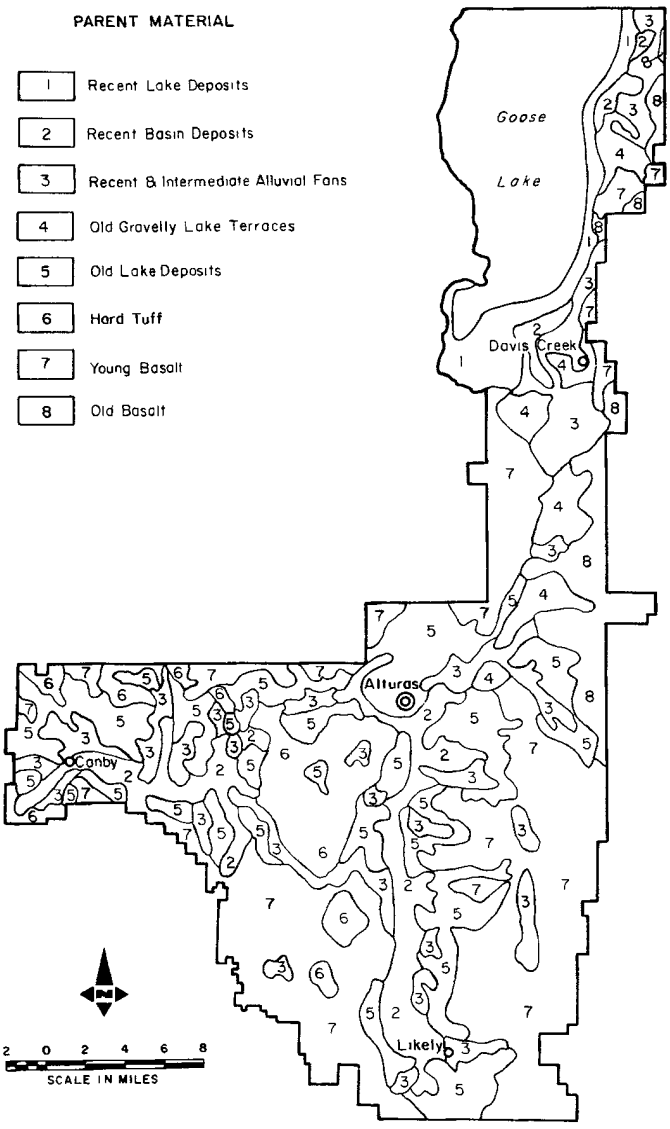

***Figure 12.*—Parent material of the soils in the Alturas Area.**

zons and the removal of salts and minerals from the soil.

Temperature and precipitation in the survey area vary according to elevation. In general, temperatures are warmer at the lower elevations in valleys and are colder at the higher elevations on uplands. The amount of rainfall is higher in the upland areas and lower in the valleys. The valleys also receive some runoff from the uplands.

The distribution of moisture and temperature affects the kind of soils in an area. The climate of the Alturas Area is characterized by cold, moist winters and dry, warm summers. A typical sequence of moisture and temperature is as follows: The first autumn rains wet the soil. Then snow falls before the ground freezes to any appreciable depth. Temperatures are too cold for plant growth. Precipitation is stored in the form of snow. The accumulated snow melts gradually in spring and combines with spring rain to produce a period of maximum moisture and soil leaching. In some years, rains and high temperatures early in spring result in rapid snow melt and high runoff. As temperatures increase, plant growth becomes rapid. Plants soon require more water than is supplied by precipitation, and the moisture stored in the soil is used. When this stored moisture is depleted, about June 20th to July 10th in the Alturas Area (*8*), most plant growth stops. From this date until the next autumn rains, little plant growth takes place. Detailed climatic data for the area are in the section "General Nature of the Area."

The depth to a zone of carbonate accumulation represents the depth to which the soil has been leached. This varies from year to year. The zone of maximum weathering and translocation of clay occurs where there is sufficient moisture. This is generally where the clayey subsoil horizon occurs. The depth to a silica-cemented hardpan also generally represents the depth of leaching. Many hardpans are just above a gravelly or cobbly layer. The difference in pore size between the gravelly or cobbly layers and the layers above affects the movement and retention of moisture. Most of the soils in the survey area have had relatively little leaching throughout the profile. The base saturation values tend to be high, and the exchangeable bases are mainly calcium, magnesium, sodium, and potassium.

Freezing and thawing generally occur late in fall, in winter, and early in spring, except when the ground is covered by snow. The effects of frost action are evidenced by heaving of plants, formation of thin surface cracks, segregation of coarse particles, and movement of saturated surface soil.

Biological activity

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Vegetation is of particular importance. It affects the accumulation of organic matter in the surface layer and, through the penetration and decay of roots, throughout the soil. Organic matter is the energy source for the biological activity in the soil.

In the poorly drained soils, such as Goose Lake, Tulana, and Pasquetti soils, the water-tolerant vegetation produces a large amount of organic matter. These soils have a thick, dark surface layer. Areas of sagebrush and grass or juniper, sagebrush, and grass produce less organic matter than other areas and the soils have a thinner surface layer.

The kind of vegetation, by its influence on organic-matter content, has a strong influence on soil formation. Soils that formed under conifers, such as the Gleason, Kinkle, Lyonman, and Woodcock soils, have a thin layer of undecomposed leaf litter on top of the mineral soil. This leaf litter, which provides a large proportion of the organic-matter content of these soils, is low in bases.

Soils of the Balman and Rumbo series are affected by saline or alkali salts or both, and they support salt-tolerant plants, such as saltgrass, greasewood, and

alkali meadowgrass. Production of organic matter is low on these soils. The organic matter is high in bases.

Well drained soils generally have an abundant population of burrowing animals such as ground squirrels. These animals are active in mixing organic matter into the soil, and through their burrowing activities, they disturb soil horizon formation and increase the movement of air and water in the soil.

Shrubs on Tandy loamy fine sand grow mostly on small mounds. These mounds are a result of soil blowing and the accumulation of organic matter under the shrubs.

Time

Soil formation needs time. The soils in the survey area differ in both age and maturity. Age refers to the length of time the soil has been forming; maturity refers to the degree that well defined genetically related horizons have formed and are approaching equilibrium with the environment. A soil may be old in years but young in development, if the parent material is very resistant to weathering. The geologic age of the parent rock, therefore, is not necessarily related to the age of the soil.

The relationship between soil profiles and the relative age of the landscape on which they are located gives us some idea of how long it takes horizons to form. The recent landscapes, such as lake or basin deposits, stream alluvium, and recent alluvial fans, have soils which are mostly young in years and immature. These soils have had only enough time for organic matter to accumulate in their surface layer. Tandy soils on lake deposits, Pasquetti soils on basin deposits, and Calimus soils on recent alluvial fans are examples of soils that formed in recent parent materials. The older landscapes like the intermediate alluvial fans, older alluvial fans, near-shore deposits, and lake deposits of Plio-Pleistocene age have had time to weather and to form a clay subsoil. Profiles of the older soils are more mature. Some of the soils have had time to form a hardpan or zones of lime accumulation. Examples of this are the Alturas soil on intermediate alluvial fans, the Drews soil on older alluvial fans, the Bieber soil on near-shore deposits, and the Delma soil on Plio-Pleistocene lake deposits. Upland soils, which are mostly on the oldest landforms, almost all have some degree of horizon formation and a clay subsoil or hardpan. An exception is the Gleason soils. The Puls soils are the most mature of the soils on uplands.

A few soils in the survey area are on older landscapes but can be considered relatively immature. These soils have high shrink-swell properties, as do the Karcal soils. They have formed only a deep surface layer with accumulations of organic matter, and their cracking and churning has prevented the formation of other horizons. These soils are in horizon genesis, although they are mature in one sense by being in equilibrium with their environment.

Morphology

This section discusses the various horizons in the soils of the Alturas Area and some of the processes active in their formation. The soil profile is a vertical cross-section of the various soil horizons. These horizons, or layers, are distinctive in each soil and they may differ in either *kind* or *degree*. A soil horizon may be thick or thin, but must be thick enough to have some significance.

Horizon differentiation in soils is the result of four basic kinds of changes (*14*). These are additions, removals, transfers, and transformations in the soil system. In most soils more than one of these processes has been active in horizon development.

The A1 horizon results mainly from the accumulation of organic matter. The A1 horizon of the Goose Lake, Gleason, and Barnard soils contains various amounts of organic carbon (fig. 13). The Goose Lake soil, which formed under poorly drained conditions, produces a large amount of grasses and grasslike vegetation. Anarobic conditions reduce decomposition of matter, and the percent of organic carbon is high. The Gleason soil is at higher elevations, and has a short growing season, cold temperatures, and conifer vegetation. The kind and amount of vegetation produced and the slow decomposition of organic matter result in an organic carbon content of about 2 percent. The Barnard soil has a low organic-matter content because it produces less vegetation and more of the organic matter undergoes rapid decomposition.

The transfer of salts from a lower horizon to an upper horizon is illustrated in the Balman soil. An A1 horizon with a concentration of soluble carbonates

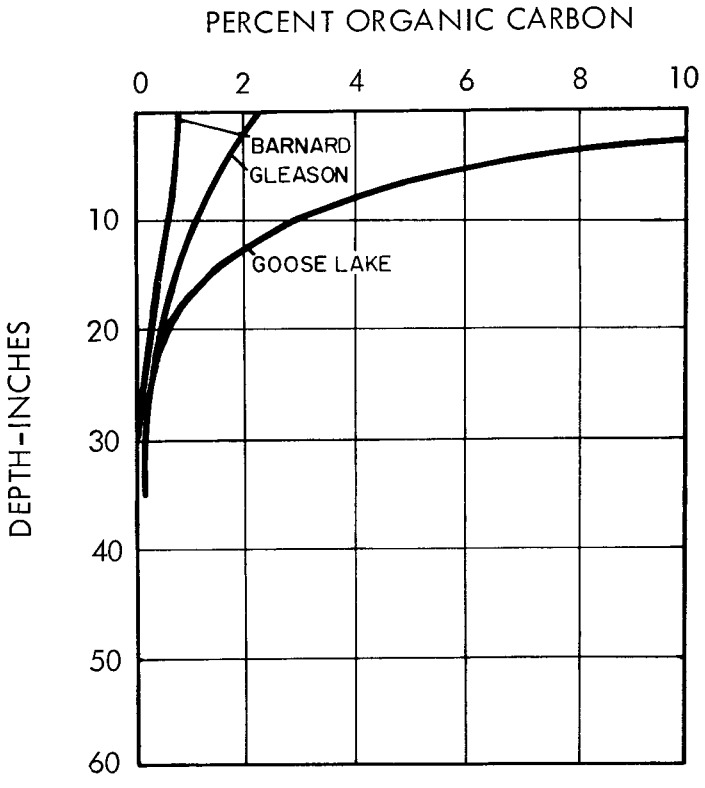

Figure 13.—**Content of organic carbon at various depths in the profiles of Barnard, Gleason, and Goose Lake soils.**

TABLE 13.—*Engineering*

Soil name and location	Report No.	Depth	Moisture-density [1]		Mechanical analysis of percentage passing sieve—[2]			
			Maximum dry density	Optimum moisture	3 in	2 in	1.5 in	1 in
		In	*Lb/cu ft*	*Pct*				
Ager clay: 1,500 ft. S and 1,300 ft. W of NW¼ cor. sec. 20, T. 42 N., R. 10 E.	43733	6–25	84	27				
	43734	25–33	86	25				
Barnard loam: 950 ft S and 240 ft. E of N¼ cor. sec. 27, T. 43 N., R. 13 E.	43735	0–7	112	17				
	43736	11–24	100	21			100	96
	43737	24–38	102	23	100	99	91	85
Bieber loam: NW¼, SE¼ sec. 27, T. 42 N., R. 13 E.	2068	0–6	122	12	100	99	97	95
	2069	13–18	109	15		100	92	84
Buntingville clay loam: NE¼, SW¼, sec. 22, T. 42 N., R. 9 E.	45003	3–7	90	23				
	45004	7–18	89	22				
Casuse sandy loam: 600 ft. N and 180 ft. W of S¼ cor. sec. 23, T 42 N., R. 12 E.	43740	0–2	106	18				
	43741	6–14	102	16				
Casuse sandy loam: NE¼ NE¼ sec. 17, T. 41 N., R. 12 E.	2070	0–2	98	21				
	2071	8–12	99	21				
Deven clay loam: NE¼ SW¼ sec. 6, T. 42 N., R. 12 E.	45008	6–16	98	21				
Donica gravelly clay loam: 950 ft. E and 425 ft. S of NW cor. sec. 1, T. 47 N., R. 14 E.	43744	4–14	120	12	96	91	84	80
	43745	14–29	127	9	95	85	78	67
	43746	29–33	125	11	100	87	79	69
Exel loam: 1,050 ft. S and 1,600 ft. W of E¼ cor. sec. 18, T.43 N., R.14 E.	43742	0–5	116	14				
	43743	23–30	109	16	95	94	90	87
Gleason gravelly sandy loam: 30 ft. S and 90 ft. W of E¼ cor. of sec. 10, T. 46 N., R. 14 E.	45005	2–12	100	19			100	98
Goose Lake silt loam: SW¼ SW¼ sec. 12, T. 45 N., R. 13 E.	2066	0–8	52	61				
	2067	21–34	95	21				
Lyonman loam: NW¼ SW¼ sec. 2, T. 44 N., R. 14 E.	45006	0–6	99	20				100
	45007	32–44	105	16	100	97	95	92

test data

Mechanical analysis of percentage passing sieve[2]—Cont.					Liquid limit[3]	Plasticity index[3]	Classification	
¾ in	No. 4 (4.7mm)	No. 10 (2.0mm)	No. 40 (0.42mm)	No. 200 (0.074mm)			AASHTO[4]	Unified[5]
					Pct	*Pct*		
----------	----------	100	99	93	112	58	A–7–6 (69)	MH
----------	----------	100	99	94	112	56	A–7–6 (68)	MH
----------	100	98	84	51	37	14	A–6 (6)	CL
96	96	83	79	55	61	24	A–7–5 (12)	MH
82	71	66	58	36	54	19	A–7–5 (2)	SM
93	86	80	63	47	28	9	A–4 (1)	SC
80	65	59	49	39	65	33	A–7–5 (5)	GM–GC
100	99	99	97	75	51	24	A–7–6 (19)	CH
100	99	99	96	80	57	29	A–7–6 (25)	CH
----------	100	96	77	45	31	7	A–4 (1)	SM
----------	100	98	84	55	37	12	A–6 (5)	ML
----------	100	97	85	57	37	8	A–4 (3)	ML
100	99	97	87	61	43	16	A–7–6 (8)	ML
100	99	94	82	72	62	33	A–7–6 (23)	CH
77	59	52	41	25	31	8	A–2–4 (0)	SM
61	33	24	12	5	29	6	A–2–4 (0)	SM
62	42	30	18	10	32	9	A–2–4 (0)	SM–SC
----------	100	93	68	46	30	7	A–4 (1)	SM–SC
83	75	70	56	41	42	17	A–7–6 (3)	SC
97	84	75	61	37	----------	[6]NP	A–5	SM
----------	----------	100	99	90	109	24	A–7–5 (45)	MH
----------	----------	100	99	90	86	59	A–7–6 (61)	CH
99	85	75	57	46	42	3	A–5 (0)	SM
91	80	73	56	43	42	14	A–7–6 (3)	SM

TABLE 13.—*Engineering*

Soil name and location	Report No.	Depth	Moisture-density[1]		Mechanical analysis of percentage passing sieve—[2]			
			Maximum dry density	Optimum moisture	3 in	2 in	1.5 in	1 in
		In	*Lb/cu ft*	*Pct*				
Modoc loam: 400 ft. E of W¼ cor. sec. 35, T. 41 N., R 14 E.	43747	0–4	112	15			100	98
	43748	10–15	113	14				
	43749	15–30	108	14				
Rumbo loam: NE¼ SW¼, sec. 25, T. 42 N., R. 10 E.	45009	0–2	102	17				
	45010	2–8	100	18				
	45011	37–58	80	27				
Tulana mucky loam: NW¼ SW¼ sec. 24, T. 40 N., R.12 E.	2072	0–8	50	58				
	2073	16–23	46	69				
	2074	31–60	50	62				

[1] California Division of Highways, Method No. 216. (*6*)
[2] California Division of Highways, Method No. 202 and 203 (*6*). Particle sizes passing no. 10 and 40 sieves were obtained from plotted data.
[3] California Division of Highways, Method No. 204. (*6*)

results from the upward capillary movement of water from the water table. Clay, iron oxides, and some organic matter have been removed from the whitish colored A2 horizon in the Goose Lake soil. The whitish color of the clean sand and silt grains in this horizon result from extensive leaching.

The B2 horizon is generally below the A horizon and is the zone of maximum clay accumulation (fig. 14). The Gleason soils are relatively low in clay content and show little translocation of clay. The clay content of the Barnard soils increases with depth and reaches a maximum in the B2t horizon. Some of this clay has been translocated from the A horizon, but most has been transformed by weathering in place. The Ager soil has a high clay content in the upper 33 inches. This is the result of the transformation of the primary minerals to clay and the subsequent mixing that results from the high shrink-swell properties of this soil. Ager soils do not form a B2 horizon because of this mixing. Balman soils, on the other hand, have not formed a B2 horizon because of their recent origin and the movement upward of capillary water from the water table.

The C horizon generally is below the B horizon. This horizon is weathered parent material. It is absent in some soils, such as the Deven soils. A common C horizon in this area, however, is the hardpan. These hardpans, or cemented layers, are formed when the soluble silica or silica and lime transfer downward from the solum to the C horizon and are precipitated. The Barnard soils are an example. Carbonates are transferred downward from the solum into the C horizon where they are reprecipitated and form a zone of carbonate (Cca), such as in the Ager soils.

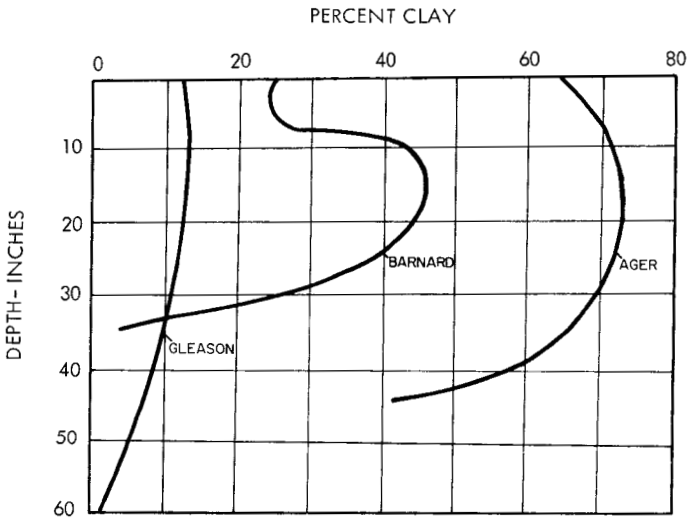

***Figure 14.*—Content of clay at various depths in the profiles of Ager, Barnard, and Gleason soils.**

test data—Continued

Mechanical analysis of percentage passing sieve [2]—Cont.					Liquid limit [3]	Plasticity index [3]	Classification	
¾ in	No. 4 (4.7mm)	No. 10 (2.0mm)	No. 40 (0.42mm)	No. 200 (0.074mm)			AASHTO [4]	Unified [5]
					Pct	*Pct*		
96	79	68	56	44	31	8	A–4 (0)	GM
100	89	82	72	56	33	14	A–6 (5)	CL
100	90	82	72	58	37	14	A–6 (6)	CL
100	99	98	92	66	30	3	A–4 (1)	ML
100	99	98	94	74	50	28	A–7–6 (21)	CH
100	92	92	89	81	106	58	A–7–5 (52)	MH
			100	92	115	23	A–8 (43)	Pt
			100	95		NP	A–5	MH
			100	97		NP	A–5	MH

[4] AASHTO Designation: M145–66I. (*1*)
[5] ASTM Designation: D2487–66T. (*3*)
[6] NP = Nonplastic.

Classification

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature available (*20*).

The system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the bases for classification are the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 14 the soils of the survey area are classified according to the system. Categories of the system are briefly discussed in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol.* An example is Mollisol.

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. The name of a great group ends with the name of a suborder. A prefix added to the name suggests something about the properties of the soil. An example is Cryaquoll (*cry,* meaning cold, plus *aquoll,* the suborder of Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group is divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades that have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. The names of subgroups are derived by placing one or more adjectives before the name of the great group. The adjective *Typic* is used for the subgroup that is thought to typify the great group. An example is Typic Cryaquoll.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the

TABLE 14.—*Classification of the soils*

[An asterisk in the first column indicates a taxadjunct to the series. See "Descriptions of the Soils" for a discussion of the characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Ager	Very-fine, montmorillonitic, mesic Entic Chromoxererts
Alturas	Fine, montmorillonitic, mesic Typic Natrixerolls
Balman	Fine-loamy, mixed, mesic Aquic Calciorthids
Barnard	Fine, montmorillonitic, mesic Aridic Durixerolls
Bieber	Clayey, montmorillonitic, mesic, shallow Aridic Durixerolls
Buntingville	Fine-loamy, mixed, mesic Typic Argiaquolls
Calimus	Fine-loamy, mixed, mesic Pachic Haploxerolls
Casuse	Loamy, mixed, mesic, shallow Xeralfic Haplargids
Daphnedale	Fine, montmorillonitic, mesic Typic Argixerolls
Daphnedale deep variant	Fine, montmorillonitic, mesic Typic Argixerolls
Delma	Clayey, montmorillonitic, mesic, shallow Aridic Argixerolls
Deven	Clayey, montmorillonitic, mesic Lithic Argixerolls
Ditchcamp	Fine-loamy, mixed, mesic Xerollic Durargids
Donica	Loamy-skeletal, mixed, mesic Aridic Haploxerolls
Drews	Fine-loamy, mixed, mesic Pachic Argixerolls
Exel	Fine-loamy, mixed, mesic Xerollic Durargids
Fluvaquents	Mesic Fluvaquents
Gleason	Coarse-loamy, mixed, frigid Entic Haploxerolls
Goose Lake	Fine, montmorillonitic, mesic Typic Argialbolls
Jenny	Fine, montmorillonitic, mesic Typic Chromoxererts
Karcal	Fine, montmorillonitic, mesic Entic Chromoxererts
*Kinkel	Loamy-skeletal, mixed, mesic Ultic Haploxeralfs
Ladd	Fine-loamy, mixed, mesic Typic Argixerolls
Lakeview	Fine-loamy, mixed, mesic Cumulic Haploxerolls
Lithic Xerorthents	Lithic Xerorthents
Lolak	Fine, montmorillonitic (calcareous), frigid Typic Halaquepts
Lorella	Clayey-skeletal, montmorillonitic, mesic Lithic Argixerolls
Lorella deep variant	Clayey-skeletal, montmorillonitic, mesic Pachic Argixerolls
*Lovejoy	Fine, montmorillonitic, mesic Abruptic Xerollic Durargids
Lyonman	Fine-loamy, mixed Argic Cryoborolls
McQuarrie	Loamy, mixed, mesic Lithic Argixerolls
Modoc	Fine-loamy, mixed, mesic Aridic Durixerolls
Ninekar	Fine, montmorillonitic, mesic Xerertic Haplargids
Packwood	Loamy, mixed, mesic, shallow Xerollic Durargids
Pasquetti	Fine-loamy, mixed, mesic Andaqueptic Haplaquolls
Pineal	Clayey, montmorillonitic, mesic, shallow Natric Durixeralfs
Pit	Fine, montmorillonitic, mesic Chromic Pelloxererts
Puls	Clayey, montmorillonitic, mesic, shallow Abruptic Xerollic Durargids
Reba	Fine, montmorillonitic, mesic Xerollic Paleargids
Rumbo	Fine, montmorillonitic, mesic Haploxerollic Natrargids
Salisbury	Fine, montmorillonitic, mesic Typic Durixerolls
Tandy	Sandy over loamy, mixed (calcareous), mesic Aquic Udifluvents
Thoms	Loamy, mixed, mesic, shallow Xerollic Durargids
Tulana	Medial, nonacid, mesic Mollic Andaquepts
Typic Xerorthents	Typic Xerorthents
*Woodcock	Loamy-skeletal, mixed Argic Pachic Cryoborolls
Xerofluvents	Mesic Xerofluvents

soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic, Typic Cryaquoll.

SERIES. The series consists of a group of soils that are formed from a particular kind of parent material and have horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

General Nature of the Area

This section describes the physiography, relief, drainage, geology, and geomorphic history of the survey area. It also gives information on the climate, water supply, settlement and development, and agriculture.

Physiography, Relief, and Drainage

The Alturas Area is in the eastern part of the Modoc Plateau geomorphic province (*5*). It is characterized by several landforms consisting of northwest- to north-trending, block-faulted mountain ranges on

the east and southwest edges; broad basalt lava flow plateaus on the northwest edge; and small erosion- or fault-formed valleys in the center and on the extreme northeast edge. Land areas of gentle slopes include the lava plains that were formed by extensive basalt outflows; the alluvial plains consisting of level lake plains, sloping alluvial fan aprons, and high alluvial terraces; and the erosional basin floors cut into old lake deposits. The steeper areas include the dissected mountain ranges and the fault- or erosion-formed escarpments (*13*). Numerous escarpment faces drop from the lava plateau level to the valley floor, a difference in elevation of 600 feet. Valley elevations range from 4,300 feet in the Warm Springs Valley to 4,750 feet in the Goose Lake Valley.

The Graven Ridge in the southwestern part of the survey area has the highest elevation: more than 5,700 feet. The elevation at the base of the Warner Mountains along the entire eastern boundary is 5,500 to 5,800 feet. The soil surface varies in any one of the different landforms, creating a complex pattern of soils.

The survey area is drained by the Pit River. The headwaters of this river are in the Warner Mountains east of the survey area. The North Fork of the river starts east of the town of Davis Creek and flows south to join the South Fork near the town of Alturas where the two forks form the Pit River. The South Fork of the river flows west and turns south near the town of Likely. The Pit River flows through the Warm Springs Valley in a southwesterly direction that eventually leads it into Lake Shasta, then into the Sacramento River, and finally into the Pacific Ocean.

The Goose Lake Valley area drains into Goose Lake. This area is now a closed basin, but reportedly it drained into the Pit River twice since 1871. Numerous intermittent streams flow into these major drainages.

Geology and Geomorphic History

The geology of the survey area is strongly influenced by faulting and by volcanic and erosional activity. Two main groups of rocks—sedimentary and volcanic—are common in the area. A brief discussion of the geology of the three major landforms–mountains, lava plateaus, and valleys—follows. The mountains consist mostly of Miocene age basalt and andesite rocks and flows of the Cedarville series that cover much of the survey area. Also included are some tuff and tuff breccia. Small amounts of Miocene volcanic, undivided, and pyroclastic rocks are also found. These rocks are usually in dissected areas that were not protected by more recent lava flows. Small amounts of Pliocene basalt are in the extreme western corner of the survey area. Rhyolite is in small areas in the Warner Mountains east of Goose Lake Valley.

The lava plateaus are capped by Pleistocene and Plio-Pleistocene basalt. The highly fractured Pleistocene olivine basalt is common on the Devil's Garden area northwest of the town of Alturas. The highly fractured Plio-Pleistocene basalt is common in the Graven Ridge and the southern part of the Likely Tableland.

The valley area is underlain by Warm Springs tuff rock. A large area is southwest of the town of Alturas. It consists of various pyroclastic rocks that differ in hardness. There is welded tuff where this area is hard. This tuff is resistant to erosion and forms chimney rocks if the surrounding softer tuff is eroded away. The Alturas Formation consists of Plio-Pleistocene lake deposits and is found throughout the Alturas Basin area. Near-shore deposits of Pleistocene age are found throughout the Goose Lake Valley and northeast Alturas basin. These deposits formed along the edges of prehistoric lakes that once occupied the valleys, and they consist mostly of highly stratified gravel, sand, silt, and clay. The rest of the valley area consists of various kinds of recent deposits, including lake, basin, talus, and alluvial fan deposits.

The geomorphic history helps explain the location of various present day landforms (*13*). In the late Miocene age the survey area had an undulating surface with a few fault block ridges. Fossils of broad-leaf trees indicate that the climate was much wetter. In the Mio-Pliocene age, large basalt flows were common. These flows left only the higher peaks exposed. There was much deformation of the landscape after this and the Warner Mountains, Alturas Basin, and Graven Ridge started to form.

By mid-Pliocene time the valleys were filled with ash deposits. The Alturas Basin was filled in the late-Pliocene and was at about the same elevation as that of Rocky Prairie today. The climate also changed during this period. The broad-leaf trees were replaced with vegetation similar to that of today.

In the Plio-Pleistocene age more basalt lava flowed from the earth. These flows were very thin and spread over much of the previously formed lacustrine deposits. The most recent lava flows now cover the Devil's Garden area. The Pleistocene age produced much of the present landscape with renewed faulting. The Goose Lake and South Fork valleys were formed by faulting and the down dropping of the southern part of the area. The Warm Springs Valley also formed at this time, and the South Fork Valley deposits began to accumulate. All of these events resulted in the present complex landscape.

Climate [10]

The Alturas Area is more than 150 miles inland and is separated from the Pacific Ocean by rugged mountain ranges. The Pacific Ocean does not significantly influence the Area's climate. Most migrating winter storms moving inland from the Pacific carry a large amount of moisture because of the long distance the air travels over water. Much of this moisture is lost as the air moves inland over the mountains west of the survey area, and the air descends in the lee of the mountains before passing across the Alturas Area. Precipitation is considerably lighter because of the influence of the mountains to the west. Where the air is again lifted by the local mountains within the Area, the amount and intensity of the precipitation usually increase.

[10] By C. ROBERT ELFORD, State climatologist, and MAX R. MCDONOUGH, assistant climatologist, National Weather Service, U.S. Department of Commerce, San Francisco, California (*8*).

The average temperature generally decreases with elevation, but this is not always true of extreme temperatures. Both maximum and minimum temperatures are influenced by the local topography. Low temperatures, especially, can change sharply within short distances because of drainage or blockage of cold air.

Winter in the survey area is marked by the frequent passage of low pressure systems and the predominance of maritime polar air. Precipitation is frequent but generally is light on the plateaus and somewhat heavier in the mountains. High pressure areas between the storm centers are often associated with polar continental air.

Under clear skies there is rapid radiational cooling at night. This generally results in low minimum temperatures. Much of the winter precipitation falls as snow. Snow cover can last for long periods at the higher elevations. Snowfall is lighter and temperatures are higher at lower elevations, and the snow generally does not stay on the ground so long.

In spring, precipitation gradually decreases after February or March as the storm centers move northward. There is, however, a secondary maximum in May. This increase is associated with the passage of cold lows across the area.

In summer there are few storms except for occasional thundershowers. Precipitation is very light. Summers are usually warm.

Table 15 shows the means and extremes for temperature and precipitation at Alturas. The data are for a period of 30 years, except for driest and wettest year data which are for a period of 66 years.

The growing season, as defined by 32° F temperatures in spring and fall, ranges from 80 to 110 days. There is a 50 percent probability that the last freeze in spring will occur on June 9 and that the first freeze in fall will occur on August 30 at Alturas. When defined by 28° temperatures in spring and fall, the growing season ranges from 120 to 140 days. There is a 50 percent probability that the last 28° reading in spring will occur on May 26 and that the first freeze in fall will occur on September 23 at Alturas.

The relative humidity in the area changes seasonally. Cool weather and frequent precipitation in winter result in fairly high relative humidity. In January the average relative humidity is 75 percent. On the average, the relative humidity drops to 15 to 20 percent on a midsummer afternoon and to about 40 percent at night. Dry northerly or easterly winds occasionally cause the humidity to drop below 10 percent. This is a serious fire hazard.

Because of the broad, open topography of the plateaus, winds occasionally are strong. Although available data is limited, it is estimated that in areas of typical exposure, a wind of 55 miles or more per hour occurs every other year; a wind of 75 miles or more per hour once in 50 years; and a wind of 90 miles per hour once in 100 years. Winds are not so strong in protected areas. Wind speeds are usually less than 15 miles per hour.

TABLE 15.—*Temperature and precipitation*

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for—		Average snowfall
					Driest year (1908)	Wettest year (1907)	
	°F	°F	°F	*Inches*	*Inches*	*Inches*	*Inches*
December	32.1	71	−25	1.63	0.67	1.82	6.4
January	28.1	66	−32	1.62	1.04	1.35	11.2
February	32.2	75	−30	1.45	.16	2.87	6.8
Winter	30.8	75	−32	4.70	1.87	6.04	24.4
March	38.4	82	−6	1.37	.26	4.13	5.9
April	45 4	85	10	1.03	.35	.39	2.3
May	52.3	89	20	1.31	1.31	1.21	.2
Spring	45.4	89	−6	3.71	1.92	5.73	8.4
June	59.0	99	26	1.03	.42	1.68	[1]T
July	66.3	107	31	.31	.21	.55	0
August	63.9	102	26	.22	.19	.27	0
Summer	63.1	107	26	1.56	.82	2.50	0
September	57.5	106	15	.43	.10	1.09	T
October	48.0	90	10	1.70	1.42	1.90	.5
November	37.9	79	−6	1.35	.66	1.11	3.3
Fall	47.8	106	−6	3.48	2.18	4.10	3.8
Year	46.8	107	−32	13.45	6.79	18.37	36.6

[1] "T" means trace.

The average cloud cover varies from 70 percent of the sky in winter to as little as 20 percent in summer. These figures refer only to the hours between sunrise and sunset; cloud cover at night may be somewhat more. The percentage of possible sunshine ranges from 45 percent in winter to 90 percent in summer.

Water Supply

Water in the survey area comes from surface and underground sources (*7*). Because of the rainfall distribution, there is an excess of runoff in spring and a shortage in summer and fall unless supplemented by upstream storage or pumping from ground-water supplies. Water development started immediately after settlement. It was relatively easy to divert water or to back up streams causing flooding of the surrounding lowlands. The East Side and West Side Canals were constructed around 1900 to reclaim part of the South Fork Valley. Reservoirs were constructed later in the surrounding uplands. Big Sage Reservoir was constructed in 1921. It is of earthfill construction and is faced with rock. The Hot Springs Valley Irrigation District services the Warm Spring Valley area, and the South Fork Irrigation District services the Likely area. The West Valley Reservoir supplies water to the Likely area, and the Big Sage Reservoir just outside the survey area is the water source for the Warm Springs Valley area. Stream diversions throughout the survey area are made under the administration of the State watermaster.

Water quality for irrigation from streams and ground water is generally good throughout the area. Bicarbonate of sodium and calcium are present in some waters. In areas of hot springs the water has excess amounts of soluble salts, sodium, and boron. This water is often used for duck ponds. The local reservoirs are often cloudy because of suspended fine clay particles.

The survey area lies in the Central Valley Drainage Basin, which includes two separate hydrographic units: the Goose Lake Valley Basin and the Alturas Basin. The Goose Lake Valley Basin contains Goose Lake. Several streams from the Warner Mountains flow into the lake, but within the last 60 years the lake has dried up several times. If full, Goose Lake drains to the south into the North Fork of the Pit River by way of a narrow channel. Its water quality is poor because of high salt concentrations. Most of the water used for irrigation in the Goose Lake Valley Basin comes from diverted stream water. Well water is mainly used for domestic and stock water.

The Alturas Basin includes the area adjacent to the Pit River and its tributaries. Water is diverted from these streams and used to irrigate the agricultural land in the valleys.

The Pit River is dammed at various points to allow flooding of the surrounding lowlands or to divert water into irrigation canals. Water shortages are common, and ground-water development will probably take place in the future. This area also has many reservoirs and ponds to store streamflow for later irrigation use.

Settlement and Development

The first settlers to the Alturas Area were probably trappers in the 1820's. Various wagon trains went through the area in the 1840's and especially in the 1849 gold migration. Little actual settlement took place after that. In 1864 there was some travel eastward through the area to the new gold mines in Idaho. In 1867 the first permanent settlements were established, but settlers did not remain in any number until after the Indian Wars of 1873. Modoc County was established in 1874 with Dorris Bridge as the county seat. In 1876, Dorris Bridge was renamed Alturas, a Spanish word meaning "a valley on top of a mountain." By 1880 the Goose Lake Valley had more than 700 residents.

The land survey of the area was made concurrently with the initial settlement. The 1862 Homestead Act, the Desert Land Act in 1877, and the Swamp Act of 1850 were used in the acquisition of low-cost acreage. Water rights were established in 1873 with the introduction of riparian rights. These encouraged settlers to acquire land along the Pit River, which had the most stable water flow.

The export of cash crops became possible when the Nevada, California, and Oregon Railroad from Reno was constructed in 1881. The railroad was extended to Likely in 1908 and through the Goose Lake Valley to Lakeview, Oregon by 1912. The railroad was widened in 1928–29 and extended to a connecting line to Klamath Falls, Oregon. Alturas became a central shipping point. U.S. Highway 395 serves as the north to south route, and State Highway 299 serves the east to west traffic.

More recently, there has been a trend toward larger ranch holdings with the accompanying decline in the ranch population. The population for Modoc County peaked in 1950 and has declined slightly since then. It was 5,425 in 1920; 8,038 in 1930; 8,713 in 1940; 9,678 in 1950; 8,308 in 1960; and 7,469 in 1970. The estimated population of Alturas in 1974 was 3,185; of Canby, 370; of Davis Creek, 155; of Likely, 225; and of New Pine Creek-Willow Ranch, 145.

Agriculture

The present agriculture reflects the economics, land ownership, and natural resources of the survey area. The area consists of several valleys and their surrounding lava plateaus. The surrounding mountainous areas are largely excluded, but they do influence the operations of the ranches in the valleys. Land ownership is approximately half private and half federal. Federal lands are mostly used for summer grazing.

The area is a large producer of livestock, mostly beef cattle. Land used for this type of livestock operations is also used for irrigated hay and pasture, dry-farmed hay and pasture, and range. Some cash crops are grown and are mostly dry-farmed grains.

A typical livestock operation in the area includes the production of irrigated hay for feeding through the winter months; summer grazing of dryland pastures, range, or high meadows; and fall pasturing of the irrigated haylands. It is possible to meet the total annual feed requirements for livestock by using cropland for both hay and pasture. Converting native shrubgrass ranges that were in poor condition to dryland wheatgrass and legume or wheatgrass pasture has increased the available forage for livestock. Some hay can be

harvested from some of these areas if rainfall is above average.

Each area has a unique cropland situation because of soil, water availability, slope, and climate. The Goose Lake Valley is commonly dry-farmed or irrigated. The limited supply and the poor distribution of water in the Goose Lake Valley result in dry-farming of extensive areas. The South Fork Valley area grows irrigated hay or barley if water is available, but some dryland pasture is on the slightly higher areas. In the Warm Spring Valley irrigated cropland is mostly along the flood plain of the Pit River and its tributaries.

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Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. A fan-shaped area where a stream flows onto a level plain or meets a slower stream and deposits sand, gravel, and fine material.

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

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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 also given.

Basic igneous rock. Rock in which minerals that are comparatively low in silica and rich in metallic bases are dominant.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

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.

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

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

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

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

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

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

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

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

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Continental climate. Climate, as that in the interior of a continent, characterized by considerable variation in temperature and in other weather conditions.

Control section. The horizons in a soil profile that determine the placement of the soil in the new system of soil classification.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth

of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Durinodes. Silica-cemented soil aggregates.

Duripan. A subsurface horizon that is so cemented by silica that fragments from this horizon will not slake after prolonged soaking in water or hydrochloric acid. A duripan can also contain accessory cements, for example, calcium carbonate.

Effervescence. The fizz that results when dilute hydrochloric acid is applied to soil material that contains free carbonates.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November–May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, diagnostic soil. Soil horizons having specific soil characteristics that identify certain classes of soil. Epipedons are diagnostic horizons that occur at the surface, and diagnostic subsurface horizons are below the surface horizon. Four kinds of diagnostic horizons that commonly occur in this survey area are—

Argillic horizon.—A horizon in which illuvial silicate clay has accumulated. If the horizon has more than 15 percent saturation with exchangeable sodium and prismatic, columnar, or blocky structure, it is called a natric horizon.

Cambic horizon.—A horizon in which development has been sufficient to give rise to structure, to free iron oxide, to form silicate clay minerals, to obliterate most evidence of original rock structure, or to show evidence of some combination of these characteristics. The illuviation of iron, humus, or clay is not sufficient to classify a horizon as argillic or spodic.

Mollic epipedon.—A thick, dark colored surface horizon that is similar to the surface horizon in soils that formed under grass. This horizon has moderate to strong structure and a base saturation of 50 percent or higher; calcium is the dominant metallic cation.

Ochric epipedon.—A surface horizon that has some organic matter but that is too light in color or too thin to be classed as any other kind of epipedon.

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

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

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

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

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Illuviation. The accumulation of material in a soil horizon by the deposition of suspended material and organic matter from upper horizons. For example, if some clay has been deposited in the B horizon from the A horizon, this B horizon is called an illuvial horizon.

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.

Intermittent stream. A stream or part of a stream that only carries water from precipitation. It carries little or no water from springs and has no long-term supply of water from melting snow or other sources.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lava plateau. A broad, elevated tableland or flat highland that is underlain by lava flows.

Leaching. The removal of soluble material from soil or other material by percolating water.

Low strength. Inadequate strength for supporting loads.

Microrelief. Minor surface irregularities in the land surface, for example, low mounds or shallow depressions.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

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.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining 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.

Surface soil. 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."

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

GUIDE TO MAP UNITS

For a full description of a map unit, read the description of the map unit and that of the soil series to which the map unit belongs. For Woodland interpretation, see the section "Uses of the Soils for Woodland." For information on the Storie index ratings, see page 68.

Map symbol	Map unit	Page	Capability unit				Range site	Storie index
			Irrigated		Dryland			
		Page	Symbol	Page	Symbol	Page	Number	
100	Ager clay, 2 to 15 percent slopes	9	IIIe-5	64	IVe-5	67	6	20
101	Ager cobbly clay, 2 to 15 percent slopes	10	------	--	IVe-7	67	6	12
102	Ager cobbly clay, 30 to 50 percent slopes	10	------	---	VIe-1	67	6	4
103	Alturas loam	11	IIIw-6	65	IIIw-6	65	7	32
104	Balman loam	12	------	--	IIIw-6	65	7	7
105	Balman loam, wet	12	------	--	IIIw-6	65	7	4
106	Barnard gravelly loam, 0 to 9 percent slopes	13	IIIe-3	64	IVe-3	66	2	20
107	Barnard cobbly loam, 0 to 9 percent slopes	13	------	--	VIs-1	67	2	20
108	Barnard clay loam, 9 to 15 percent slopes	14	IVe-3	66	IVe-3	66	2	22
109	Bieber gravelly loam, 0 to 9 percent slopes	15	IVe-3	66	VIe-1	67	8	11
110	Bieber gravelly loam, 9 to 15 percent slopes	15	IVe-3	66	VIe-1	67	8	8
111	Bieber cobbly loam, 2 to 15 percent slopes, eroded	15	------	--	VIIe-1	68	8	8
112	Buntingville clay loam, 0 to 2 percent slopes	17	IIIw-2	64	------	--	--	65
113	Buntingville clay loam, 2 to 9 percent slopes	17	IIIe-1	63	IVe-1	66	--	58
114	Calimus loam, 0 to 2 percent slopes	18	IIIc-1	66	-------	--	--	100
115	Calimus loam, 2 to 9 percent slopes	18	IIIe-1	63	-------	--	--	95
116	Calimus gravelly loam, 2 to 5 percent slopes	18	IIIe-1	63	-------	--	--	63
117	Calimus clay loam, 0 to 2 percent slopes	18	IIIc-1	66	-------	--	--	85
118	Casuse sandy loam, 2 to 9 percent slopes	19	------	--	VIe-1	67	3	23
119	Daphnedale loam, 2 to 9 percent slopes	20	IVe-1	66	IVe-1	66	1	24
120	Daphnedale cobbly loam, 9 to 30 percent slopes	20	IVe-7	67	IVe-7	67	1	14
121	Daphnedale stony loam, 30 to 50 percent slopes	20	------	--	VIe-1	67	1	5
122	Daphnedale-Delma loams, 2 to 9 percent slopes	20	IVe-1	66	IVe-1	66	1, 3	*24
123	Daphnedale very cobbly loam, deep variant, 5 to 15 percent slopes	22	------	--	VIs-1	67	1	15
124	Daphnedale very cobbly loam, deep variant, 30 to 50 percent slopes	22	------	--	VIs-1	67	1	5
125	Daphnedale clay loam, deep variant, 5 to 15 percent slopes	22	------	--	VIe-3	66	1	18
126	Delma loam, 15 to 30 percent slopes, eroded	23	------	--	VIe-1	67	3	32
127	Delma loam, 30 to 50 percent slopes	23	------	--	VIIe-1	68	3	11
128	Delma cobbly loam, 0 to 9 percent slopes	23	IVe-1	66	VIe-1	67	3	28
129	Delma cobbly loam, 9 to 30 percent slopes	23	------	--	VIe-1	67	3	20
130	Deven clay loam, 0 to 9 percent slopes	24	------	--	VIe-1	67	4	24
131	Deven very stony clay loam, 30 to 50 percent slopes	24	------	--	VIIs-1	68	4	3
132	Deven-Rock outcrop complex, 2 to 30 percent slopes	24	------	--	VIIs-1	68	4	8
133	Donica gravelly clay loam, 2 to 9 percent slopes	26	IIIe-4	64	VIIe-1	68	5	39
134	Drews loam, 0 to 5 percent slopes	27	IIIe-1	63	-------	--	--	72
135	Drews gravelly loam, 0 to 9 percent slopes	27	IIIe-1	63	-------	--	--	48
136	Drews gravelly loam, 15 to 30 percent slopes	27	------	--	IVe-1	66	1	33
137	Drews clay loam, 2 to 5 percent slopes	27	IIIe-1	63	-------	--	--	65
138	Drews clay loam, wet, 0 to 2 percent slopes	28	IIIw-2	64	-------	--	--	62
139	Fluvaquents	29	------	--	VIIw-1	68	9	**10
140	Gleason loam, 9 to 30 percent slopes	30	------	--	IVe-1	66	--	32
141	Gleason gravelly loam, 30 to 50 percent slopes	30	------	--	VIe-1	67	--	5
142	Goose Lake silt loam	32	IIIw-2	64	-------	--	--	30
143	Gravel pits	32	------	--	VIIIs-1	68	--	**10
144	Jenny silty clay loam, overwash, 0 to 5 percent slopes	33	IIIe-1	63	IVe-1	66	6	77
145	Jenny silty clay, 0 to 5 percent slopes	33	IIIe-5	64	IVe-5	67	6	60
146	Karcal very cobbly clay, 0 to 9 percent slopes	34	------	--	VIs-1	67	6	17
147	Karcal-Ninekar complex, 0 to 9 percent slopes	34	------	--	VIs-1	67	6	*17
148	Kinkel loam, 2 to 15 percent slopes	35	------	--	IVe-1	66	--	34
149	Kinkel loam, 30 to 50 percent slopes	35	------	--	VIe-1	67	--	9
150	Ladd sandy loam, 0 to 2 percent slopes	36	IIIc-1	66	IVe-1	66	1	81

Map symbol	Map unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Number	Storie index
151	Ladd sandy loam, 2 to 9 percent slopes	36	IIIe-1	63	IVe-1	66	1	77
152	Lakeview loam, 0 to 2 percent slopes	38	IIIc-1	66	-------	--	--	95
153	Lakeview clay loam, 2 to 5 percent slopes	38	IIIe-1	63	-------	--	--	31
154	Lolak silty clay loam	39	-------	--	VIIw-1	68	9	1
155	Lorella loam, 5 to 30 percent slopes	40	------	--	VIe-1	67	4	12
156	Lorella loam, 5 to 30 percent slopes, eroded	40	------	--	VIIe-1	68	4	10
157	Lorella loam, 30 to 50 percent slopes	40	------	--	VIIe-1	68	4	7
158	Lorella cobbly clay loam, 15 to 30 percent slopes	40	------	--	VIe-1	67	4	11
159	Lorella cobbly clay loam, 30 to 50 percent slopes	40	------	--	VIIe-1	68	4	6
160	Lorella cobbly clay loam, 30 to 50 percent slopes, eroded	40	------	--	VIIe-1	68	4	17
161	Lorella, deep variant-Rubble land association, steep-	41	------	--	-------	--	--	3
	Lorella, deep variant	--	------	--	VIIe-1	68	2	--
	Rubble land	--	------	--	VIIIs-1	68	--	--
162	Lovejoy silt loam, 0 to 5 percent slopes	42	------	--	IVe-3	66	8	23
163	Lovejoy-Reba complex, 0 to 5 percent slopes	42	------	--	IVe-3	66	8, 1	*73
164	Lyonman loam, 15 to 30 percent slopes	43	------	--	VIe-1	67	--	32
165	Lyonman loam, 30 to 50 percent slopes	43	------	--	VIIe-1	68	--	9
166	McQuarrie sandy loam, 5 to 30 percent slopes	44	------	--	VIe-1	67	3	26
167	McQuarrie stony loam, 30 to 50 percent slopes	44	------	--	VIIe-1	68	3	3
168	Modoc sandy loam, 0 to 9 percent slopes	45	IIIe-3	64	IVe-3	66	1	34
169	Modoc gravelly loam, 0 to 9 percent slopes	45	IIIe-3	64	IVe-3	66	1	25
170	Ninekar very stony silt loam, 0 to 9 percent slopes	46	------	--	VIs-1	67	6	17
171	Packwood-Ditchcamp complex	47	------	--	VIIs-1	68	4, 2	*13
172	Packwood-Rock outcrop complex	47	------	--	VIIs-1	68	4, 2	*13
173	Pasquetti silty clay loam, partially drained	48	IIIw-2	64	-------	--	--	72
174	Pasquetti silty clay loam, drained	48	IIIs-3	65	-------	--	--	81
175	Pineal silt loam	49	------	--	VIs-1	67	7	11
176	Pit silty clay loam, 0 to 2 percent slopes	50	IIIw-5	65	-------	--	--	13
177	Pit clay, 2 to 5 percent slopes	50	IIIw-5	65	-------	--	--	7
178	Pit clay, seeped, 0 to 2 percent slopes	50	------	--	Vw-1	67	10	7
179	Puls extremely stony clay loam, 0 to 9 percent slopes	52	------	--	VIIs-1	68	4	12
180	Puls-Ninekar complex, sloping	52	------	--	VIIs-1	68	4, 6	*11
181	Puls-Rock outcrop complex, 0 to 9 percent slopes	52	------	--	VIIs-1	68	4	10
182	Reba loam, 0 to 5 percent slopes	53	------	--	IIIe-3	64	1	41
183	Rock outcrop-Lithic Xerorthents complex	54	------	--	VIIIs-1	68	--	**10
184	Rubble land	54	------	--	VIIIs-1	68	--	**10
185	Rumbo loam, 0 to 2 percent slopes	55	------	--	IIIs-6	65	7	35
186	Rumbo loam, 2 to 5 percent slopes, eroded	55	------	--	IIIs-6	65	7	17
187	Salisbury very fine sandy loam, 0 to 9 percent slopes	56	IIIe-3	64	IIIe-3	64	1	22
188	Salisbury gravelly loam, 0 to 9 percent slopes	56	IIIe-3	64	IIIe-3	64	1	15
189	Salisbury very cobbly loam, 0 to 9 percent slopes	56	------	--	VIs-1	67	1	15
190	Salisbury clay loam, 9 to 15 percent slopes	56	------	--	IVe-3	66	1	16
191	Tandy loamy fine sand	57	------	--	VIe-1	67	10	11
192	Thoms-Exel complex	58	------	--	VIIs-1	68	8, 2	*8
193	Tuff outcrop-Casuse, eroded complex, 2 to 15 percent slopes	58	------	--	VIIs-1	68	3	5
194	Tuff outcrop-Casuse, eroded complex, 30 to 50 percent slopes	59	------	--	VIIs-1	68	3	2
195	Tulana mucky loam, partially drained	60	IIIw-2	64	-------	--	--	30
196	Tulana mucky loam, drained	60	IIIc-1	66	-------	--	--	30
197	Typic Xerorthents	60	------	--	VIIIs-1	68	--	**10
198	Woodcock stony loam, 2 to 30 percent slopes	61	------	--	VIe-1	67	--	36
199	Woodcock stony loam, 30 to 50 percent slopes	61	------	--	VIe-1	67	--	11
200	Xerofluvents, occasionally flooded	61	------	--	VIIIw-1	68	--	**10

* Rated according to proportion of dominant soils in the complex.
** Rated nonagricultural because of impractical conditions of terrain or of use.

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