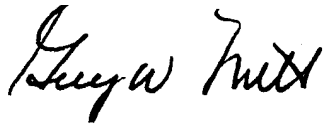
foreword

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

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

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

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



Guy W. Nutt
State Conservationist
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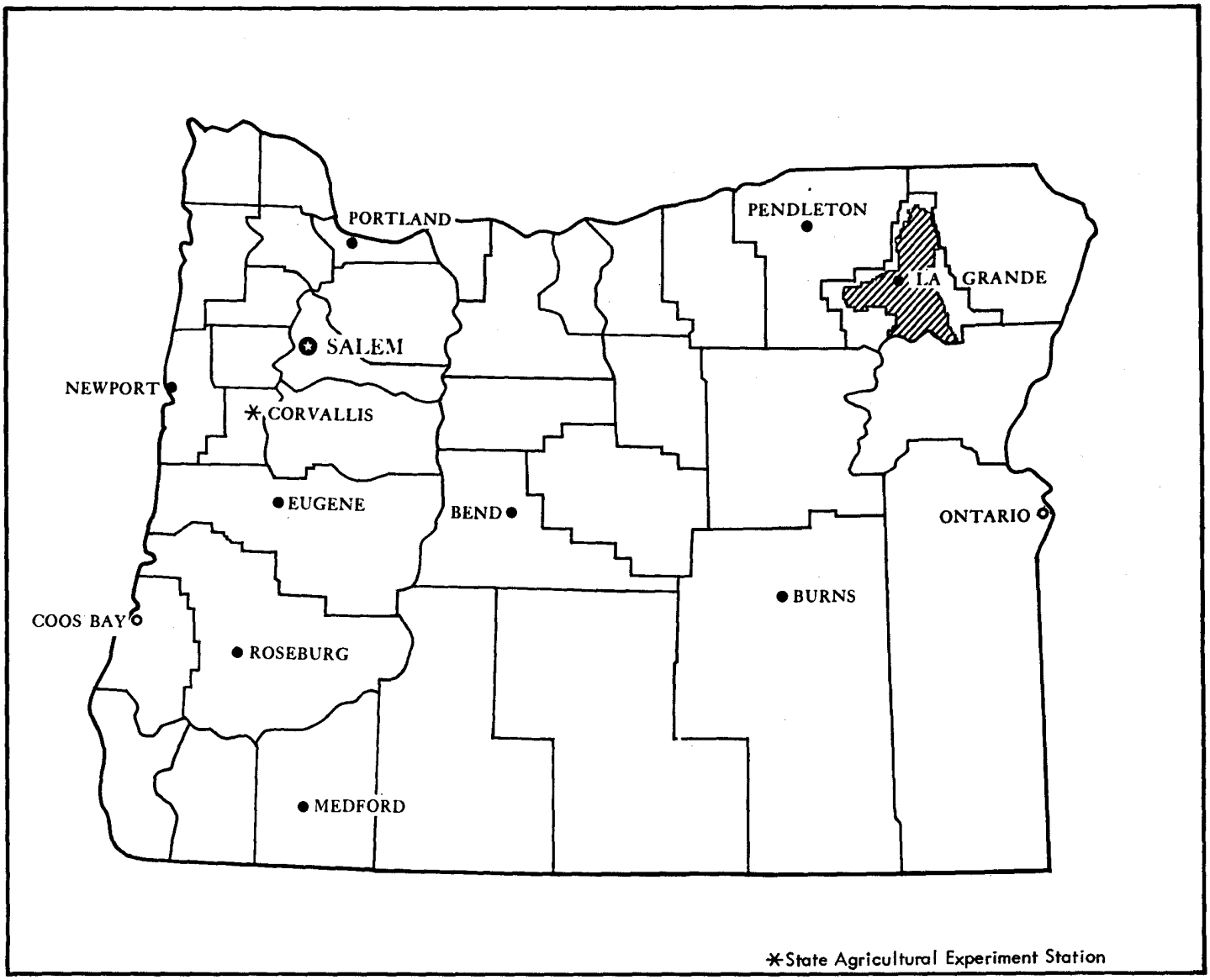

Location of Union County Area in Oregon.

soil survey of
Union County Area, Oregon

By Eugene L. Dyksterhuis and Calvin T. High, Soil Conservation Service

Fieldwork by Eugene L. Dyksterhuis, William E. Laird, Calvin T. High, John A. Shipman, Pat L. Aguilar, Howard M. Vance, and M. Grant Lindsay, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Oregon Agricultural Experiment Station

UNION COUNTY AREA is in the north eastern part of Oregon. It consists of the central two-thirds of Union County but excludes national forest land in the surrounding mountains. The soil survey area is about 671,300 acres, or 1,049 square miles. La Grande, the county seat, has a population of 10,410.

Union County Area is in the Blue Mountains. The northern part of the area is drained by the Grande Ronde River. Originating in the Elkhorn Range, the river meanders through Grande Ronde Valley, a nearly round basin within the mountains, and drains it to the north. The southern part of the area is part of another basin, Baker Valley. It is drained by the Powder River, which also originates in the Elkhorn Range. All drainage water ultimately flows into the Snake River.

Elevation in the survey area ranges from 2,315 feet on the Grande Ronde River in the northern part of the area to 5,493 feet on Shaw Mountain, northwest of North Powder. Peaks in the nearby Elkhorn and Wallowa Ranges rise to more than 9,000 feet.

The survey area has a modified continental climate. Winters are cool and moist, and summers are warm and dry. Temperature and precipitation vary considerably with elevation. From the valley floors into the surrounding mountains, the average annual temperature decreases from about 50 degrees to 45 degrees and the average annual precipitation increases from 10 inches or less to more than 60 inches (8).

The nearly level valley floors and low terraces are used mainly for cultivated crops, the rolling foothills are used mainly as rangeland, and the timbered mountains are used for timber production and cattle grazing.

In mapping the area, the soils of the relatively smooth basins were examined at close intervals and were mapped in considerably more detail than those on the surrounding uplands. Most of the soils mapped at this higher intensity have a narrow range in slope. In the uplands, the soils were examined at moderate to wide intervals and were mapped at medium intensity.

An older survey of part of the Grande Ronde Area of Union County was published in 1926 (9). The present survey provides additional information and larger maps that show the soils in greater detail.

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

general nature of the survey area

This section discusses the settlement and development, transportation and industries, farming, and climate in the survey area.

settlement and development

The earliest inhabitants of the Union County Area were probably members of the Cayuse tribe of Indians. They

hunted bison and deer, fished for salmon and steelhead, and gathered roots and berries.

The area was well known to early nineteenth-century fur trappers. The Grande Ronde Valley was so named by French trappers because of its generally round shape. Before settlement, much of the valley was marsh and swamp and beaver were abundant.

The first permanent settlers arrived in the Grande Ronde Valley in 1861, and the following year a number of families established homes there. Two years later Union County was organized. Located on the Old Oregon Trail, this beautiful valley attracted the attention of many homeseekers on their way to western Oregon. Some went no farther. Others returned from western Oregon to make their home here. Settlement was slow, however, with only the better drained parts of the valley being occupied. In 1884 the railroad was built, which added impetus to settlement.

At first agriculture in the Grande Ronde Valley consisted primarily of livestock production. A little later small grain, potatoes, vegetables, and fruit became important crops. All found a good market with the gold miners in the mountains to the east and south.

The boundaries of Union County have been changed from time to time. In 1887 a part was taken to form Wallowa County. Another part was annexed to Wallowa County between 1890 and 1900. A part was annexed to Baker County in 1902. Parts were annexed to Umatilla County in 1913 and to Wallowa County in 1915. Finally, parts of Umatilla and Wallowa Counties were annexed to Union County in 1913 and 1915, respectively.

La Grande, the county seat and largest town, is a railroad division and junction point and is noted for its manufacture of lumber. La Grande's population in 1920 was 6,913. The population of Union County in 1920 was 16,636. The population in 1975 was 22,100 in the county and 10,410 in La Grande.

Union County, surrounded by national forests, has abundant recreational sites including campgrounds, picnic areas, dude ranches, and ski areas. Activities include hunting, fishing, hiking, camping, nature study, berry picking, and skiing. A more detailed discussion of the recreational activities available in Union County is given in the section "Recreation."

transportation and industries

The survey area has very good transportation facilities. Interstate 84, one of the more extensively traveled highway routes across the continent, traverses the area, roughly following the Old Oregon Trail. State highways connect most of the towns and villages in the area. Nearly all farms are served by paved or graveled county roads that join the federal and state highways. Graded roads extend to most of the mountainous areas, but many of them are not maintained throughout the year. Numerous spur and access roads branch off the main roads. Many of these have been abandoned or are not maintained.

The transcontinental line of the Union Pacific Railroad, connecting Portland with Salt Lake City and points East, serves the area. From La Grande, the Elgin branch of this line extends north through the central part of the valley. A short branch line connects Union with the main line. No point in Grande Ronde Valley is more than 7 miles from a shipping point, and most farms are within 5 miles.

Several truck lines provide freight service to the area. Passenger bus service is available at La Grande. The terminal for Air Oregon is at the La Grande Airport. The airport also serves private aircraft.

Most of the industries in the area are directly related to the production or processing of agricultural and woodland products. The farm service industries are centered in Island City. Agricultural goods are shipped throughout the county. Sawmills are located in La Grande, Elgin, Union, Alicel, and North Powder. Wood products such as hardboard, plywood, lumber, and wood by-products are manufactured locally and are a major source of income.

farming

The Union County area produces a variety of crops including wheat, barley, alfalfa and grass hay, grass seed, green peas, potatoes, cherries, and pasture crops. Much of the valley has been drained, and the hazard of flooding has been reduced by construction of the State Ditch and by extensive diking. For maximum production of most crops, irrigation is required in summer.

Beef cattle production is the most important livestock enterprise. Most cattle operations are cow-calf, with feeder steers being shipped to feedlots elsewhere. Sheep production has recently shown a modest increase. Swine production is important. There are two large dairy operations in Grande Ronde Valley.

For many years, as the population of the area increased, farms increased in number and decreased in size, but this trend has reversed since the introduction of modern farm machinery. The number of farms decreased from 873 in 1959 to 705 in 1974; during the same period, however, the average size of farms increased from 600 acres to 650 acres. Many homesteads in the hilly and mountainous uplands were abandoned after a few years because of the harsh climate and remoteness. Later, many small farms were incorporated into larger units that could be operated more efficiently and economically. A significant change in farm organization in the past decade has been the shift from owner-operated to lessor-operated farms. Also, many farms in the area are operated on a part-time basis, with a large number of farm personnel being employed in other industries.

climate

In the Union County Area, summers are warm or hot in most of the valleys and much cooler in the mountains.

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

Table 1 gives data on temperature and precipitation for the survey area as recorded at Elgin, Meacham, and Union for the period 1951 to 1977. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperatures at Elgin, Meacham, and Union are 32, 29, and 33 degrees F, respectively. The average daily minimum temperature is 24 degrees at Elgin, 23 degrees at Meacham, and 26 degrees at Union. The lowest recorded temperature occurred at Elgin on January 4, 1959, and is -27 degrees. In summer the average temperature is 64 degrees at Elgin, 61 degrees at Meacham, and 64 degrees at Union. The average daily maximum temperature is about 79 degrees. The. highest recorded temperature, which occurred at Elgin on August 4, 1961; is 110 degrees.

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

Of the total annual precipitation, 7 to 10 inches, or about 40 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 7 inches. The heaviest 1-day rainfall during the period of record was 2.08 inches at Meacham on December 11, 1956. Thunderstorms occur on about 10 days each year, and most occur in summer.

Average seasonal snowfall is 50 inches at Elgin, 147 inches at Meacham, and 27 inches at Union. The greatest snow depth at any one time during the period of record was 23 inches at Elgin, 50 inches at Meacham, and 12 inches at Union. On the average, 13 days at Elgin, 63 days at Meacham, and 17 days at Union have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The percentage of possible sunshine is 80 in summer and 25 in winter. The prevailing wind is from the southeast. Average windspeed is highest, 11 miles per hour, in spring. Both the speed and direction of winds are highly variable, depending principally on the topography in the various parts of the survey area. Wind velocities in the southern part of the Grande Ronde Valley are higher than the average for the survey area, and a moderate hazard of soil blowing exists on some soils.

Climatic data for this section were especially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

how this survey was made

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

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

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

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their, characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

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

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of

soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

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

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

The 11 map units in this survey have been grouped into four general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

areas dominated by deep and moderately deep, well drained to somewhat poorly drained soils that formed in alluvial and lacustrine deposits

This group consists of two map units. It makes up about 16 percent of the survey area.

This group is on flood plains, terraces, and fans in the Grande Ronde Valley and in tributary valleys. Slope is 0 to 5 percent. Flooding is a hazard in some areas.

This group is used mainly for hay and pasture. It is also used for grain crops.

1. Catherine-La Grande-Veazie

Deep, well drained to somewhat poorly drained soils that formed in alluvial and lacustrine deposits derived mainly from basalt, andesite, and granite

This map unit is on flood plains in Grande Ronde Valley and in tributary valleys. The Veazie soils are the dominant soils in the tributary valleys in the mountainous areas surrounding the main valley. Slope is 0 to 3 percent. Elevation ranges from 2,200 to 4,000 feet. The average annual precipitation ranges from 11 to 25 inches, the average annual air temperature ranges from 45 to 53 degrees F, and the frost-free period ranges from 50 to 160 days.

This unit makes up about 9 percent of the survey area. About 35 percent of the unit is Catherine soils, 35 percent is La Grande soils, and 15 percent is Veazie soils. The remaining 15 percent is soils of minor extent.

Catherine soils are somewhat poorly drained. The surface layer is black silt loam. Below this to a depth of 60 inches or more is very dark grayish brown silt loam underlain by layers of sand, sandy loam, or silt loam. These layers are 0 to 50 percent gravel. These soils have a water table at a depth of 24 to 48 inches in winter and spring.

La Grande soils are moderately well drained. The surface layer is black silt loam, the subsoil is dark yellowish brown silty clay loam, and the substratum is stratified sand to loam and is 0 to 70 percent gravel or cobbles. These soils have a water table at a depth of 24 to 48 inches in winter and spring.

Veazie soils are well drained. The surface layer is very dark brown loam, the subsoil is very dark grayish brown loam, and the substratum to a depth of 60 inches or more is stratified sand and gravel. These soils have a water table at a depth of 48 to 72 inches in winter and spring.

Of minor extent in this unit are Voats soils that are shallow to gravel; deep, well drained Jeff soils; somewhat poorly drained, calcareous, strongly alkaline Umapine soils; somewhat poorly drained Hot Lake soils; and poorly drained Hoopal soils.

This unit is used mainly for small grain, hay, pasture, urban development, and wildlife habitat. Most of the acreage has been cleared, and some of it has been drained. There are some undrained, swampy areas.

Wetness is the main limitation of this unit for farming and for most other uses. Also, flooding and ponding are common in winter and spring. When adequately drained, this unit has good potential for cultivated crops. Wetness and flooding are such severe limitations on the Catherine soils that their potential for urban development is poor. The potential for urban development is fair on the better drained La Grande soils, which are rarely subject to flooding.

2. Hot Lake-Conley-Hoopal

Moderately deep *and* deep, *somewhat poorly drained soils that formed in lacustrine sediment mixed with diatomaceous sediment and volcanic ash*

This map unit is on old lakebeds in the Grande Ronde Valley. Elevation is 2,600 to 3,500 feet. Slope is 0 to 5 percent. The average annual precipitation is 13 to 23 inches. The average annual air temperature is 45 to 53 degrees F, and the frost-free period is 110 to 150 days.

This unit makes up about 7 percent of the survey area. About 55 percent of the unit is Hot Lake soils, 20 percent is Conley soils, and 10 percent is Hoopal soils. The remaining 15 percent is soils of minor extent.

The Hot Lake soils have a surface layer of black silt loam. The upper part of the substratum is grayish brown silt loam and very fine sandy loam, and the lower part is silty diatomaceous sediment. The water table is at a depth of 18 to 30 inches in winter and spring. Slope is 0 to 2 percent.

The Conley soils have a surface layer of black silty clay loam, a subsoil of very dark gray clay, and a substratum of dark brown silty clay loam. The water table is perched above the clay subsoil in winter and spring. Slope is 0 to 5 percent.

The Hoopal soils have a surface layer of very dark grayish brown fine sandy loam. The subsoil is dark brown silt loam over a weakly cemented duripan that is underlain by fine sandy loam. A water table is perched above the duripan in winter and spring. Slope is 0 to 2 percent.

Of minor extent in this unit are Hoopal Variant soils that are shallow to a duripan, Hooly soils that are shallow to diatomaceous sediment, somewhat poorly drained Catherine soils, and somewhat poorly drained, calcareous, strongly alkaline Umapine soils.

This unit is used mainly for small grain, hay, pasture, and wildlife habitat.

The main limitations of this unit for farming and for most other uses are wetness and shallow depth to diatomaceous sediment or to a duripan. The duripan can be ripped, and deep plowing into the diatomaceous sediment increases rooting depth. The water table can be lowered with artificial drainage.

The potential for urban development and intensive recreational development on this unit is poor. The main limitations are wetness and the shallow depth to diatomaceous sediment or to a duripan.

areas dominated by deep and moderately deep, well drained soils that formed, in alluvial; eolian, and lacustrine deposits and in residuum and colluvium derived from basalt and volcanic tuff

This group consists of four map units. It makes up about 22 percent of the survey area.

This group is on terraces, fans, and upland foot slopes in Grande Ronde Valley, the Elgin area, and the south-central part of Union County. Slope is 0 to 45 percent. Most of the soils in this group are well drained, but some are moderately well drained.

This group is used mainly for irrigated crops, hay, pasture, and rangeland.

3. Ramo-Phys-Ramo Variant

Moderately deep and deep, well drained soils that formed in old alluvial deposits mixed with volcanic ash, tuff, and loess

This map unit is on foot slopes, fans, and terraces near the margin of Grande Ronde Valley, in High Valley, and near Elgin. Elevation is 2,700 to 3,800 feet. Slope is 1 to 35 percent. The average annual precipitation is 16 to 21 inches, the average annual temperature is 47 to 51 degrees F, and the frost-free period is 100 to 150 days.

This unit makes up about 3 percent of the survey area. About 60 percent of the unit is Ramo soils, 20 percent is Phys soils, and 10 percent is Ramo Variant soils. The remaining 10 percent is soils of minor extent.

The Ramo soils are deep. They have a surface layer of black silty clay loam or very stony silty clay loam, a subsoil of very dark brown silty clay loam, and a buried subsoil of dark reddish brown gravelly clay. Slope is 2 to 35 percent.

The Phys soils are deep. They have a surface layer of very dark brown silt loam, a subsoil of very dark brown very cobbly clay loam, and a substratum of dark brown extremely cobbly loam. Slope is 1 to 5 percent.

The Ramo Variant soils are moderately deep. They have a surface layer of black silt loam and a subsoil of dark brown clay over a very gravelly, weakly cemented duripan that is underlain by extremely cobbly sand. Slope is 2 to 12 percent.

Of minor extent in this unit are deep, somewhat poorly drained Conley soils in depressional areas, and shallow Gwinly soils and moderately deep, clayey Ukiah soils, both on adjacent uplands.

This unit is used mostly for small grain, pasture, rangeland, and wildlife habitat.

The main limitations for farming are the slow permeability of the soils and their content of rock fragments. Crop yields can be increased with irrigation where water is available.

The potential for urban and intensive recreational development on this unit is moderate. The unit is limited mainly by the slow permeability of the soils, the content of rock fragments in the soils, and the shrink-swell potential. The duripan in the Ramo Variant soils is a limitation for most uses.

4. Imbler-Palouse-Alicel

Deep, well drained soils that formed in sandy and silty eolian material

This map unit is in the "sand ridge" area of the Grande Ronde Valley, mainly near the towns of Alicel and Imbler. It is also on Pumpkin Ridge, near the town of Elgin. The soils in this unit formed on terraces and uplands in wind-deposited material from old, adjacent flood plains. Slope is 0 to 45 percent. Elevation is 2,600 to 3,500 feet. The average annual precipitation is 16 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the frost-free period is 120 to 160 days.

This unit makes up about 8 percent of the survey area. About 35 percent of the unit is Imbler soils, 30 percent is Palouse soils, and 25 percent is Alicel soils. The remaining 10 percent is soils of minor extent.

The Imbler soils have a surface layer of very dark brown coarse sandy loam or fine sandy loam and a substratum of dark brown loamy fine sand. Slope is 1 to 5 percent.

The Palouse soils have a surface layer of black silt loam, a subsoil of dark brown silty clay loam, and a substratum of brown silt loam. Slope is 0 to 45 percent.

The Alicel soils have a surface layer of very dark brown loam, a subsoil of dark brown clay loam, and a substratum of dark yellowish brown fine sandy loam. Slope is 1 to 15 percent.

Of minor extent in this unit are deep, moderately well drained La Grande soils on low terraces and deep, ashy Wolot soils on adjacent uplands.

This unit is used mainly for small grain, grass seed, green peas, alfalfa hay, and wildlife habitat. Most crops are irrigated.

The moderately rapid permeability of the Imbler soils and the susceptibility of the unit to soil blowing are the main limitations for farming.

The potential for urban and intensive recreational development is good.

5. Watama-McMurdie-Lookingglass

Moderately deep and deep, well drained and moderately well drained soils that formed in residuum and colluvium derived from basalt, volcanic tuff, loess, and volcanic ash

This map unit is on old, high terraces, on uplands, and in basins in the Cricket Flat area north and east of the town of Elgin. Elevation is 2,600 to 4,000 feet. Slope is 2 to 25 percent. The average annual precipitation is 14 to 25 inches, the average annual air temperature is 46 to 52 degrees F, and the frost-free period is 120 to 160 days.

This unit makes up about 7 percent of the survey area. About 35 percent of the unit is Watama soils, 25 percent is McMurdie soils, and 20 percent is Lookingglass soils. The remaining 20 percent is soils of minor extent.

The Watama soils are moderately deep and well drained. They have a surface layer of very dark brown silt loam and a subsoil of very dark brown silty clay loam. Basalt is at a depth of 20 to 40 inches. These soils commonly are in complexes with Gwinly soils. They occur as "biscuits," or circular mounds, in areas of biscuit-scabland. Slope is 2 to 12 percent.

The McMurdie soils are deep and well drained. They have a surface layer of black silt loam and a buried subsoil of dark brown clay. Basalt is at a depth of 40 to 60 inches. Slope is 2 to 25 percent.

The Lookingglass soils are deep and moderately well drained. They have a surface layer of very dark brown silt loam, a buried subsoil of dark brown clay, and a substratum of brown silty clay loam. A water table is perched over the clay subsoil in winter and spring. Slope is 2 to 20 percent.

Of minor extent in this unit are shallow Gwinly soils; moderately deep and clayey Ukiah soils; deep, silty Palouse soils; deep, somewhat poorly drained Conley soils; and deep, ashy Wolot soils.

This unit is used mainly for small grain, hay, pasture, rangeland, and wildlife habitat.

The main limitations of the unit for farming are restricted rooting depth, slow permeability, and slope. Irrigation is seldom used, because precipitation is normally adequate for most crops. There is a hazard of erosion in the more steeply sloping areas.

This unit is poorly suited to urban and intensive recreational development. It is limited mainly by slow permeability, shallow depth to rock, and slope.

6. Coughanour-Encina-Hutchinson

Moderately deep and deep, well drained soils that formed in old alluvial deposits and volcanic tuff

This map unit is in the drier, southern part of Union County, primarily in the northern part of Baker Valley. It is on old glacial outwash terraces on which volcanic tuff and, later, volcanic ash and loess were deposited. Slope is 0 to 45 percent. Elevation is 2,300 to 4,000 feet. The average annual precipitation is 9 to 16 inches, the average annual air temperature is 45 to 50 degrees F, and the frost-free period is 110 to 140 days.

This unit makes up about 4 percent of the survey area. About 35 percent of the unit is Coughanour soils, 30 percent is Encina soils, and 20 percent is Hutchinson soils. The remaining 15 percent is soils of minor extent.

The Coughanour soils are moderately deep. They have a surface layer of dark brown silt loam and a subsoil of dark yellowish brown silty clay loam. Below this is a strongly cemented duripan that is underlain by dark brown sandy loam. Slope is 0 to 12 percent.

The Encina soils are deep. They have a surface layer of very dark gray silt loam, a subsoil of very dark grayish brown clay, and a substratum of yellowish brown silt loam. Slope is 2 to 45 percent.

The Hutchinson soils are deep. They have a surface layer of very dark grayish brown silt loam and a subsoil of dark brown clay. Below this is a strongly cemented duripan that is underlain by dark brown extremely cobbly sandy loam. Slope is 1 to 20 percent.

Of minor extent in this unit are Lookout soils that have a duripan, Ruckles soils that are shallow over basalt, and moderately deep North Powder soils that are underlain by granitic rock. All of these soils are on uplands.

This unit is used mainly for small grain, hay, pasture, and wildlife habitat. Most crops are irrigated.

The main limitations for farming are slow permeability and restricted rooting depth.

The potential for urban and intensive recreational development is poor. The unit is limited mainly by slow permeability, shallow depth, and steepness of slope.

areas dominated by shallow and moderately deep, well drained soils that formed in colluvium and residuum derived from basalt and volcanic tuff

This group consists of two map units. It makes up about 21 percent of the survey area.

This group is on dry foothills adjacent to and generally at lower elevations than timbered areas. Slope is 1 to 70 percent. The soils in this group are well drained. Water erosion is a hazard on some of the soils.

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

7. Ruckles-Lookout

Shallow and moderately deep, well drained soils that formed mainly in colluvium and residuum derived from basalt and volcanic tuff

This map unit is in the warm, driest foothill areas, mainly in the southern part of the survey area. Slope is 1 to 65 percent. Elevation is 2,400 to 3,600 feet. The average annual precipitation is 8 to 14 inches, the average annual air temperature is 45 to 50 degrees F, and the frost-free period is 100 to 140 days.

This unit makes up about 2 percent of the survey area. About 65 percent of the unit is Ruckles soils, and 20 percent is Lookout soils. The remaining 15 percent is soils of minor extent.

The Ruckles soils are shallow. They have a surface layer of very dark gray very stony clay loam and a subsoil of dark yellowish brown very cobbly clay. They are 10 to 20 inches deep over basalt. Slope is 1 to 65 percent.

The Lookout soils are moderately deep. They have a surface layer of very dark grayish brown very stony silt loam and a subsoil of dark brown clay. They are 20 to 40 inches deep over an indurated duripan. Slope is 2 to 20 percent.

Of minor extent in this unit are deep, clayey Encina soils on terraces; moderately deep North Powder soils on uplands; somewhat poorly drained Umapine soils on flood plains; and Rock outcrop.

This unit is used mainly as rangeland and for wildlife habitat. The vegetation is dominantly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, buckwheat, and sagebrush.

This unit is poorly suited to cultivated crops because of rock fragments on the surface, shallow rooting depth, dry climate, and lack of irrigation water. Some small included areas, however, are used for alfalfa, small grain, and pasture.

This unit is poorly suited to use as homesites and for other urban uses because of rock fragments on the surface, shallow depth, and the slow permeability of the clayey subsoil.

The suitability of this unit for intensive recreational development such as campgrounds and picnic areas is poor because of the rock fragments on the surface, shallow depth to rock, and the slowly permeable subsoil. The suitability for recreational activities such as nature study and hunting is good.

8. Gwinly-Anatone-Ukiah

Shallow and moderately deep, well drained soils that formed mainly in colluvium and residuum derived from basalt and volcanic tuff

This map unit is on warm to cool, dry foothills that are adjacent to timbered areas and are generally lower in elevation. The Gwinly soils commonly are on south- and west-facing side slopes, and the Anatone soils commonly are on north- and east-facing side slopes. The Ukiah soils generally are in broad, nearly level to moderately steep areas. Elevation is 2,300 to 5,000 feet. Slope is 2 to 70 percent. The average annual precipitation is 15 to 30 inches, the average annual air temperature is 43 to 50 degrees F, and the frost-free period is 80 to 150 days.

This unit makes up about 19 percent of the survey area. About 50 percent of the unit is Gwinly soils, 25 percent is Anatone soils, and 15 percent is Ukiah soils. The remaining 10 percent is soils of minor extent.

The Gwinly soils are shallow. They have a surface layer of very dark grayish brown very cobbly silt loam and a subsoil of dark brown extremely cobbly clay. They are 10 to 20 inches deep over basalt. Slope is 2 to 70 percent.

The Anatone soils are shallow. They have a surface layer of dark brown extremely stony loam and a subsoil of dark brown very cobbly loam. They are 10 to 20 inches deep over basalt. These soils are in the coolest areas of this unit. Slope is 2 to 65 percent.

The Ukiah soils are moderately deep .They have a surface layer of black silty clay loam and a subsoil of very dark gray clay. They are 20 to 40 inches deep over soft volcanic tuff. Slope is 2 to 40 percent.

Of minor extent in this unit are very shallow Bocker and Rockly soils; moderately deep, very stony Royst soils; shallow, stony, clayey Starkey soils; deep, clayey McMurdie soils; and moderately deep, timbered Klicker soils.

This unit is used mainly as rangeland and for wildlife habitat. Vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and perennial forbs.

This unit is poorly suited to cultivated crops because of rock fragments on the surface, shallow rooting depth, the slowly permeable subsoil, and lack of irrigation water. Small, nonstony areas at the lower elevations are used for hay, pasture, and small grain.

This unit is poorly suited for use as homesites and for other urban uses because of rock fragments on the surface, shallow soil depth, the slowly permeable subsoil, and, in most areas, steepness of slope.

This unit is poorly suited to intensive recreational development such as campgrounds and picnic areas because of rock fragments on the surface, shallow soil depth, the slowly permeable subsoil, and, in most areas, steepness of slope. The unit is well suited to recreational activities such as nature study and hunting.

areas dominated by deep and moderately deep, well drained and moderately well drained soils that formed in colluvium and residuum derived from basalt and volcanic tuff and recent volcanic ash

This group consists of three map units. It makes up about 41 percent of the survey area.

This group is on forested uplands of the Blue Mountains, which surround the Grande Ronde Valley. Slope is 2 to 65 percent. Most of the soils in this group are well drained, but a few soils are moderately well drained.

This group is used mainly for timber production, woodland grazing, and wildlife habitat.

9. Lookingglass-Emily-Wolot

Deep, well drained and moderately well drained soils that formed in colluvium and residuum derived from volcanic tuff and basalt and in volcanic ash and loess

This map unit is on the lower mountains that are transitional to the nontimbered foothill areas. The unit consists of the warmest and driest of the timbered areas. The Wolot and Lookingglass soils generally are on gently sloping to moderately sloping uplands. The Emily soils are on foot slopes and alluvial fans, where alluvium and colluvium derived from basalt has accumulated. Slope is 2 to 20 percent. Elevation is 2,700 to 3,900 feet. The average annual precipitation is 17 to 30 inches, the average annual air temperature is 45 to 49 degrees F, and the frost-free period is 100 to 150 days.

This unit makes up about 5 percent of the survey area. About 45 percent of the unit is Lookingglass soils, 25 percent is Emily soils, and 15 percent is Wolot soils. The remaining 15 percent is soils of minor extent.

The Lookingglass soils are moderately well drained. They have a surface layer of very dark brown silt loam and a subsurface layer of dark grayish brown silt loam. The next layer is a buried subsoil of dark brown clay. The substratum to a depth of 60 inches or more is brown silty clay loam. Slope is 2 to 20 percent.

The Emily soils are well drained. They have a surface layer of dark brown cobbly silt loam, a subsoil of dark brown very cobbly clay loam, and a substratum of dark brown extremely cobbly loam that extends to a depth of 60 inches or more. The coarse fragments in these soils make them more droughty than the Lookingglass and Wolot soils. Slope is 2 to 12 percent.

The Wolot soils are well drained. They have a surface layer of dark brown silt loam. The subsoil is dark yellowish brown silt loam that formed in volcanic ash that was deposited over a brown silty clay loam soil that extends to a depth of 60 inches or more. These soils have exceptionally high available water capacity and commonly support the most dense and diverse stands of timber in this unit. Slope is 2 to 12 percent.

Of minor extent in this unit are deep, clayey Cowsley soils; moderately deep Klicker soils; and deep, ashy Tolo soils. All of these soils are timbered. Also in this unit are shallow Gwinly soils and very shallow Rockly soils.

This unit is used mainly for timber production. The principal timber species are ponderosa pine, Douglas-fir, and grand fir. Open grassland areas in this unit are used for livestock grazing. Cleared areas are used for cultivated crops such as small grain, alfalfa, hay, and pasture.

This unit is suited to use as homesites and to other urban uses. The most limiting soil features for urban development are the very slow permeability of the Lookingglass soils and the large number of coarse fragments in and on the Emily soils. The Wolot soils are often quite dusty during the dry summer months.

This unit is well suited to intensive recreational development such as campgrounds and picnic areas. The limiting soil features are the same as those for urban development. The unit is well suited to recreational activities such as nature study, hiking, fishing, and hunting.

10. Tolo-Klicker-Cowsley

Moderately deep and deep, well drained and moderately well drained soils that formed in volcanic ash and loess and in colluvium and residuum derived from volcanic tuff and basalt

This map unit is in the cool, moist, mountainous uplands. Tolo and Cowsley soils commonly are on north- and east-facing side slopes, where deposits of volcanic ash and volcanic tuff are thickest. Wicker soils, derived from basalt, are on nearly level ridgetops and on sloping hillsides. Slope is 2 to 65 percent. Elevation is 2,500 to 5,000 feet. The average annual precipitation is 17 to 35 inches, the average annual air temperature is 42 to 46 degrees F, and the frost-free period is 50 to 120 days.

This unit makes up about 32 percent of the survey area. About 45 percent of the unit is Tolo soils, 35 percent is Klicker soils, and 10 percent is Cowsley soils. The remaining 10 percent is soils of minor extent.

The Tolo soils are deep and well drained. They have a surface layer of black silt loam. The subsoil is dark brown silt loam that formed in volcanic ash that was deposited over a dark yellowish brown silty clay loam soil that extends to a depth of 60 inches or more. These soils have exceptionally high available water capacity and commonly support the most diverse and dense stands of timber on this unit. Slope is 12 to 65 percent.

The Klicker soils are moderately deep and well drained. They have a surface layer of dark reddish brown stony silt loam and a subsoil of dark reddish brown very cobbly clay loam. They are 20 to 40 inches deep over basalt. These soils are droughtier than the Tolo and Cowsley soils, commonly support less dense stands of timber, and are associated with more shallow soils. Slope is 2 to 65 percent.

The Cowsley soils are deep and moderately well drained. They have a surface layer of very dark grayish brown silt loam deposited over a dark brown clay subsoil that is cobbly in the lower part and extends to a depth of 60 inches or more. These soils are between the Klicker and Tolo soils in the density of the stands of timber on them. The soils in places are adjacent to wet mountain meadows. Slope is 2 to 20 percent.

Of minor extent in this unit are shallow Anatone soils; very shallow Bocker soils; moderately deep Hall Ranch soils; clayey Hutchinson Variant soils on terraces; moderately deep, ashy Olot soils; gravelly Veazie soils on flood plains; and poorly drained Wilkins soils in wet mountain meadows.

This unit is used mainly for timber production. It provides excellent food and cover for many kinds of wildlife. The principal timber species are grand fir, Douglas-fir, ponderosa pine, western larch, and lodgepole pine. Open grassland areas in this unit are used for livestock grazing.

This unit is unsuitable for cultivation because of cool climate, steepness of slope, and content of rock fragments. These same limitations make this unit poorly suited for use as homesites and for other urban uses.

The suitability of this unit for intensive recreational development such as campgrounds and picnic areas is good in the less steeply sloping areas where the soils are deep. Suitability for recreational activities such as nature study, hiking, hunting, and fishing is excellent.

11. Kamela-Loneridge-Helter

Moderately deep and deep, well drained soils that formed in volcanic ash and loess and in colluvium and residuum derived from basalt

This unit is on cold, moist, mountainous uplands that are at a high elevation. It is on gently sloping ridgetops and on steep and very steep side slopes. The Kamela soils are mainly on south-facing side slopes, and the Helter soils are mainly on steep, north-facing side slopes. Slope is 2 to 65 percent. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 30 to 60 inches, the average annual air temperature is 40 to 46 degrees F, and the frost-free period is 20 to 90 days.

This unit makes up about 4 percent of the survey area. About 40 percent of the unit is Kamela soils, 25 percent is Loneridge soils, and 20 percent is Helter soils. The remaining 15 percent is soils of minor extent.

The Kamela soils are moderately deep. They have a surface layer of dark brown very stony silt loam and a subsoil of dark brown extremely cobbly silt loam. They are 20 to 40 inches deep over basalt. These soils are droughtier than Loneridge and Helter soils and commonly support less dense stands of timber. Slope is 2 to 35 percent.

The Loneridge soils are deep. They have a surface layer of dark brown stony silt loam. The subsoil to a depth of 60 inches or more is dark brown very cobbly silty clay loam grading to very cobbly clay. These soils have a greater variety of understory vegetation than do the other soils in this unit. Slope is 12 to 40 percent.

The Helter soils are deep. They have a surface layer of very dark brown silt loam and a subsoil of yellowish brown silt loam, both of which are mainly volcanic ash that was deposited over a dark brown silty clay loam subsoil that extends to a depth of 60 inches or more. These soils are in the highest, coldest, and wettest areas of this unit. They have exceptionally high available water capacity and commonly support the most dense stands of timber on this unit. Slope is 12 to 65 percent.

Of minor extent in this unit are shallow Anatone soils, very shallow Bocker soils, moderately deep Klicker soils; gravelly Veazie soils on flood plains, and somewhat poorly drained Wilkins soils in wet mountain meadows.

This unit is used mainly for timber production. It provides good food and cover for many kinds of wildlife. The principal timber species are western larch, Douglas-fir, grand fir, subalpine fir, Englemann spruce, lodgepole pine, and ponderosa pine.

This unit is unsuitable for cultivation because of the cold climate, steepness of slope, and rock fragments. Because of these same limitations, the unit is poorly suited for use as homesites and for other urban uses.

The suitability of this unit for intensive recreational development such as campgrounds and picnic areas is good in the less steeply sloping areas where the soils are deep. The suitability for extensive recreation such as nature study, hiking, hunting, and fishing is excellent.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alicel fine sandy loam, 1 to 5 percent slopes, is one of several phases in the Alice[series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Anatone-Bocker complex, 2 to 35 percent slopes, is an example.

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

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

This survey was mapped at two levels of intensity. The more detailed survey is identified by narrowly defined map units. The less detailed portion is identified by broadly defined units. In the narrowly defined units the soil delineation boundaries were plotted and verified at closely spaced intervals. In the broadly defined units the soil delineation boundaries were plotted and verified at greater intervals. The intensity of mapping selected was based on the anticipated long term use of the survey, and the mapping units were designed to meet the needs for that use. The broadly defined units are identified on the soil legend at the back of this survey at the back of this survey by an asterisk following the map unit name.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

map unit descriptions

1B-Alicel fine sandy loam, 1 to 5 percent slopes. This deep, well drained, gently undulating soil is on valley terraces. It formed in mixed eolian material derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,600 to 3,000 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is very dark brown fine sandy loam about 18 inches thick. The upper 13 inches of the subsoil is very dark grayish brown loam. The lower 16 inches is dark brown clay loam. The substratum to a depth of 60 inches or more is dark yellowish brown fine sandy loam.

Included in this unit are small areas of Alicel loam, Alicel silt loam, Imbler soils, and Palouse soils.

Permeability of this Alicel soil is moderate to a depth of 47 inches and moderately rapid below this depth. Available water capacity is about 11 to 13 inches. Water supplying capacity is 14 to 17 inches. Effective rooting

depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas of this unit are used for crops, mainly winter wheat and alfalfa. Among the other crops grown are green peas and grass seed. Some areas are used for wildlife habitat and homesite development.

This unit is well suited to cultivated crops. The main limitation is the hazard of soil blowing.

In summer, irrigation is required for maximum production of most crops grown on this unit. Sprinkler irrigation is the most suitable method of applying water. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain soil tilth and organic matter content. Soil blowing can also be reduced by stripcropping and by planting field windbreaks. The risk of water erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and waterways are shaped and seeded to perennial grass.

Grain and grasses grown on this unit respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is well suited to hay and pasture: Grasses and legumes grow well if adequate fertilizer is used. If the unit is irrigated, water can be applied by the sprinkler method. Use of proper stocking rates, pasture rotation, and restricted grazing during wet periods helps to keep the pasture in good condition and to protect the unit from erosion.

This unit is well suited to windbreaks and environmental plantings. Among the trees suitable for planting are Russian-olive, ponderosa pine, black locust, and hybrid poplar. Among the shrubs are rose, Amur honeysuckle, and lilac. Supplemental irrigation may be needed when planting and during dry periods.

This unit is well suited to recreational development.

Population growth has resulted in increased construction of homes on this unit. The main limitation for homesite development is the hazard of soil blowing. Preserving the existing plant cover during construction helps to control erosion, and revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. In summer, irrigation is required for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Buildings and roads constructed on this unit should be designed to offset the limited ability of the soil to support a load. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

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

2B-Alicel loam, 1 to 5 percent slopes. This deep, well drained, gently undulating soil is on valley terraces. It formed in mixed eolian material derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,600 to 3,000 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is very dark brown loam about 18 inches thick. The upper 13 inches of the subsoil is very dark grayish brown loam. The lower 16 inches is dark brown clay loam. The substratum to a depth of 60 inches or more is dark yellowish brown fine sandy loam.

Included in this unit are small areas of Alicel silt loam, Alicel fine sandy loam, Imbler soils, and Palouse soils.

Permeability of this Alice[soil is moderate to a depth of 47 inches and moderately rapid below this depth. Available water capacity is about 11 to 13 inches. Water supplying capacity is 14 to 17 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is slight.

Most areas of this unit are used for crops, mainly winter wheat and alfalfa. Among the other crops grown are green peas and grass seed. Some areas are used for wildlife habitat and homesite development.

This unit is well suited to cultivated crops. In summer, irrigation is required for maximum production of most crops grown on this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Sprinkler irrigation is the most suitable method of applying water.

Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. The risk of water erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and waterways are shaped and seeded to perennial grass.

Grain and grasses grown on this unit respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is well suited to hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. If the unit is irrigated, water can be applied by the sprinkler method. Use of proper stocking rates, pasture rotation, and restricted grazing during wet periods helps to keep the pasture in good condition and to protect the unit from erosion.

This unit is well suited to environmental plantings. Among the trees suitable for planting are Russian-olive; ponderosa pine, black locust, and hybrid poplar. Among the shrubs are rose, Amur honeysuckle, and lilac. Supplemental irrigation may be needed when planting and during dry periods.

This unit is well suited to recreational development.

Population growth has resulted in increased construction of homes on the soil in this unit. Preserving the existing plant cover during construction helps to control erosion. In summer, irrigation is required for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Buildings and roads constructed on the unit should be designed to offset the limited ability of the soil to support a load. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

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

3C-Alicel silt loam, 2 to 15 percent slopes. This deep, well drained, rolling soil is on valley terraces. It formed in mixed eolian material derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,600 to 3,000 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is very dark brown silt loam about 18 inches thick. The upper 13 inches of the subsoil is very dark grayish brown loam. The lower 16 inches is dark brown clay loam. The substratum to a depth of 60 inches or more is dark yellowish brown fine sandy loam.

Included in this unit are small areas of Alicel loam and Alicel fine sandy loam. Also included are small areas of Imbler and Palouse soils.

Permeability of this Alicel soil is moderate to a depth of 47 inches and moderately rapid below this depth. Available water capacity is about 11 to 13 inches. Water supplying capacity is 14 to 17 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of soil blowing is slight.

Most areas of this unit are used for crops, mainly winter wheat and alfalfa. Among the other crops grown are green peas, grass seed, and pasture. The unit is also used for wildlife habitat and homesite development.

This unit is well suited to cultivated crops. The main limitation is the hazard of water erosion.

In summer, irrigation is required for maximum production of most crops grown on this unit. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Sprinkler irrigation is the most suitable method of applying water.

Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content. The risk of erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, tillage and seeding are on the contour or across the slope, and waterways are shaped and seeded to perennial grass.

Grain and grasses grown on this unit respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is well suited to hay and pasture. Grasses and legumes grow well on the unit if adequate fertilizer is used. If the unit is irrigated, water can be applied by the sprinkler method. Use of proper stocking rates, pasture rotation, and restricted grazing during wet periods helps to keep the pasture in good condition and to protect the soil from erosion.

This unit is well suited to environmental plantings. Among the trees suitable for planting are Russian-olive, ponderosa pine, black locust, and hybrid poplar. Among the shrubs are rose, Amur honeysuckle, and lilac. Supplemental irrigation may be needed when planting and during dry periods.

This unit is moderately well suited to recreational use. The main limitations are slope and dustiness.

Population growth has resulted in increased construction of homes on this unit. The main limitation for homesite development is the hazard of water erosion. Preserving the existing plant cover during construction helps to control erosion. In summer, irrigation is required for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Buildings and roads constructed on this unit should be designed to offset the limited ability of the soil to support a load. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of Water supplies as a result of seepage from onsite sewage disposal systems.

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

4E-Anatone extremely stony loam, 2 to 35 percent slopes. This shallow, well drained soil is on ridgetops and on south- and west-facing side slopes of uplands. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 90 to 130 days.

Typically, the surface layer is dark brown extremely stony loam about 6 inches thick. The subsoil is dark brown very cobbly loam about 5 inches thick. Below this is basalt that is fractured in the upper 5 inches. Depth to basalt ranges from 10 to 20 inches (fig. 1). Included in this unit are small areas of Klicker and Bocker soils and Rock outcrop. Included areas make up about 20 percent of the total acreage.

Permeability of this Anatone soil is moderate. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and stiff

Figure 1.-Profile of Anatone extremely stony loam, 2 to 35 percent slopes.

sagebrush. The production of vegetation suitable for livestock grazing is limited by the shallow depth to bedrock and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations for seeding and seedbed preparation are the extremely stony surface and the shallow depth to bedrock. Use of mechanical treatment practices is not practical, because the surface is extremely stony and the slopes in some areas are steep.

This unit responds well to proper grazing use. Management practices suitable for use on this unit are deferred grazing, rotation grazing, and aerial spraying for brush management. Livestock grazing should be managed to protect the soil in this unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce vegetation suitable for grazing.

This unit is poorly suited to homesite and recreational development. The main limitations are depth to bedrock, large stones, and the steepness of slope in some areas.

This map unit is in capability subclass VIIs, nonirrigated.

5E-Anatone-Bocker complex, 2 to 35 percent slopes. This map unit is on ridgetops and on south- and west-facing side slopes of uplands. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 90 to 130-days:

This unit is about 50 percent Anatone extremely stony loam and about 40 percent Bocker very cobbly silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Rock outcrop and Royst soils.

The Anatone soil is shallow and well drained. It formed in residuum and colluvium derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Typically, the surface layer is dark brown extremely stony loam about 6 inches thick. The subsoil is dark brown very cobbly loam about 5 inches thick. Below this is basalt that is fractured in the upper 5 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of the Anatone soil is moderate. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Bocker soil is very shallow and well drained. It formed in residuum and colluvium derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Typically, the surface layer is dark reddish brown very cobbly silt loam about 2 inches thick. The subsoil is dark reddish brown very gravelly loam about 5 inches thick. Fractured basalt is at a depth of 7 inches. Depth to basalt ranges from 4 to 10 inches.

Permeability of the Bocker soil is moderate. Available water capacity is about 0.5 to 1 inch. Water supplying

capacity is 2 to 5 inches. Effective rooting depth is 4 to 10 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and stiff sagebrush. The production of vegetation suitable for livestock grazing is limited by depth to rock and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations for seedbed preparation and seeding are the depth to rock and the extremely stony and very cobbly surface layer.

Use of mechanical treatment practices on this unit is not practical, because the surface is stony and the slopes in some areas are steep. Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce vegetation suitable for grazing.

This unit is poorly suited to homesite and recreational development. The main limitations are stoniness and depth to bedrock.

This map unit is in capability subclass VIIs, nonirrigated.

6F-Anatone-Klicker complex, 40 to 65 percent slopes. This map unit is in irregularly shaped areas on mountainous uplands. Elevation is 2,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 degrees F, and the average frost-free period is 100 to 120 days.

This unit is about 60 percent Anatone extremely stony loam and 30 percent Klicker stony silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bocker, Cowsly, Hall Ranch, and Tolobo soils and Rock outcrop.

The Anatone soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Typically, the surface layer is dark brown extremely stony loam about 6 inches thick. The subsoil is dark brown very cobbly loam about 5 inches thick. Below this is basalt that is fractured in the upper 5 inches. Basalt is at a depth of about 16 inches. Depth to basalt ranges from 10 to 20 inches.

Permeability of the Anatone soil is moderate. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Klicker soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from basalt. Mixed loess and volcanic ash are in the surface layer. Typically, the surface layer is dark reddish brown stony silt loam about 11 inches thick. The upper 7 inches of the subsoil is dark reddish brown very cobbly silt loam. The lower 15 inches is dark reddish brown very cobbly clay loam. Basalt is at a depth of about 33 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 4.5 to 6 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

If the range vegetation on the Anatone soil is in good or excellent condition, the native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and stiff sagebrush. The production of vegetation suitable for livestock grazing is limited by shallow rooting depth, droughtiness, and steepness of slope. The vegetation on the Klicker soil is mainly ponderosa pine with an understory of elk sedge and pinegrass. The production of vegetation suitable for livestock grazing is limited by competition with trees, stones on the surface, and steepness of slope.

The suitability of this unit for rangeland seeding is poor. The main limitations for seeding are stones on the surface, droughtiness, and steepness of slope.

Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas of this unit. Trails or walkways can be constructed in places to encourage livestock grazing in areas where access is limited. Other management practices suitable for use on the unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Use of mechanical treatment practices on this unit is not practical, because the surface is stony and the slopes are steep. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

The Klicker soil is suited to the production of ponderosa pine. Based on a site index of 76 (10), the potential production per acre of wood fiber is 3,150 cubic feet from an even-aged, fully stocked stand of trees 50 years old or 32,480 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 160 years old.

The main concerns in producing and harvesting timber on this unit are steepness of slope and the scattered small stands. Conventional methods of harvest are difficult to use because of the steepness of slope. The steepness of slope also limits the kinds of equipment that can be used in forest management.

Management that minimizes the risk of erosion is essential in harvesting timber. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing.

Plant competition on this unit delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. The main limitations for planting trees are steepness of slope and stoniness.

This unit is poorly suited to homesite and recreational development. The main limitations are steepness of slope, stoniness, and depth to rock.

This map unit is in capability subclass VIIs, nonirrigated.

7-Catherine silt loam. This deep, somewhat poorly drained soil is on flood plains and low stream terraces. It formed in mixed alluvium derived dominantly from basalt, granite, and andesite. Slope is 0 to 3 percent. The vegetation in areas not cultivated is mainly water-tolerant grasses, sedges, and rushes. Elevation is 2,200 to 4,000 feet. The average annual precipitation is 11 to 23 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 160 days.

Typically, the surface layer is black heavy silt loam about 30 inches thick. The subsurface layer is very dark grayish brown silt loam about 10 inches thick. The upper 8 inches of the substratum is very dark grayish brown silt loam. The lower part to a depth of 60 inches or more is very dark grayish brown very gravelly silt loam.

Included in this unit are small areas of Conley, La Grande, Umapine, and Veazie soils. Also included are small areas of Catherine silty clay loam and areas of soils that are more poorly drained than this Catherine soil.

Permeability of this Catherine soil is moderate. Available water capacity is about 10 to 13 inches. Water supplying capacity is 8 to 18 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 48 inches in winter and spring. This soil is subject to occasional, brief periods of flooding in winter and spring.

Most areas of this unit are used for crops, mainly wheat and alfalfa. A few areas are used for pasture and wildlife habitat.

This unit is suited to most cultivated crops. The water table that builds up during the rainy period in winter and spring generally limits the suitability of the soil for deep-rooted crops. Tile drainage can be used to lower the water table if a suitable outlet is available. The risk of flooding can be reduced by the use of channel improvements, dikes, and levees.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed.

Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content.

This unit is suited to hay and pasture. The main limitations are restricted rooting depth and wetness. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Grasses and legumes grow well if adequate fertilizer is used. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite and recreational development. The main limitations are the hazard of flooding and wetness.

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

8-Catherine silty clay loam. This deep, somewhat poorly drained soil is on flood plains and. low stream terraces. It formed in mixed alluvium derived dominantly from basalt, granite, and andesite. Slope is 0 to 3 percent. The vegetation in areas not cultivated is mainly water-tolerant grasses, sedges, and rushes. Elevation is 2,200 to 4,000 feet. The average annual precipitation is 11 to 23 inches, the average annual air temperature is 45 to 50 degrees F; and the average-frost-free period is 110 to 160 days.

Typically, the surface layer is black silty clay loam about 30 inches thick. The subsurface layer is very dark grayish brown silt loam about 10 inches thick. The upper 8 inches of the substratum is very dark grayish brown silt loam. The lower part to a depth of 60 inches or more is very dark grayish brown very gravelly silt loam.

Included in this unit are small areas of Conley, La Grande, Umapine, and Veazie soils. Also included are small areas of Catherine silt loam and areas of soils that are more poorly drained than this Catherine soil.

Permeability of this Catherine soil is moderate. Available water capacity is about 10 to 13 inches. Water supplying capacity is 8 to 18 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 48 inches in winter and spring. This soil is subject to occasional, brief periods of flooding in winter and spring.

Most areas of this unit are used for crops, mainly wheat and alfalfa. A few areas are used for pasture and wildlife habitat.

This unit is suited to most cultivated crops. The water table that builds up during the rainy period in winter and spring generally limits the suitability of the soil for deep-rooted crops. Tile drainage can be used to lower the water table if a suitable outlet is available. The risk of flooding can be reduced by the use of channel improvements, dikes, and levees.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed.

Maintaining crop residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter content.

This unit is suited to hay and pasture. The main limitations are restricted rooting depth and wetness. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Grasses and legumes grow well if adequate fertilizer is used. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite and recreational development. The main limitations are the hazard of flooding and wetness.

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

9A-Conley silty clay loam, 0 to 2 percent slopes. This deep, somewhat poorly drained soil is on alluvial fans and in old lake basins. It formed in mixed alluvial and lacustrine material derived dominantly from basalt; granite, and argillite. Elevation is 2,600 to 3,500 feet. The average annual precipitation is about 17 to 23 inches, the average annual air temperature is 45 to 53 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is dark gray silt loam about 3 inches thick. The subsoil is very dark gray clay about 37 inches thick. The substratum to a depth of 60 inches or more is dark brown silty clay loam. In some areas the surface layer is silt loam.

Included in this unit are small areas of Catherine, Hot Lake, and La Grande soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Conley soil is very slow. Available water capacity is about 8 to 11 inches. Water supplying capacity is 14 to 17 inches. Effective rooting depth is 18 to 30 inches. Few roots penetrate the dense clay subsoil. Runoff is slow, and the hazard of water erosion is slight. A water table is at a depth of 18 to 30 inches from December to April.

Most areas of this unit are used for crops, mainly wheat, alfalfa, peas, bluegrass seed, and grass hay. A few areas are used for cherry production and pasture.

This unit is suited to most irrigated and nonirrigated crops. The perched water table that develops during the rainy period from December to April generally limits the suitability of the unit for deep-rooted crops. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess water from the surface.

Irrigation is required for some crops grown on this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. Irrigation water must be applied carefully to prevent the development of a perched water table. Drainage may also be required.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. Leaving crop residue on or near the surface helps to conserve moisture and maintain tilth. Crops respond to nitrogen, phosphorus, boron, and sulfur fertilizer.

This unit is suited to hay and pasture. The main limitation is a seasonal water table that is perched above the dense clay subsoil. The perched water table can be lowered by using drainage tile and grassed waterways. Unless the soil in this unit is drained, the use of equipment is limited by wetness.

If this unit is irrigated, water can be applied by the sprinkler and flood methods. Irrigation water must be applied carefully to prevent the development of a perched water table.

Grasses and legumes grow well on this unit if adequate fertilizer is used. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth.

This unit is moderately well suited to recreational development. It is limited mainly by wetness and very slow permeability.

This unit is poorly suited to homesite development. The main limitations are wetness, very slow permeability, and shrink-swell potential.

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

9B-Conley silty clay loam, 2 to 5 percent slopes. This deep, somewhat poorly drained soil is on alluvial fans and in old lake basins. It formed in mixed alluvial and lacustrine material derived dominantly from basalt, granite, and argillite. Elevation is 2,600 to 3,500 feet. The average annual precipitation is about 17 to 23 inches, the average annual air temperature is 45 to 53 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is dark gray silt loam about 3 inches thick. The subsoil is very dark gray clay about 37 inches thick. The substratum to a depth of 60 inches or more is dark brown silty clay loam. In some areas the surface layer is silt loam.

Included in this unit are small areas of Catherine, Hot Lake, and La Grande soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Conley soil is very slow. Available water capacity is about 8 to 11 inches. Water supplying capacity is 14 to 17 inches. Effective rooting depth is 18 to 30 inches. Few roots penetrate the dense clay

subsoil. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. A water table is at a depth of 18 to 30 inches from December to April.

Most areas of this unit are used for crops, mainly wheat, alfalfa, peas; bluegrass seed, and grass hay. A few areas are used for cherry production and pasture.

This unit is suited to irrigated and nonirrigated crops. The perched water table that develops during the rainy period from December to April generally limits the suitability of the unit for deep-rooted crops. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess water from the surface.

Irrigation is required for some crops grown on this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. Irrigation water must be applied carefully to prevent the development of a perched water table. Drainage may also be required.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Limiting tillage for seedbed preparation and weed control reduces runoff and erosion. When the soil is plowed in fall, runoff and erosion can be reduced by fertilizing and seeding to a cover crop. Crop residue left on or near the surface helps to conserve moisture, maintain tilth, and control erosion. Crops respond to nitrogen, phosphorus, boron, and sulfur fertilizer.

This unit is suited to hay and pasture. The main limitation is a seasonal water table that is perched above the dense clay subsoil. The perched water table can be lowered by using drainage tile and grassed waterways. Unless the soil in this unit is drained, the use of equipment is limited by wetness.

If this unit is irrigated, water can be applied by the sprinkler and flood methods. Irrigation water must be applied carefully to prevent the development of a perched water table.

Grasses and legumes grow well on this unit if adequate fertilizer is used. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth.

This unit is moderately well suited to recreational development. It is limited mainly by wetness and very slow permeability.

This unit is poorly suited to homesite development. The main limitations are wetness, very slow permeability, and shrink-swell potential.

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

10A-Coughanour silt loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces and fans. It formed in mixed alluvium derived mainly from loess and volcanic ash deposited over glacial outwash. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,700 to 3,500 feet. The average annual precipitation is about 9 to 13 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is dark brown silt loam about 18 inches thick. The upper 8 inches of the subsoil is dark yellowish brown silty clay loam. The lower 6 inches is dark brown, calcareous silty clay loam. The next layer is a platy hardpan that is strongly cemented with silica and lime. It is about 8 inches thick. The substratum to a depth of 60 inches or more is dark brown sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Encina and Hutchison soils. Also included are small areas of more steeply sloping Coughanour soils.

Permeability of this Coughanour soil is moderate to a depth of 18 inches and moderately slow below this depth. Available water capacity is about 4 to 9 inches. Water supplying capacity is 5 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for crops, mainly wheat and alfalfa. Some areas are used for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the cemented pan, which reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation, and sprinkler, irrigation systems are suited to the soil in this unit. Irrigation water needs to be applied carefully to prevent the development of a high water table. Drainage may also be needed.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. The main limitation is the cemented pan, which reduces the yield of deep-rooted crops. Deep ripping of the cemented pan, where feasible, helps to overcome this limitation. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition.

This unit is poorly suited to homesite and recreational development. The main limitations are the cemented pan, shrinking and swelling of the soil, and low soil strength. Seepage is a concern if waste water penetrates to the material beneath the hardpan.

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

10B-Coughanour silt loam, 2 to 7 percent slopes. This moderately deep, well drained soil is on terraces and fans. It formed in mixed alluvium derived dominantly from loess and volcanic ash deposited over glacial outwash. The vegetation in areas not cultivated is mainly

bunchgrasses and annual forbs. Elevation is 2,700 to 3,500 feet. The average annual precipitation is about 9 to 13 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is dark brown silt loam about 18 inches thick. The upper 8 inches of the subsoil is dark yellowish brown silty clay loam. The lower 6 inches is dark brown, calcareous silty clay loam. The next layer is a platy hardpan that is strongly cemented with silica and lime. It is about 8 inches thick. The underlying material to a depth of 60 inches or more is dark brown sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Encina and Hutchinson soils. Also included are small areas of more steeply sloping and less steeply sloping Coughanour soils.

Permeability of this Coughanour soil is moderate to a depth of 18 inches and moderately slow below this depth. Available water capacity is about 4 to 9 inches. Water supplying capacity is 5 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for crops, mainly wheat and alfalfa. Some areas are used for wildlife habitat.

This unit is suited to most cultivated crops. It is limited mainly by the cemented pan, which reduces the yield of deep-rooted plants. Deep ripping of the cemented pan, where feasible, helps to overcome this limitation and reduces runoff and erosion.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Irrigation water needs to be applied carefully to prevent the development of a high water table. Drainage may also be needed.

The hazard of erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and waterways are shaped and seeded to perennial grass.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. The main limitation is the cemented pan, which reduces the yield of deep-rooted plants. Deep ripping of the cemented pan, where feasible, helps to overcome this limitation. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite and recreational development. The main limitations are the cemented pan, shrinking and swelling of the soil, and low soil strength. Seepage is a concern if waste water penetrates to the material beneath the hardpan.

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

10C-Coughanour silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on terraces and fans. It formed in mixed alluvium, derived dominantly from loess and volcanic ash, deposited over glacial outwash. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,700 to 3,500 feet. The average annual precipitation is about 9 to 13 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is dark brown silt loam about 18 inches thick. The upper 8 inches of the subsoil is dark yellowish brown silty clay loam. The lower 6 inches is dark brown, calcareous silty clay loam. The next layer is a platy hardpan that is strongly. cemented with silica and lime. It is about 8 inches thick. The underlying material to a depth of 60 inches or more is dark brown sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Encina and Hutchinson soils. Also included are small areas of more steeply sloping and less steeply sloping Coughanour soils.

Permeability of this Coughanour soil is moderate to a depth of 18 inches and moderately slow below this depth. Available water capacity is about 4 to 9 inches. Water supplying capacity is 5 to 8 inches. Effective rooting depth is 20 to 40inches. Runoff is medium, and the hazard of water erosion is moderate.

Most areas of this unit are used for crops, mainly wheat and alfalfa. Some areas are used for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the cemented pan, which reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation and reduces runoff and erosion.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Irrigation water needs to be applied carefully to prevent the development of a high water table. Drainage may also be needed.

Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. The main limitation is the cemented pan, which reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite and recreational development. The main limitations are the cemented pan, shrinking and swelling of the soil, and low soil strength. Seepage is a concern if waste water penetrates to the material beneath the hardpan.

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

11C-Cowsly silt loam, 2 to 12 percent slopes. This deep, moderately well drained soil is on mountainous uplands. It formed in loess and volcanic ash overlying older residuum and colluvium derived dominantly from volcanic tuff and basalt. The native vegetation is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 to 46 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface layer is very dark grayish brown silt loam about 15 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The next layer is a buried subsoil of dark brown clay about 23 inches thick. The underlying material to a depth of 60 inches or more is dark brown cobbly clay.

Included in this unit are small areas of Anatone, Hall Ranch, Klicker, Tolo, and Wilkins soils. Also included are small areas of more steeply sloping Cowsly soils and stony Cowsly soils.

Permeability of this Cowsly soil is moderate to a depth of 19 inches and very slow below this depth. Available water capacity is about 8 to 10 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 20 to 60 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. Water is perched above the clay subsoil in winter and spring.

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

This unit is well suited to the production of ponderosa pine and Douglas-fir. The site index for ponderosa pine ranges from 99 to 112. On the basis of a site index of 105 (10), the potential production per acre of wood fiber is 4,480 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,040 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The main concerns in producing and harvesting timber are the very slow permeability of the clay subsoil and the seasonal perched water table.

Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong. Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Roads for year-round use need heavy base rock.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The production of understory forage is limited by the density of the tree stand. If the understory is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

If this unit is used for recreational development, the main limitations are the very slow permeability of the clay subsoil and the seasonal perched water table.

This unit is poorly suited to homesite development. The main limitations are the very slow permeability of the clay subsoil and the seasonal perched water table.

This map unit is in capability subclass IIIe, nonirrigated.

11D-Cowsly silt loam, 12 to 20 percent slopes. This deep, moderately well drained soil is on mountainous uplands. It formed in loess and volcanic ash overlying older residuum and colluvium derived dominantly from volcanic tuff and basalt. The native vegetation is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 to 46 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface layer is very dark grayish brown silt loam about 15 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The next layer is a buried subsoil of dark brown clay about 23 inches thick. The underlying material to a depth of 60 inches or more is dark brown cobbly clay.

Included in this unit are small areas of Anatone, Hall Ranch, Klicker, Tolo, and Wilkins soils. Also included are small areas of less steeply sloping Cowsly soils and stony Cowsly soils.

Permeability of this Cowsly soil is moderate to a depth of 19 inches and very slow below this depth. Available water capacity is about 8 to 10 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 20 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate. Water is perched above the clay subsoil in winter and spring.

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

This unit is well suited to the production of ponderosa pine and Douglas-fir. The site index for ponderosa pine ranges from 99 to 112. On the basis of a site index of 105 (10), the potential production per acre of wood fiber is 4,480 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,040 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The main concerns in producing and harvesting timber are the very slow permeability of the clay subsoil and the seasonal perched water table. Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Roads for year-around use need heavy base rock.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the density of the tree stand. If the understory is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

If this unit is used for recreational development, the main limitations are the very slow permeability of the clay subsoil and the seasonal perched water table.

This unit is poorly suited to homesite development. The main limitations are the very slow permeability of the clay subsoil and the seasonal perched water table.

This map unit is in capability subclass IIIe, nonirrigated.

12D-Cowsly very stony silt loam, 2 to 20 percent slopes. This deep, moderately well drained soil is on mountainous uplands. It formed in loess and volcanic ash overlying older residuum and colluvium derived dominantly from volcanic tuff and basalt. The native vegetation is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 to 46 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface layer is very dark grayish brown very stony silt loam about 15 inches thick. The subsurface layer is brown silt loam about 4 inches thick. The next layer is a buried subsoil of dark brown clay about 23 inches thick. The underlying material to a depth of 60 inches or more is dark brown cobbly clay.

Included in this unit are small areas of Anatone, Hall Ranch, Klicker, Tolo, and Wilkins soils. Also included are small areas of Cowsly soils that are not stony.

Permeability of this Cowsly soil is moderate to a depth of 19 inches and very slow below this depth. Available water capacity is about 8 to 10 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 20 to 60 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. Water is perched above the clay subsoil in winter and spring.

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

This unit is well suited to the production of ponderosa pine and Douglas-fir. The site index for ponderosa pine ranges from 99 to 112. On the basis of a site index of 105 (10), the potential production per acre of wood fiber is 4,480 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,040 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The main concerns in producing and harvesting timber are the very slow permeability of the clay subsoil, the seasonal perched water table, and stones on the surface.

Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong. Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Roads for year-round use need heavy base rock. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked normal stand of trees. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, bluebunch wheatgrass, and Idaho fescue. The production of understory forage is limited by the stones on the surface and the density of the tree stands. If the understory is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

If this unit is used for recreational development, the main limitations are the very slow permeability of the clay subsoil, the seasonal perched water table, and stones on the surface.

This unit is poorly suited to homesite development. The main limitations are the very slow permeability of the clay subsoil, the seasonal perched water table, stones on the surface, and slope.

This map unit is in capability subclass VIs, nonirrigated.

13C-Emily silt loam, 2 to 12 percent slopes. This deep, well drained soil is mainly on the toe slopes and alluvial fans of steep mountains. It is on north- and east-facing slopes. It formed in alluvium and colluvium derive dominantly from basalt. Some volcanic ash and loess is in the surface layer. The native vegetation is mainly coniferous forest with an understory of grasses, forbs,

and shrubs. Elevation is 2,700 to 3,200 feet. The average annual precipitation is about 22 to 24 inches, the average annual air temperature is 47 to 49 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface is covered with a mat of duff, needles, twigs, and leaves about 1 inch thick. The surface layer is dark brown silt loam about 6 inches thick. The upper 8 inches of the subsoil is dark brown gravelly light clay loam. The lower 20 inches is dark brown very cobbly light clay loam. The substratum to a depth of 60 inches or more is dark brown extremely cobbly loam.

Included in this unit are small areas of Conley, Klicker, and Wolot soils. Also included are small areas of Emily cobbly silt loam.

Permeability of this Emily soil is moderate. Available water capacity is about 3 to 6 inches. Water supplying capacity is 6 to 10 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly for timber production. It is also used for some cultivated crops, suburban homesites, and wildlife habitat.

This unit is well suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 84 to 88. On the basis of a site index of 85 (10), the potential production per acre of wood fiber is 3,080 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 38;700 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 150 years old.

This unit has few limitations for timber production. Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked normal stand of trees. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the density of the tree stand. If the understory is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Cleared areas of this unit are suited to cultivated crops. The major crops grown are alfalfa hay and winter wheat.

This unit is limited for cultivated crops mainly by the high content of rock fragments in the soil, which reduces the available water capacity and may interfere with tillage.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Irrigation water needs to be applied at a rate that insures optimum production without increasing runoff, deep percolation, and erosion.

Grain and grasses grown on the soil in this unit respond to nitrogen, and legumes respond to phosphorous, boron, and sulfur. The risk of erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass.

This unit is well suited to recreational development. It has few limitations. Dustiness may be a problem during dry periods.

Population growth has resulted in increased construction of homes on this unit. The main limitations for homesite development are slow permeability and the content of rock fragments in the soil.

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

14C-Emily cobbly silt loam, 2 to 12 percent slopes. This deep, well drained soil is mainly on the toe slopes and alluvial fans of mountains. It is on north- and east-facing-side slopes.-The soil formed in alluvium and colluvium derived dominantly from basalt. Some volcanic ash and loess is in the surface layer. The native vegetation is mainly coniferous forest with an understory of grasses, forbs, and shrubs. Elevation is 2,700 to 3,200 feet. The average annual precipitation is about 22 to 24 inches, the average annual air temperature is 47 to 49 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface is covered with a mat of duff, needles, twigs, and leaves about 1 inch thick. The surface layer is dark brown cobbly silt loam about 6 inches thick. The upper 8 inches of the subsoil is dark brown gravelly light clay loam. The lower 20 inches is dark brown very cobbly light clay loam. The substratum to a depth of 60 inches or more is dark brown extremely cobbly loam.

Included in this unit are small areas of Conley, Klicker, and Wolot soils. Also included are small areas of Emily silt loam.

Permeability of this Emily soil is moderate. Available water capacity is about 3 to 6 inches. Water supplying capacity is 6 to 10 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly for timber production. It is also used for some cultivated crops, suburban homesites, and wildlife habitat.

This unit is well suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 84 to 88. On the basis of a site index of 85 (10), the

potential production per acre of wood fiber is 3,080 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 38,700 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 150 years old.

This unit has few limitations for timber production. Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked normal stand of trees. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the stones on the surface and the density of the tree stand. If the understory is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

This unit is well suited to recreational development. It is limited mainly by rock fragments on the surface.

Population growth has resulted in increased construction of homes on this unit. The main limitations for homesite development are slow permeability and the content of rock fragments in the soil and on the surface.

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

15C-Encina silt loam, 2 to 12 percent slopes. This deep, well drained soil is on old, dissected terraces. It formed in loess and volcanic ash mixed with old sediment derived dominantly from volcanic tuff, argillite, basalt, and granite. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,300 to 4,000 feet. The average annual precipitation is about 10 to 14 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is very dark gray silt loam over silty clay loam. It is about 8 inches thick. The upper 12 inches of the subsoil is very dark grayish brown clay. The lower 8 inches is yellowish brown silty clay loam. The upper 15 inches of the substratum is yellowish brown, calcareous silt loam, and the lower part to a depth of 60 inches or more is pale yellow, calcareous silt loam.

Included in this unit are small areas of Coughanour, Hutchinson, Lookout, and Ruckles soils. Also included are small areas of more steeply sloping Encina soils.

Permeability of this Encina soil is slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 7 to 10 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly as rangeland. It is also used for some cultivated crops and for wildlife habitat. It is suited to dryland alfalfa.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be delayed until the soil in this unit has drained sufficiently and is firm enough to withstand trampling by livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

If this unit is used for cultivated crops, the main limitations are the slow permeability of the clay subsoil, low precipitation, and lack of readily available water for irrigation. Because precipitation is not sufficient for annual cropping, a cropping system that includes small grain and summer fallow is most suitable.

A tillage pan forms easily if the soil is tilled when wet. Chiseling or subsoiling breaks up the tillage pan. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

The hazard of erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass.

This unit is poorly suited to homesite and recreational development. The main limitations are the slow permeability of the clay subsoil, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass IIIe, nonirrigated.

15E-Encina silt loam, 12 to 45 percent north slopes. This deep, well drained soil is on old, dissected terraces. It formed in loess and volcanic ash mixed with old sediment derived dominantly from volcanic tuff, argillite, basalt, and granite. The native vegetation is mainly bunchgrasses and annual forbs. Elevation is 2,300 to 4,000 feet. The average annual precipitation is about 10 to 14 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is very dark gray silt loam over silty clay loam. It is about 8 inches thick. The upper 12 inches of the subsoil is very dark grayish brown clay. The lower 8 inches is yellowish brown silty clay loam. The upper 15 inches of the substratum is yellowish

brown, calcareous silt loam, and the lower part to a depth of 60 inches or more is pale yellow, calcareous silt loam.

Included in this unit are small areas of Coughanour, Hutchinson, Lookout, and Ruckles soils. Also included are small areas of less steeply sloping Encina soils.

Permeability of this Encina soil is slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 8 to 11 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

This unit is used as rangeland.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be delayed until the soil in this unit has drained sufficiently and is firm enough to withstand trampling by livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. The main limitation for seeding is steepness of slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater hazard of erosion.

This unit is poorly suited to homesite and recreational development. The main limitations are the steepness of slope, the slow permeability of the clay subsoil, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass VIe, nonirrigated.

16E-Encina silt loam, 12 to 45 percent south slopes. This deep, well drained soil is on old, dissected terraces. It formed in loess and volcanic ash mixed with old sediment derived dominantly from volcanic tuff, argillite, basalt, and granite. The native vegetation is mainly bunchgrasses and annual forbs. Elevation is 2,300 to 4,000 feet. The average annual precipitation is about 10 to 14 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is very dark gray silt loam over silty clay loam. It is about 8 inches thick. The upper 12 inches of the subsoil is very dark grayish brown clay. The lower 8 inches is yellowish brown silty clay loam. The upper 15 inches of the substratum is yellowish brown, calcareous silt loam, and the lower part to a depth of 60 inches or more is pale yellow, calcareous silt loam.

Included in this unit are small areas of Coughanour, Hutchinson, Lookout, and Ruckles soils. Also included are small areas of less steeply sloping Encina soils.

Permeability of this Encina soil is slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 6 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

This unit is used as rangeland.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be delayed until the soil in this unit has drained sufficiently and is firm enough to withstand trampling by livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. The main limitation for seeding is steepness of slope. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater hazard of erosion.

This unit is poorly suited to homesite and recreational development. The main limitations are the steepness of slope, the slow permeability of the clay subsoil, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass VIe, nonirrigated.

17D-Gwinly very cobbly silt loam, 12 to 20 percent slopes. This shallow, well drained soil is mainly on ridgetops, but in some places it is on south- and west-facing side slopes of uplands. It formed in colluvium and residuum derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. Elevation is 2,300 to 4,600 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is very dark grayish brown very cobbly silt loam about 4 inches thick. The next layer is very dark grayish brown very cobbly silty clay loam about 3 inches thick. The subsoil is dark brown extremely cobbly clay about 9 inches thick. Basalt is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are small areas of Rockly, Ukiah, Watama, and Starkey soils and Rock outcrop. Included areas make up about 30 percent of the total acreage.

Permeability of this Gwinly soil is slow. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of vegetation suitable for livestock grazing is limited by stoniness and depth to rock. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of the soil in this unit for rangeland seeding is poor. The main limitations are the very cobbly surface layer and depth to rock. Use of mechanical treatment practices is not practical because of the very cobbly surface.

This unit responds well to proper grazing use. Other management practices suitable for use on the unit are deferred grazing, rotation grazing, and aerial spraying for brush management. Livestock grazing should be managed to protect the soil from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce vegetation suitable for grazing.

This unit is poorly suited to homesite and recreational development. The main limitations are stoniness and depth to rock.

This map unit is in capability subclass VIIs, nonirrigated.

17E-Gwinly very cobbly silt loam, 20 to 40 percent slopes. This shallow, well drained soil is on south- and west-facing side slopes of uplands. It formed in colluvium and residuum derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. Elevation is 2,300 to 4,600 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is very dark grayish brown very cobbly silt loam about 4 inches thick. The next layer is very dark grayish brown very cobbly silty clay loam about 3 inches thick. The subsoil is dark brown extremely cobbly clay about 9 inches thick. Basalt is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are small areas of Starkey and Rockly soils and Rock outcrop. Included areas make up about 25 percent of the total acreage.

Permeability of this Gwinly soil is slow. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of vegetation suitable for livestock grazing is limited by stoniness and depth to rock. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are the very cobbly surface, depth to rock, and steepness of slope. Use of mechanical treatment practices is not practical because of the very cobbly surface and the steepness of slope. The unit responds well to proper grazing use. Other management practices suitable for use on the unit are deferred grazing, rotation grazing, and aerial spraying for brush management.

Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce vegetation suitable for grazing.

This unit is poorly suited to homesite and recreational development. The main limitations are depth to rock, stoniness, and steepness of slope.

This map unit is in capability subclass VIIs, nonirrigated.

18E-Gwinly-Rockly complex, 5 to 40 percent slopes. This map unit is on ridgetops and on south- and west-facing side slopes of uplands. Elevation is 2,300 to 4,600 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 150 days.

This unit is about 50 percent Gwinly very cobbly silt loam and 40 percent Rockly extremely stony loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Rock outcrop and Watama, Ukiah, and Starkey soils.

The Gwinly soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. Typically, the surface layer is very dark grayish brown very cobbly silt loam about 4 inches thick. The next layer is very dark grayish brown very cobbly silty clay loam about 3 inches thick. The subsoil is dark brown extremely cobbly clay about 9 inches thick. Basalt is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Gwinly soil is slow. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

The Rockly soil is very shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt. Some loess is in the surface layer. Typically, the surface layer is very dark brown extremely stony loam about 6 inches thick. The subsoil is dark brown very stony loam about 2 inches thick. Basalt is at a depth of 8 inches. Depth to bedrock ranges from 5 to 10 inches.

Permeability of the Rockly soil is moderate. Available water capacity is about 0.3 to 1.0 inch. Water supplying capacity is 1 inch to 3 inches. Effective rooting depth is 5 to 10 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of vegetation suitable for livestock grazing is limited by depth to rock and droughtiness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are depth to rock, the very cobbly and extremely stony surface layer, and steepness of slope.

Use of mechanical treatment practices on this unit is not practical, because the surface is very cobbly and extremely stony and the slopes in places are steep. Management practices suitable for use on the unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce vegetation suitable for grazing.

This unit is poorly suited to homesite and recreational development. The main limitations are depth to rock, stoniness, and steepness of slope.

This map unit is in capability subclass VIIs, nonirrigated.

18F-Gwinly-Rockly complex, 40 to 70 percent slopes. This map unit is on south- and west-facing side slopes of uplands. Elevation is 2,300 to 4,600 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 150 days.

This unit is about 50 percent Gwinly very cobbly silt loam and 40.percent Rockly extremely stony loam. The components of the unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Rock outcrop and Watama, Ukiah, and Starkey soils.

The Gwinly soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. Typically, the surface layer is very dark grayish brown very cobbly silt loam about 4 inches thick. The next layer is very dark grayish brown very cobbly silty clay loam about 3 inches thick. The subsoil is dark brown extremely cobbly clay about 9 inches thick. Basalt is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Gwinly soil is slow. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Rockly soil is very shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt. Some loess is in the surface layer. Typically, the surface layer is very dark brown extremely stony loam about 6 inches thick. The subsoil is dark brown very stony loam about 2 inches thick. Basalt is at a depth of 8 inches. Depth to bedrock ranges from 5 to 10 inches.

Permeability of the Rockly soil is moderate. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 0.3 to 1.0 inch. Effective rooting depth is 5 to 10 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of vegetation suitable for livestock grazing is limited by depth to rock, droughtiness, and steepness of slope. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for rangeland seeding is poor. The main limitations are the very cobbly and extremely stony surface layer, depth to rock, and steepness of slope.

Use of mechanical treatment practices on this unit is not practical, because the surface is very cobbly and extremely stony slopes are steep. Management practices suitable for use on the unit are proper range use, deferred grazing, and rotation grazing. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce vegetation suitable for grazing.

This unit is poorly suited to homesite and recreational development. The main limitations are the depth to rock, stoniness, and steepness of slope.

This map unit is in capability subclass VIIs, nonirrigated.

19E-Hall Ranch stony loam, 2 to 35 percent slopes. This moderately deep, well drained soil is on

mountainous uplands. It formed in colluvium and residuum derived dominantly from andesite and rhyolite. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly coniferous forest and an understory of grasses,, forbs, and shrubs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 18 to 30 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface is covered with a mat of needles, twigs, and leaves about 1 inch thick. The surface layer is very dark brown stony loam about 8 inches thick. The subsoil is dark grayish brown gravelly loam about 23 inches thick. The substratum is grayish brown very cobbly loam that is underlain by soft, platy andesite at a depth of 35 inches. Depth to soft bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Klicker, Tolo, and Olot soils. Also included are small areas of more steeply sloping Hall Ranch soils and Rock outcrop.

Permeability of this Hall Ranch soil is moderate. Available water capacity is about 2.5 to 6.5 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

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

This unit is well suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 85 to 95. On the basis of a site index of 90 (10), the potential production per acre of wood fiber is 3,400 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 37,960 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

This unit is limited mainly by stones on the surface, which can interfere with felling, yarding, and other operations involving the use of equipment. Conventional methods of harvesting timber can be used. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the stones on the surface and the density of the tree stand. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

If this unit is used for homesite or recreational development, the main limitations are shallow depth to bedrock, stones on the surface, and steepness of slope.

This map unit is in capability subclass VIe, nonirrigated.

19F-Hall Ranch stony loam, 35 to 65 percent north slopes. This moderately deep, well drained soil is on mountainous uplands. It formed in colluvium and residuum derived dominantly from andesite and rhyolite. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 18 to 30 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface is covered with a mat of needles, twigs, and leaves about 1 inch thick. The surface layer is very dark brown stony loam about 8 inches thick. The subsoil is dark grayish brown gravelly loam about 23 inches thick. The substratum is grayish brown very cobbly loam that is underlain by soft, platy andesite at a depth of 35 inches. Depth to soft bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Klicker, Tolo, and Olot soils. Also included are small areas of less steeply sloping Hall Ranch soils and Rock outcrop

Permeability of this Hall Ranch soil is moderate. Available water capacity is about 2.5 to 6.5 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is well suited to the production of ponderosa pine and Douglas-fir. The site index for ponderosa pine ranges from 85 to 95. On the basis of a site index of 90 (10), the potential production per acre of wood fiber is 3,400 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 37,960 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

The main concerns in producing and harvesting timber are stones on the surface and steepness of slope. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steepness of slope limits the kinds of equipment that can be used in forest management. The high-lead logging method is more efficient than most other methods and is less damaging to the soil surface. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The

production of vegetation suitable for livestock grazing is limited by the stones on the surface, slope, and the density of the tree stand. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

If this unit is used for homesite or recreational development, the main limitations are shallow depth to bedrock, stones on the surface, and steepness of slope.

This map unit is in capability subclass VIIe, nonirrigated.

20F-Hall Ranch stony loam, 35 to 65 percent south slopes. This moderately deep, well drained soil is on mountainous uplands. It formed in colluvium and residuum derived dominantly from andesite and rhyolite. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 18 to 30 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface is covered with a mat of needles, twigs, and leaves about 1 inch thick. The surface layer is very dark brown stony loam about 8 inches thick. The subsoil is dark grayish brown gravelly loam about 23 inches thick. The substratum is grayish brown very cobbly loam that is underlain by soft, platy andesite at a depth of 35 inches. Depth to soft bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Klicker, Tolo, and Olot soils. Also included are small areas of less steeply sloping Hall Ranch soils and Rock outcrop.

Permeability of this Hall Ranch soil is moderate. Available water capacity is about 2.5 to 6.5 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 75 to 85. On the basis of a site index of 80 (10), the potential production per acre of wood fiber is 2,760 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 33,750 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 150 years old.

The main concerns in producing and harvesting timber are stones on the surface and steepness of slope. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steepness of slope limits the kinds of equipment that can be used in forest management. The high-lead logging method is more efficient than most other methods and is less damaging to the soil surface. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

The potential understory plant community on this unit is mainly bluebunch wheatgrass and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the stones on the surface, slope, and the density of the tree stand. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

If this unit is used for homesite or recreational development, the main limitations are shallow depth to bedrock, stones on the surface, and steepness of slope.

This map unit is in capability subclass VIIe, nonirrigated.

21E-Helter silt loam, 12 to 35 percent slopes. This deep, well drained soil is in irregularly shaped areas on mountainous. uplands. It formed in volcanic ash -and some loess deposited over older buried loess and weathered basalt. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 4,000 to 5,500 feet. The average annual precipitation is about 40 to 60 inches, the average annual air temperature is 40 to 44 degrees F, and the average frost-free period is 20 to 60 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 1 inch thick. The surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish brown silt loam about 10 inches thick over a buried subsoil of dark brown silty clay loam grading to cobbly silty clay loam that extends to a depth of 60 inches or more.

Included in this unit are small areas of Anatone, Bocker, Kamela, and Loneridge soils. Also included are small areas of more steeply sloping and less steeply sloping Helter soils.

Permeability of this Helter soil is moderate to a depth of 22 inches and moderately slow below this depth. Available water capacity is about 10 to 20 inches. Water supplying capacity is 20 to 24 inches. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

This unit is well suited to the production of Engelmann spruce, subalpine fir, grand fir, and western larch. The site index for Engelmann spruce ranges from 66 to 76. On the basis of a site index of 71 (3), the potential

production per acre of wood fiber is 13,500 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 86,000 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for subalpine fir ranges from 57 to 67. On the basis of a site index of 62 (3), the potential production per acre of wood fiber is 11,850 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 72,000 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for grand fir ranges from 46 to 52. On the basis of a site index of 49 (7), the potential production per acre of wood fiber is 10,100 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 54,000 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

The main concerns in producing and harvesting timber on this unit are steepness of slope and the need to disturb the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods the material is easily detached, and operating equipment on the unit causes dustiness.

Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Proper design of road drainage systems and care in the placement of culverts help to control erosion on this unit.

Conventional methods of harvesting trees can be used in the more gently sloping areas of this unit but are difficult to use in the steeper areas. Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand:

If this unit is used for recreational development, the main limitations are steepness of slope and dustiness during the dry summer months. Steepness of slope limits the use of areas of the unit mainly to a few paths and trails, which should extend across the slope. Areas used for recreation can be protected from dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitations are slope and low soil strength.

This map unit is in capability subclass VIe, nonirrigated.

21F-Helter silt loam, 35 to 65 percent slopes. This deep, well drained soil is in irregularly shaped areas on mountainous uplands. It formed in volcanic ash and some loess deposited over older buried loess and weathered basalt. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 4,000 to 5,500 feet. The average annual precipitation is about 40 to 60 inches, the average annual air temperature is 40 to 44 degrees F, and the average frost-free period is 20 to 60 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 1 inch thick. The surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish brown silt loam about 10 inches thick over a buried subsoil of dark brown silty clay loam and cobbly silty clay loam that extends to a depth of 60 inches or more.

Included in this unit are small areas of Anatone, Bocker, Kamela, and Loneridge soils. Also included are small areas of more steeply sloping and less steeply sloping Helter soils.

Permeability of this Helter soil is moderate to a depth of 22 inches and moderately slow below this depth. Available water capacity is about 10 to 20 inches. Water supplying capacity is 20 to 24 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is well suited to the production of Engelmann spruce, subalpine fir, grand fir, and western larch. The site index for Engelmann spruce ranges from 66 to 76. On the basis of a site index of 71 (3), the potential production per acre of wood fiber is 13,500 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 86,000 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for subalpine fir ranges from 57 to 67. On the basis of a site index of 62 (3), the potential production per acre of wood fiber is 11,850 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 72,000 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for grand fir ranges from 46 to 52. On the basis of a site index of 49 (7), the potential production per acre of wood fiber is 10,100 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 54,100 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

The main concerns in producing and harvesting timber on this unit are steepness of slope and the need to disturb the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods the material is easily detached, and operating equipment on the unit causes dustiness. The steepness of slope limits the kinds of equipment that can be used in forest management on this unit. The high-lead logging method is more efficient than most other methods and is less damaging to the soil surface.

Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand.

This unit is poorly suited to recreational development. Steepness of slope limits the use of areas of the unit mainly to a few paths and trails, which should extend across the slope. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitations are steepness of slope and low soil strength.

This map unit is in capability subclass VIIe, nonirrigated.

22-Hooly silt loam. This somewhat poorly drained soil is in old lake basins and on valley floors. It is shallow to diatomaceous sediment. It formed in loess and volcanic ash. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly grasses, sedges, rushes, and annual forbs. Elevation is 2,600 to 2,800 feet. The average annual precipitation is 11 to 20 inches, the average-annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The upper part of the underlying material is light brownish gray silt about 4 inches thick. The lower part to a depth of 60 inches or more is pale brown, compact silt that is nearly impenetrable by roots. Depth to diatomaceous sediment ranges from 10 to 20 inches.

Included in this unit are small areas of Catherine, Hot Lake, and Conley soils. Also included are small areas of Hooly soils that are more poorly drained than this Hooly soil.

Permeability of this Hooly soil is moderately slow. Available water capacity is about 4 to 6 inches within the effective rooting depth. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 20 to 30 inches. Runoff is slow, and the hazard of water erosion is slight. The soil is subject to occasional flooding. A seasonal high water table fluctuates between depths of 18 and 30 inches in winter and spring.

This unit is used primarily for crops, mainly wheat and alfalfa. It is also used for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the seasonal high water table and the diatomaceous sediment, which restrict rooting depth. Crops that require good drainage can be grown if a properly designed tile drainage system is installed.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. Because of the moderately slow permeability of the soil, the application of water should be regulated so that water does not stand on the surface and damage the crops.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth.

This unit is poorly suited to homesite or recreational development. The main limitations are the hazard of flooding and wetness.

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

23-Hoopal fine sandy loam. This moderately deep, somewhat poorly drained soil is on the bottoms of old lakes and rivers. It formed in alluvial and lacustrine deposits derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt-tolerant grasses, forbs, and shrubs. Elevation is 2,600 to 3,000 feet. The average annual precipitation is 12 to 17 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is dark brown silt loam about 21 inches thick. The next layer is a weakly cemented hardpan about 4 inches thick. The substratum to a depth of 60 inches or more is brown fine sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Catherine, Hooly, and Umapine soils. Also included are small areas of Hoopal Variant soils.

Permeability of this Hoopal soil is moderate to a depth of 31 inches and very slow through the hardpan. Available water capacity is about 8 to 10 inches. Water supplying capacity is 9 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. Water is perched above the pan in winter and spring.

This unit is used primarily for crops, mainly wheat and barley. It is also used for pasture, rangeland, and wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by restricted rooting depth and a seasonal perched water table. Tile drainage systems are difficult to install because of the shallow depth to the hardpan. Ripping and shattering the hardpan increase the effective rooting depth and improve internal drainage.

If this unit is used for irrigated crops, salinity influences the choice of crops. Soil tests to determine fertilizer requirements, salinity, and sodicity are advisable.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. Because of the very slow permeability of the hardpan, the application of water should be regulated so that water does not stand on the surface and damage the crops.

This unit is poorly suited to homesite or recreational development. The main limitations are the shallow depth to the hardpan, very slow permeability through the hardpan, and a perched water table.

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

24-Hoopal Variant silt loam. This shallow, somewhat poorly drained soil is on the bottoms of old lakes and rivers. It formed in mixed alluvium derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly salt-tolerant grasses, forbs, and shrubs. Elevation is 2,600 to 3,000 feet. The average annual precipitation is 12 to 17 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsoil is very dark grayish brown silt loam about 11 inches thick. The next layer is an indurated hardpan about 6 inches thick. The substratum, to a depth of 46 inches, is brown silt loam. Below this is a strongly cemented hardpan about 14 inches thick. Depth to the upper hardpan ranges from 10 to 20 inches.

Included in this unit are small areas of Catherine, Umapine, and Wingville soils. Also included are small areas of Hoopal soils:

Permeability of this Hoopal Variant soil is moderate above and between the hardpans and very slow through them. Available water capacity is about 2.5 to 9 inches. Water supplying capacity is 6 to 15 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 6 to 36 inches in winter and spring.

This unit is used primarily for crops, mainly wheat, barley, and annual grasses. It is also used for hay and pasture and for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by restricted rooting depth, wetness, and salt content. The water table that builds up during the rainy period in winter and spring generally limits the suitability of this unit for deep-rooted crops. Tile drainage systems are difficult to install because of the shallow depth to the hardpan. Ripping and shattering the hardpan increase the effective rooting depth and improve internal drainage.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. Because of the very slow permeability of the hardpan, the application of water should be regulated so that water does not stand on the surface and damage the crops. If the soil is irrigated, salinity influences the choice of crops. Subsoiling opens up the soil and allows water and salts to pass through.

Soil tests to determine fertilizer requirements, salinity, and sodicity are advisable.

If this unit is used for hay and pasture, the main limitations are restricted rooting depth and salt content. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table and the very slowly permeable hardpan. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the shallow depth to the hardpan and wetness.

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

25-Hot Lake silt loam. This somewhat poorly drained soil is in old lake basins and on valley floors. It is moderately deep to diatomaceous sediment. It formed in loess and volcanic ash. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly grasses, sedges, rushes, and annual forbs. Elevation is 2,600 to 2,800 feet. The average annual precipitation is about 13 to 20 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is black silt loam about 14 inches thick. The upper 5 inches of the substratum is very dark grayish brown, calcareous silt loam. The next 8 inches is dark grayish brown coarse silt loam. The lower part, to a depth of 39 inches, is grayish brown very fine sandy loam. Below this to a depth of 60 inches or more is light brownish gray, compact silt that is nearly impenetrable by roots. Depth to diatomaceous sediment ranges from 20 to 40 inches.

Included in this unit are small areas of Catherine, Hooly, and Conley soils. Also included are small areas of Hot Lake soils that are more poorly drained than this Hot Lake soil.

Permeability of this Hot Lake soil is moderately slow. Available water capacity is about 7 to 11 inches. Water supplying capacity is 10 to 18 inches. Effective rooting depth is 30 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The soil is subject to occasional flooding. A seasonal high water table fluctuates between depths of 18 and 30 inches in winter and spring.

This unit is used primarily for crops, mainly wheat and alfalfa. It is also used for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the seasonal high water table and the diatomaceous sediment, which restrict rooting depth. Crops that require good drainage can be grown if a properly designed tile drainage system is installed.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation,

and sprinkler irrigation systems are suited to this unit. Because of the moderately slow permeability of the soil in the unit, the application of water should be regulated so that water does not stand on the surface and damage the crops.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth.

This unit is poorly suited to homesite or recreational development. The main limitations are the hazard of flooding and wetness.

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

26B-Hutchinson silt loam, 2 to 7 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess, volcanic ash, and old alluvial sediment derived dominantly from basalt and granite. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and big sagebrush. Elevation is 3,400 to 4,000 feet. The average annual precipitation is about 13 to 16 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark grayish brown silt loam about 13 inches thick. The upper 11 inches of the subsoil is dark brown silt loam and silty clay loam. The lower 7 inches is dark brown clay. The next layer is a hardpan that is strongly cemented with silica and lime and is about 9 inches thick. The substratum to a depth of 60 inches or more is dark brown extremely cobbly sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Coughanour and Encina soils. Also included are small areas of Hutchinson gravelly silt loam and Hutchinson soils that are more steeply sloping than this Hutchinson soil.

Permeability of this Hutchinson soil is moderate to a depth of 21 inches and slow below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 7 to 10 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used primarily for crops, mainly wheat and alfalfa. It is also used for pasture and wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the slow permeability of the clayey subsoil and the underlying cemented hardpan. The cemented pan reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Irrigation water needs to be applied carefully to prevent the development of a high water table. Drainage may also be needed.

The hazard of erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and waterways are shaped and seeded to perennial grass.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. The main limitations are the slow permeability of the clayey subsoil and the underlying cemented hardpan. The cemented pan reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the slow permeability of the clayey subsoil, the underlying hardpan, shrinking and swelling of the soil, and low soil strength.

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

26C-Hutchinson silt loam, 7 to 12 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess, volcanic ash, and old alluvial sediment derived dominantly from basalt and granite. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and big sagebrush. Elevation is 3;400 to4,000 feet. The average annual precipitation is about 13 to 16 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark grayish brown silt loam about 13 inches thick. The upper 11 inches of the subsoil is dark brown silt loam and silty clay loam. The lower 7 inches is dark brown clay. The next layer is a hardpan that is strongly cemented with silica and lime and is about 9 inches thick. The substratum to a depth of 60 inches or more is dark brown extremely cobbly sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Coughanour and Encina soils. Also included are small areas of Hutchinson gravelly silt loam and Hutchinson soils that are less steeply sloping than this Hutchinson soil.

Permeability of this Hutchinson soil is moderate to a depth of 21 inches and slow below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 7 to 10 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used primarily for crops, mainly wheat and alfalfa. It is also used for pasture and wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the slow permeability. of the clayey subsoil, the underlying cemented hardpan, and the hazard of erosion. The cemented pan reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Irrigation water needs to be applied carefully to prevent the development of a high water table. Drainage may also be needed.

Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. The main limitations are the slow permeability of the clayey subsoil and the underlying cemented hardpan. The cemented pan reduces the yield of deep-rooted plants. Deep ripping of the pan, where feasible, helps to overcome this limitation. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the slow permeability of the clayey subsoil, the underlying cemented hardpan, shrinking and swelling of the soil, and low soil strength.

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

27D-Hutchinson gravelly silt loam, 1 to 20 percent slopes. This moderately deep, well drained soil is on terraces. It formed in loess, volcanic ash, and old alluvial sediment derived dominantly from basalt and granite. The native vegetation is mainly bunchgrasses, annual forbs, and big sagebrush. Elevation is 3,400 to 4,000 feet. The average annual precipitation is about 13 to 16 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark ,grayish brown gravelly silt loam about 13 inches thick. The upper 11 inches of the subsoil is dark brown silt loam and silty clay loam. The lower 7 inches is dark brown clay. The next layer is a hardpan that is strongly cemented with silica and lime and is about 9 inches thick. The substratum to a depth of 60 inches or more is dark brown extremely cobbly sandy loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Coughanour and Encina soils. Also included are small areas of Hutchinson silt loam.

Permeability of this Hutchinson soil is moderate to a depth of 21 inches and slow below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 7 to 10 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be delayed until the soil in the unit has drained sufficiently and is firm enough to withstand trampling by livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. The main limitation for seeding is the gravelly surface layer. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods may be subject to a greater hazard of erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the slow permeability of the clay subsoil, the underlying hardpan, shrinking and swelling of the soil; low soil strength, and; in places, steepness of slope.

This map unit is in capability subclass IVe, nonirrigated.

28C-Hutchinson Variant silt loam, 2 to 12 percent slopes. This moderately deep, well drained soil is on old terraces and fans. It formed in mixed alluvium derived dominantly from basalt, volcanic tuff, and granite. Some volcanic ash and loess is in the surface layer. The native vegetation is mainly mixed coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,200 to 4,200 feet. The average annual precipitation is 18 to 24 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 70 to 110 days.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The next layer is dark brown silty clay loam about 9 inches thick. The subsoil is brown gravelly clay about 9 inches thick. The next layer is a very gravelly and extremely cobbly, weakly cemented hardpan about 38 inches thick. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Cowsly, Klicker, and Lookingglass soils. Also included are small areas of soils that have a gravelly surface layer and Hutchinson Variant soils that are more steeply sloping than this Hutchinson Variant soil.

Permeability of this Hutchinson Variant soil is slow. Available water capacity is 5 to 7 inches. Water supplying capacity is 8 to 12 inches. Effective rooting

depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

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

This unit is well suited to timber production. The site index for ponderosa pine ranges from 85 to 95. On the basis of a site index of 90 (10), the potential production per acre of wood fiber is 3,400 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 37,960 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

This unit has few limitations for timber production. Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

During some periods of heavy rainfall, the water table is at a shallow depth for a short time. Trees commonly are subject to windthrow because the soil is saturated during these periods and because root growth is limited by the cemented and compacted substratum.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly elk sedge, pinegrass, and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock-grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This map unit is poorly suited to homesite and recreational development. The main limitations are high shrink-swell potential, slow permeability, and shallow depth to the hardpan.

This map unit is in capability subclass IVe, nonirrigated.

28E-Hutchinson Variant silt loam, 12 to 35 percent slopes. This moderately deep, well drained soil is on old terraces and fans. It formed in mixed alluvium derived dominantly from basalt, granite, and volcanic tuff. Some volcanic ash and loess is in the surface layer. The native vegetation is mainly mixed coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 3,200 to 4,200 feet. The average annual precipitation is 18 to 24 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 70 to 110 days.

Typically, the surface layer is very dark grayish brown silt loam about 4 inches thick. The next layer is dark brown silty clay loam about 9 inches thick. The subsoil is brown gravelly clay about 9 inches thick. The next layer is a very gravelly and extremely cobbly, weakly cemented hardpan about 38 inches thick. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Cowsly, Klicker, and Lookingglass soils. Also included are small areas of Hutchinson Variant soils that have a gravelly surface layer and Hutchinson Variant soils that are less steeply sloping than this Hutchinson Variant soil.

Permeability of this Hutchinson Variant soil is slow. Available water capacity is 5 to 7 inches. Water supplying capacity is 8 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

This unit is well suited to timber production. The site index for ponderosa pine ranges from 85 to 95. On the basis of a site index of 90 (10), the potential production per acre of wood fiber is 3,400 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 37,960 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old. Conventional methods of harvesting timber can be used.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

During some periods of heavy rainfall, the water table is at a shallow depth for a short time. Trees commonly are subject to windthrow because the soil is saturated during these periods and because root growth is limited by the cemented and compacted substratum.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly elk sedge, pinegrass, and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This map unit is poorly suited to homesite and recreational development. The main limitations are high shrink-swell potential, slow permeability, shallow depth to the hardpan, and slope.

This map unit is in capability subclass VIe, nonirrigated.

29B-Imbler coarse sandy loam, 1 to 5 percent slopes. This deep, well drained, undulating soil is on valley terraces. It formed in mixed eolian material derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,600 to 2,800 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is very dark brown coarse sandy loam about 14 inches thick. The subsurface layer

is dark brown fine sandy loam about 16 inches thick. The underlying material to a depth of 60 inches or more is dark brown loamy fine sand.

Included in this unit are small areas of Alicel and Palouse soils. Also included are small areas of Imbler fine sandy loam.

Permeability of this Imbler soil is moderately rapid. Available water capacity is about 5.5 to 7 inches. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Most areas of this unit are used for crops, mainly winter wheat, alfalfa hay, green peas, and bluegrass seed. Among the other crops grown are barley, grass hay, and pasture. Some areas are used for recreation, wildlife habitat, and suburban homesites.

This unit is suited to cultivated crops. It is limited mainly by the hazard of soil blowing when the surface is bare. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain organic matter content. Soil blowing can also be controlled by maintaining plant cover on the unit, stripcropping, and planting field windbreaks. These practices also help to conserve moisture. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and waterways are shaped and seeded to perennial grass.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is suited to hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Supplemental irrigation is also needed to obtain maximum production of hay and pasture. Irrigation water can be applied by the sprinkler method.

Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to windbreaks and environmental plantings (fig. 2). Among the trees that are suitable for

Figure 2.-Farmstead windbreak planting on Imbler coarse sandy loam, 1 to 5 percent slopes.

planting are ponderosa pine, black locust, and Russian-olive. Among the shrubs are wild plum and caragana. Supplemental irrigation may be needed when planting and during dry periods.

This unit is well suited to recreational development. It has few limitations.

Population growth has resulted in increased construction of homes on this unit. The main limitations for homesites are the hazards of soil blowing and seepage. Preserving the existing plant cover during construction helps to control erosion, and revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees.

If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

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

30B-Imbler fine sandy loam, 1 to 5 percent slopes. This deep, well drained soil is on undulating valley terraces. It formed in mixed eolian material derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,600 to 2,800 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is very dark brown fine sandy loam about 14 inches thick. The subsurface layer is dark brown fine sandy loam about 16 inches thick. The underlying material to a depth of 60 inches or more is dark brown loamy fine sand (fig. 3).

Included in this unit are small areas of Alicel and Palouse soils. Also included are small areas of Imbler coarse sandy loam.

Permeability of this Imbler soil is moderately rapid. Available water capacity is about 7 to 9 inches. Water supplying capacity is 10 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas of this unit are used for crops, mainly winter wheat, alfalfa hay, green peas, and bluegrass seed. Among the other crops grown are barley, grass hay, and pasture. Some areas are used for recreation, wildlife habitat, and suburban homesites.

This unit is suited to cultivated crops. It is limited mainly by the hazard of soil blowing when the surface is bare. Maintaining crop residue on or near the surface reduces runoff, reduces soil blowing, and helps to maintain organic matter content. Stripcropping and planting field windbreaks help to control soil blowing and to conserve moisture. Erosion can be reduced by

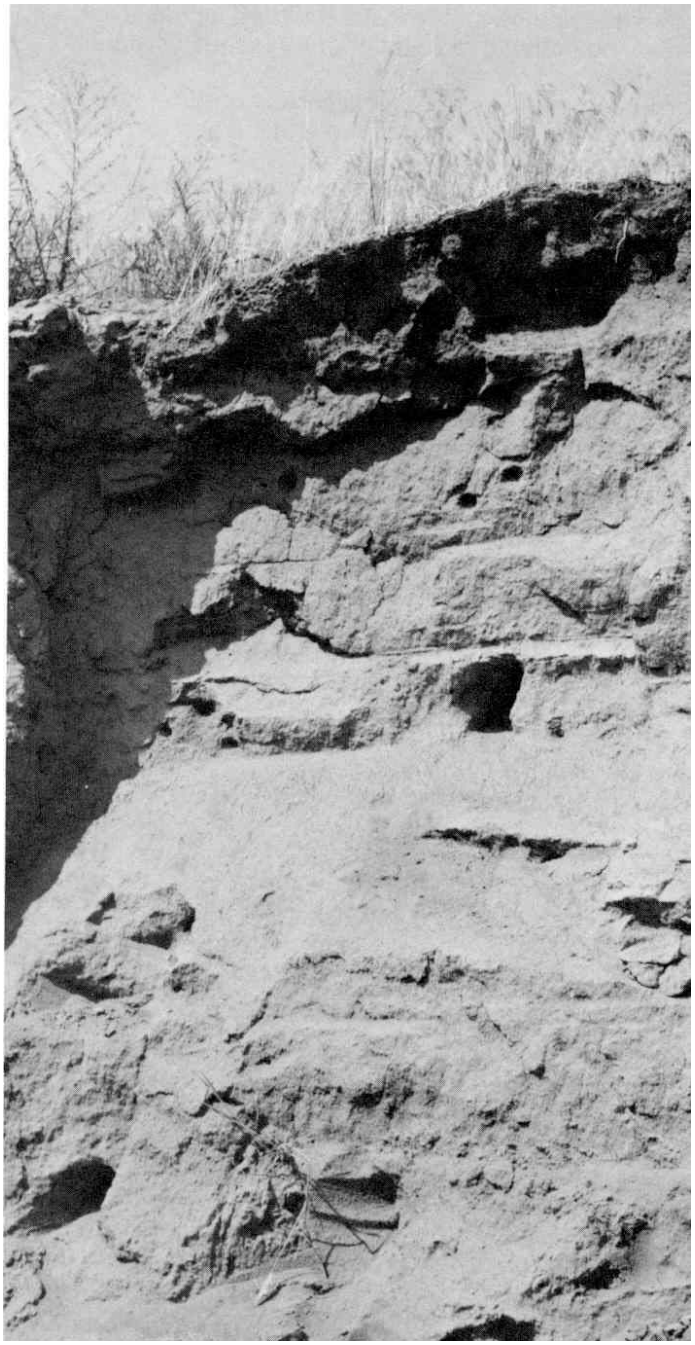

Figure 3.-Profile of Imbler fine sandy loam, 1 to 5 percent slopes.

seeding early fall grain, using stubble-mulch tillage, and shaping and seeding waterways to perennial grass.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. To avoid overirrigating and leaching of plant nutrients, applications of irrigation

water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Supplemental irrigation is also needed to obtain maximum production of hay and pasture. Irrigation water can be applied by the sprinkler method.

This unit is suited to windbreaks and environmental plantings. Among the trees that are suitable for planting are ponderosa pine, black locust, and Russian-olive. Among the shrubs are wild plum and caragana. Supplemental irrigation may be needed when planting and during dry periods.

This unit is well suited to recreational development. It has few limitations.

Population growth has resulted in increased construction of homes on this unit. The main limitations for homesites are the hazards of soil blowing and seepage. Preserving the existing plant cover during construction helps to control erosion, and revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing: In summer, irrigation is needed for lawn grasses; shrubs, vines, shade trees, and ornamental trees.

If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

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

31-Jett silt loam. This deep, well drained soil is on bottom lands. It formed in recent alluvial and lakebed deposits derived dominantly from basalt, andesite, volcanic tuff, and granite. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and big sagebrush. Elevation is 2,600 to 3,400 feet. The average annual precipitation is about 11 to 20 inches, the average annual air temperature is 46 to 49 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface layer is black silt loam about 21 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The upper 30 inches of the underlying material is dark brown silt loam. The lower part to a depth of 60 inches or more is dark yellowish brown silty clay loam.

Included in this unit are small areas of Catherine, La Grande, and Umapine soils. Also included are small areas of Jett soils that have a seasonal high water table at a depth of 40 inches or more.

Permeability of this Jett soil is moderate. Available water capacity is about 11 to 13 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The soil is subject to rare periods of flooding. It has a water table at a depth of 48 to 60 inches in spring.

This unit is used primarily for crops, mainly wheat and alfalfa. It is also used for wildlife habitat.

This unit is suited to cultivated crops. It has few limitations. In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to hay and pasture. It has few limitations. Proper grazing practices, weed control, and fertilizer are needed to insure maximum quality of forage. In some years, supplemental irrigation is also needed.

Population growth has resulted in increased construction of homes on this unit; however, the unit is poorly suited to homesite development unless it is protected from flooding. If the density of housing in protected areas is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

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

32E-Kamela very stony silt loam, 2 to 35 percent slopes. This moderately deep, well drained soil is in irregularly shaped areas on mountainous uplands. It formed in colluvium and residuum derived dominantly from basalt, loess, and volcanic ash. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 35 to 45 inches, the average annual air temperature is 42 to 46 degrees F, and the average frost-free period is 50 to 90 days.

Typically, the surface is covered with a mat of needles, twigs, leaves, and duff about 2 inches thick. The surface layer is dark brown very stony silt loam about 6 inches thick. The subsoil is dark brown very cobbly silt loam about 19 inches thick. Basalt is at a depth of about 25 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Klicker, Loneridge, Tolo, and Olot soils.

Permeability of this Kamela soil is moderate. Available water capacity is about 2.0 to 4.5 inches. Water

supplying capacity is 8 to 13 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

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

This unit is well suited to the production of Douglas-fir, ponderosa pine, and grand fir. The site index for Douglas-fir ranges from 68 to 72. On the basis of a site index of 70 (4), the potential production per acre of wood fiber is 3,760 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 43,160 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

The site index for ponderosa pine ranges from 85 to 90. On the basis of a site index of 88 (10), the potential production per acre of wood fiber is 3,280 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 41,700 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 150 years old.

The main concerns in producing and harvesting timber on this unit are stones on the surface and, in places, steep slopes and a hazard of erosion. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Conventional methods of harvesting trees can be used in the more gently sloping areas but are difficult to use in the steeper areas. Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

The potential understory plant community on this unit is mainly elk sedge, heartleaf arnica, and princes pine. The production of vegetation suitable for livestock grazing is limited by stones on the surface and competition with trees. If this unit is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for seeding is poor. The main limitations are stones on the surface and, in places, steep slopes.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, rotation grazing, and aerial spraying for brush management. Use of mechanical treatment practices is not practical, because the surface is stony and the slopes, in places, are steep. Trails or walkways can be constructed to encourage livestock grazing in areas where access is limited. Grazing should be delayed until the soil in this unit is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is poorly suited to homesite or recreational development. The main limitations are depth to rock and steepness of slope.

This map unit is in capability subclass Vls, nonirrigated.

33E-Klicker stony silt loam, 2 to 40 percent slopes. This moderately deep, well drained soil is on mountainous uplands. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly coniferous forest and an understory of bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,500 to 5,000 feet. The average annual precipitation. is 17 to 30 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 3/4 inch thick. The surface layer is dark reddish brown stony silt loam in the upper 4 inches and very cobbly silt loam in the lower 7 inches. The upper 7 inches of the subsoil is dark reddish brown very cobbly silt loam. The lower 15 inches is dark reddish brown very cobbly clay loam. Basalt is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Cowsly, Hall Ranch, and Olot soils and Rock outcrop. Also included are small areas of Klicker soils that are more steeply sloping than this Klicker soil.

Permeability of this Klicker soil is moderate to a depth of 18 inches and moderately slow below this depth. Available water capacity is about 4.5 to 6 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

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

This unit is suited to timber production. The site index for ponderosa pine ranges from 71 to 80. On the basis of a site index of 76 (10), the potential production per acre is 3,150 cubic feet of wood fiber from an even-aged, fully stocked stand of trees 50 years old or 32,480 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 160 years old.

The main concerns in producing and harvesting timber are stones on the surface and shallow depth to bedrock. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Conventional methods of harvesting timber, however, can usually be used. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, bluebunch wheatgrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the stones on the surface and the density of the tree stand. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Grazing should be delayed until the soil in this unit is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is poorly suited to homesite or recreational development. The main limitations are the shallow depth to bedrock, stones on the surface, and steepness of slope.

This map unit is in capability subclass VIs, nonirrigated.

33F-Klicker stony silt loam, 40 to 65 percent north slopes. This moderately deep, well drained soil is on north-facing slopes of mountainous uplands. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly coniferous forest and an understory of bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,500 to 5,000 feet. The average annual precipitation is 17 to 30 inches; the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 3/4 inch thick. The surface layer is dark reddish brown stony silt loam in the upper 4 inches and very cobbly silt loam in the lower 7 inches. The upper 7 inches of the subsoil is dark reddish brown very cobbly silt loam. The lower 15 inches is dark reddish brown very cobbly clay loam. Basalt is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Cowsly, Hall Ranch, and Olot soils and Rock outcrop. Also included are small areas of Klicker soils that are less steeply sloping than this Klicker soil.

Permeability of this Klicker soil is moderate to a depth of 18 inches and moderately slow below this depth. Available water capacity is about 4.5 to 6 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is suited to timber production. The site index for ponderosa pine ranges from 75 to 84. On the basis of a site index of 80 (10), the potential production per acre is 2,760 cubic feet of wood fiber from an even-aged, fully stocked stand of trees 40 years old or 33,750 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 150 years old.

The site index for Douglas-fir ranges from 58 to 64. On the basis of a site index of 61, the potential production per acre is 2,960 cubic feet of wood fiber from an even-aged, fully stocked stand of trees 40 years old or 36,750 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 150 years old.

The main concerns in producing and harvesting timber are stones on the surface and steepness of slope. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steepness of slope limits the kinds of equipment that can be used in forest management.

High-lead or other cable logging methods can be used for harvesting timber. Use of these methods is limited during the months of December through April. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, bluebunch wheatgrass, Idaho fescue, and peavine. The production of vegetation suitable for livestock grazing is limited by the stones on the surface. Access is limited by the steepness of slope. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed to encourage livestock to graze in areas where access is limited. Grazing should be delayed until the soil in this unit is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is poorly suited to homesite or recreational development. The main limitations are the steepness of slope, shallow depth to bedrock, and the stones on the surface.

This map unit is in capability subclass VIIs, nonirrigated.

34F-Klicker stony silt loam, 40 to 65 percent south slopes. This moderately deep, well drained soil is on south-facing slopes of mountainous uplands. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly coniferous forest and an understory of bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,500 to 5,000 feet. The average annual precipitation is 17 to 30 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 100 to 120 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 3/4 inch thick. The surface layer is dark reddish brown stony silt loam in the upper 4 inches and very cobbly silt loam in the lower 7 inches. The upper 7 inches of the subsoil is dark reddish brown very cobbly silt loam. The lower 15 inches is dark reddish brown very cobbly clay loam. Basalt is at a depth of 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Cowsly, Hall Ranch, and Olot soils and Rock outcrop. Also included are small areas of Klicker soils that are less steeply sloping than this Klicker soil.

Permeability of this Klicker soil is moderate to a depth of 18 inches and moderately slow below this depth. Available water capacity is about 4.5 to 6 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is suited to timber production. The site index for ponderosa pine ranges from 71 to 80. On the basis of a site index of 75 (10), the potential production per acre is 3,100 cubic feet of wood fiber from an even-aged, fully stocked stand of trees 50 years old or 31,680 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 160 years old.

The main concerns in producing and harvesting timber are the stones on the surface and steepness of slope. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steepness of slope limits the kinds of equipment that can be used in forest management.

High-lead or other cable logging methods can be used for harvesting timber. Use of these methods is limited during the months of December through April. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Seedling survival can be improved by providing shade for seedlings.

Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited mainly by stones on the surface. Access is limited by steep slopes.

If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil in this unit is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is poorly suited to homesite or recreational development. The main limitations are steepness of slope, shallow depth to bedrock, and stones on the surface.

This map unit is in capability subclass VIIs, nonirrigated.

35E-Klicker-Anatone complex, 5 to 40 percent slopes. This map unit is in irregularly shaped areas on mountainous uplands. The native vegetation is mainly pine and bunchgrasses. Elevation is 2,500 to 5,000 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 100 to 120 days.

This unit is about 50 percent Klicker stony silt loam and about 40 percent Anatone extremely stony loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Bocker, Cowsly, Hall Ranch, and Olot soils and Rock outcrop.

The Klicker soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Typically, the surface layer is dark .reddish brown stony silt loam in the upper 4 inches and very cobbly silt loam in the lower 7 inches. The upper 7 inches of the subsoil is dark reddish brown very cobbly silt loam. The lower 15 inches is dark reddish brown very cobbly clay loam. Basalt is at a depth of about 33 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Klicker soil is moderately slow. Available water capacity is about 4.5 to 6 inches. Water supplying capacity is 8 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is slight to high.

The Anatone soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is in the surface layer. Typically, the surface layer is dark brown extremely stony loam about 6 inches thick. Below this is basalt that is fractured in the upper 5 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Anatone soil is moderate. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is slight to high.

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

The Klicker soil is suited to the production of ponderosa pine; however, the trees commonly are widely scattered or are only in small stands in areas where the soil is deep enough to support them. Management is therefore limited by the nature of the stand. On the basis

of a site index of 76 (10), the potential production per acre of wood fiber is 3,150 cubic feet from an even-aged, fully stocked stand of trees 50 years old or 32,480 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 160 years old.

Conventional methods of harvesting trees can be used on this unit. Stones on the surface, however, can interfere with felling, yarding, and other operations involving the use of equipment. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Reforestation must be carefully managed to reduce competition from undesirable understory plants. The low available water capacity generally influences seedling survival in areas where understory plants are numerous.

The potential plant community on the Anatone soil is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of vegetation suitable for livestock grazing is limited by stones on the surface, shallow rooting depth, and steepness of slope.

The potential plant community on the Klicker soil is mainly ponderosa pine and an understory of elk sedge and pinegrass. The production of vegetation suitable for livestock grazing is limited by stones on the surface, steepness of slope, and competition from trees.

If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are stones on the surface, droughtiness, and steepness of slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Use of mechanical treatment practices is not practical, because the surface is stony and the slopes, in places, are steep. Trails or walkways can be constructed to encourage livestock grazing in areas where access is limited. Grazing should be delayed until the soil in this unit is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

This unit is poorly suited to homesite or recreational development. The main limitations are steepness of slope, stoniness, and depth to bedrock.

This map unit is in capability subclass VIIs, nonirrigated.

36-La Grande silt loam. This deep, moderately well drained soil is on alluvial fans and low stream terraces. It formed in mixed alluvium derived dominantly from basalt, granite, and argillite. Slope is 0 to 2 percent. Elevation is 2,200 to 4,000 feet. The average annual precipitation is about 11 to 20 inches, the average annual air temperature is 45 to 53 degrees F, and the average frost-free period is 110 to 160 days.

Typically, the surface layer is black silt loam about 14 inches thick. The upper 7 inches of the subsoil is very dark grayish brown silt loam. The lower 23 inches is dark yellowish brown silty clay loam. The substratum to a depth of 60 inches or more is multicolored extremely gravelly loam.

Included in this unit are small areas of Catherine, Jett, and Veazie soils and La Grande silty clay loam. Included areas make up about 15 percent of the total acreage.

Permeability of this La Grande soil is moderate. Available water capacity is about 8 to 13 inches. Water supplying capacity is 15 to 20 inches. Effective rooting depth is 30 to 50 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 48 inches from February through May. This soil is subject to rare periods of flooding in winter and spring.

Most areas of this unit are used for crops, mainly alfalfa for hay and small grain (fig. 4). Among the other crops grown are green peas, grass seed, and pasture. This unit is also used for wildlife habitat and as homesites.

This unit is well suited to most cultivated crops. It is limited mainly by the seasonal high water table and a short growing season.

Tile drainage can be used to lower the water table if a suitable outlet is available. The risk of flooding can be reduced by the use of dikes, levees, and improved channels. Deep-rooted crops are suited to areas of this unit where the drainage is adequate or where a drainage system has been installed.

In summer, irrigation is required for maximum production of most crops grown on this unit. Furrow, border, and sprinkler irrigation systems can be used. Irrigation water must be applied carefully to prevent the development of a perched water table. Tilth and fertility of the soil can be improved by returning crop residue to the soil.

This unit is well suited to hay and pasture. Most grasses and legumes grow well on the unit if adequate fertilizer is used. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Rotation grazing helps to maintain the quality of forage. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. If this unit is irrigated, water can be applied by the sprinkler and flooding methods.

If this unit is used for windbreaks, the main limitation is a seasonal high water table. Among the trees that are suitable for planting are Russian-olive, black willow, and Austrian pine. Among the shrubs are rose, Amur honeysuckle, and Siberian peashrub. Supplemental irrigation may be needed when planting and during dry periods.

If this unit is used for recreational development, the main limitations are the hazard of flooding and dustiness. Good drainage should be provided for paths and trails. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitations are wetness and the hazard of

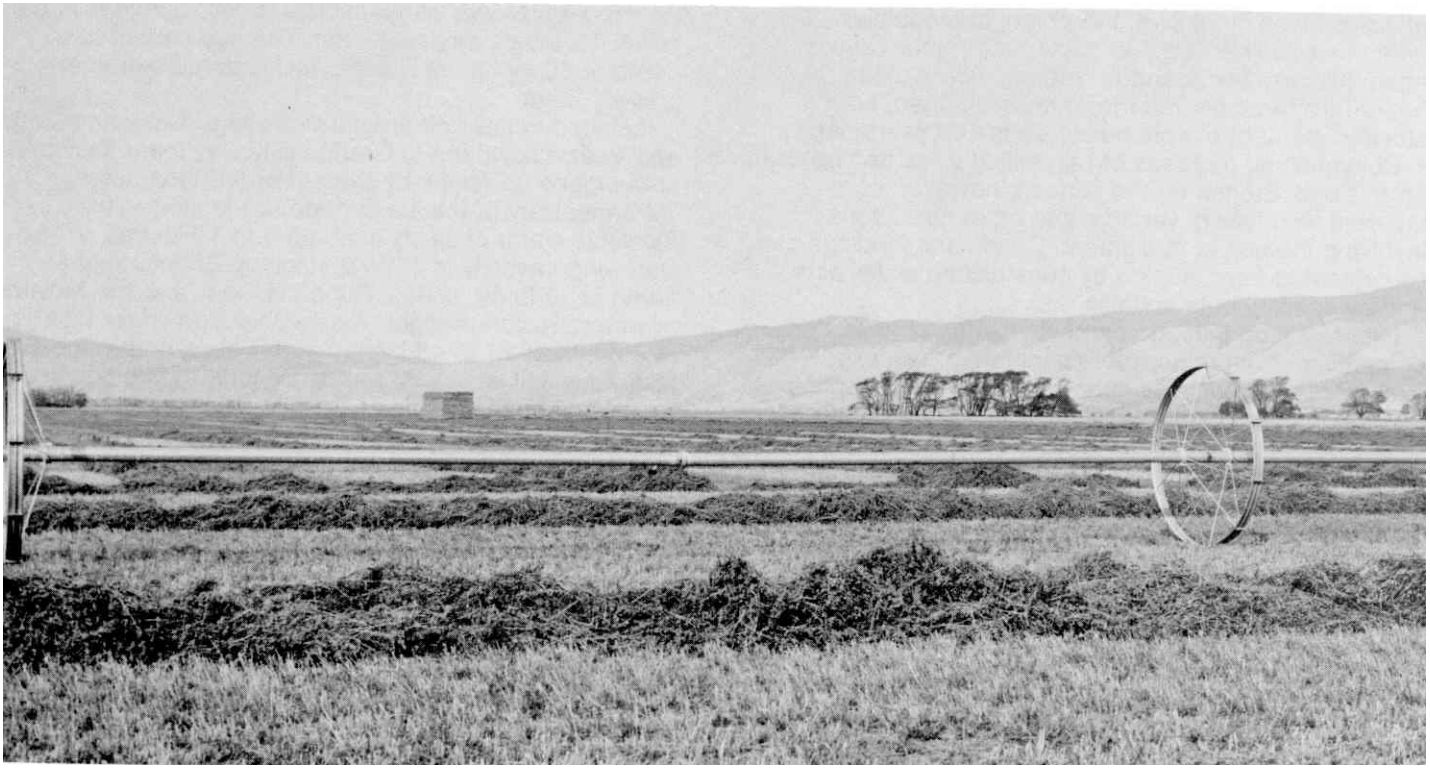

Figure 4.-Irrigated alfalfa harvested on La Grande silt loam.

flooding. Deep drainage reduces the problem of wetness. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load.

In summer, irrigation is required for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Plants that tolerate a seasonal high water table and droughtiness should be selected if drainage and irrigation are not provided.

The moderate permeability and the high water table of the soil in this unit increase the possibility of failure of septic tank absorption fields. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

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

37-La Grande silty clay loam. This deep, moderately well drained soil is on alluvial fans and low stream terraces. It formed in mixed alluvium derived dominantly from basalt, granite, and argillite. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly bunchgrasses and annual forbs. Elevation is 2,200 to 4,000 feet. The average annual precipitation is 11 to 20 inches, the average annual air temperature is 45 to 53 degrees F, and the average frost-free period is 110 to 160 days.

Typically, the surface layer is black silty clay loam about 14 inches thick. The upper 7 inches of the subsoil is very dark grayish brown silt loam. The lower 23 inches is dark yellowish brown silty clay loam. The substratum to a depth of 60 inches or more is multicolored extremely gravelly loam.

Included in this unit are small areas of Catherine, Jett, and Veazie soils. Also included are small areas of La Grande silt loam.

Permeability of this La Grande soil is moderate. Available water capacity is about 8 to 13 inches. Water supplying capacity is 15 to 18 inches. Effective rooting depth is 30 to 50 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table fluctuates between depths of 24 and 48 inches in winter and spring. This soil is subject to rare, brief periods of flooding in winter and spring.

Most areas of this unit are used for crops, mainly alfalfa hay and small grain. Among the other crops

grown are green peas, grass seed, and grass pasture. Some areas are used as homesites and for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by a seasonal high water table and a limited growing season. Deep-rooted crops are suited to areas where the natural drainage is adequate or where a drainage system has been installed. Tile drainage can be used to lower the water table if a suitable outlet is available. The risk of flooding can be reduced by the use of dikes, levees, and improved channels.

In summer, irrigation is needed for maximum production of most crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed.

Tilth and fertility can be improved by returning crop residue to the soil.

This unit is suited to hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Rotation grazing helps to maintain the quality of forage. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Irrigation water can be applied by the sprinkler and flooding methods.

If this unit is used for windbreaks and environmental plantings, the main limitation is the seasonal high water table. Supplemental irrigation may be needed when planting and during dry periods. Among the trees that are suitable for planting are Russian-olive, black willow, and Austrian pine. Among the shrubs are rose, Amur honeysuckle, and Siberian peashrub.

If this unit is used for recreational development, the main limitations are the hazard of flooding, the seasonal high water table, and dustiness. Drainage should be provided for paths and trails. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover. Protection from flooding may be needed.

This unit is poorly suited to homesite development. The main limitations are wetness and the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Deep drainage reduces wetness. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load.

The moderate permeability and the seasonal high water table increase the possibility of failure of septic tank absorption fields on this unit. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

In summer, irrigation is needed for lawn grasses, shrubs, vines, shade trees, and ornamental trees. Plants that tolerate a seasonal high water table and droughtiness should be selected unless drainage and irrigation are provided. Topsoil can be stockpiled and used to reclaim areas disturbed during construction.

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

38E-Loneridge stony silt loam, 12 to 40 percent slopes. This deep, well drained soil is in irregularly shaped areas on mountainous uplands. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash are in the surface layer. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,500 to 5,000 feet. The average annual precipitation is about 30 to 45 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 30 to 90 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 1 inch thick. The surface layer is dark brown stony silt loam about 3 inches thick. The next layer is dark brown cobbly silt loam about 13 inches thick. The upper 20 inches of the subsoil is dark brown very cobbly silty clay loam. The lower 24 inches is dark brown very cobbly clay.

Included in this unit are small areas of Anatone, Bocker, Helter, Kamela, Klicker, Olot, and Tolo soils.

Permeability of this Loneridge soil is moderate to a depth of 16 inches and moderately slow below this depth. Available water capacity is about 7 to 10 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

This unit is well suited to the production of Douglas-fir, grand fir, and western larch. The site index for Douglas-fir ranges from 76 to 80. On the basis of a site index of 78 (4), the potential production per acre of wood fiber is 4,560 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 51,120 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for grand fir ranges from 56 to 60. On the basis of a site index of 58 (7), the potential production per acre of wood fiber is 11,850 cubic feet from an even-aged, fully stocked stand of trees 100 years old or 56,000 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The main concerns in producing and harvesting timber on this unit are stones on the surface, slope, and the hazard of erosion. Conventional methods of harvesting trees can be used in the more gently sloping areas but are difficult to use in the steeper areas. The stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Roads and

landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Plant competition on this unit delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand.

The potential understory plant community on this unit is mainly elk sedge and pinegrass. The production of vegetation suitable for livestock grazing is limited by the stones on the surface and the density of the tree stand. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

This unit is poorly suited to homesite or recreational development. The main limitation is steepness of slope.

This map unit is in capability subclass Vle, nonirrigated.

39C-Lookingglass silt loam, 2 to 12 percent slopes. This deep, moderately well drained soil is on uplands. It formed in loess and volcanic ash overlying older residuum and colluvium derived dominantly from volcanic tuff and basalt. The vegetation in areas not cultivated is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 2,700 to 3,700 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark brown silt loam about 11 inches thick. The subsurface layer is dark grayish brown silt loam about 10 inches thick. The next layer is a buried subsoil of dark brown clay about 17 inches thick. The underlying material to a depth of 60 inches or more is brown silty clay loam.

Included in this unit are small areas of Gwinly, McMurdie, and Wolot soils. Also included are small areas of stony Lookingglass soils and poorly drained seepage areas:

Permeability of this Lookingglass soil is moderate to a depth of 21 inches and very slow below this depth. Available water capacity is about 10 to 12 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. Water is perched above the clay subsoil at a depth of 18 to 36 inches in winter and spring.

Most areas of this unit are used for crops, mainly wheat and alfalfa hay. A few areas are used for timber production and wildlife habitat.

If this unit is used for cultivated crops, the main limitations are the very slow permeability of the clay subsoil and the seasonal perched water table, which generally limits the suitability of the unit for deep-rooted crops.

A tillage pan forms easily if the soil in this unit is tilled when wet. Chiseling or subsoiling breaks up the tillage pan.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass.

If this unit is used for hay and pasture, the main limitations are the very slow permeability of the clay subsoil and the seasonal perched water table. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 85 to 90. On the basis of a site index of 90 (10), the potential production per acre of wood fiber is 3,400 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 37,960 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

The main concerns in producing and harvesting timber are the very slow permeability of the clay subsoil and the seasonal perched water table. Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Roads for year-round use need heavy base rock.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the density of the tree stand. If the understory is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

This unit is poorly suited to homesite and recreational development. The main limitations are the very slow permeability of the clay subsoil, the seasonal perched water table, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass IIIe, nonirrigated.

40C-Lookingglass very stony silt loam, 2 to 20 percent slopes. This deep, moderately well drained soil is on uplands. It formed in loess and volcanic ash overlying older residuum and colluvium derived

dominantly from volcanic tuff and basalt. The vegetation in areas not cultivated is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 2,700 to 3,700 feet. The average annual precipitation is about 17 to 30 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark brown stony silt loam about 11 inches thick. The subsurface layer is dark grayish brown silt loam about 10 inches thick. The next layer is a buried subsoil of dark brown clay about 17 inches thick. The underlying material to a depth of 60 inches or more is brown silty clay loam.

Included in this unit are small areas of Gwinly, McMurdie, and Wolot soils. Also included are small areas of Lookingglass silt loam and poorly drained seepage areas.

Permeability of this Lookingglass soil is moderate to a depth of 21 inches and very slow below this depth. Available water capacity is about 10 to 12 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. Water is perched above the clay subsoil in winter and spring.

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

This unit is suited to the production of ponderosa pine. The site index for ponderosa pine ranges from 85 to 90: On the basis of a site index of 90 (10), the potential production per acre of wood fiber is 3,400 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 37,960 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 130 years old.

The main concerns in producing and harvesting timber are the very slow permeability of the clay subsoil, the seasonal perched water table, and stones on the surface. Conventional methods of harvesting timber generally are suitable, but the soil may be compacted if it is wet when heavy equipment is used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Roads for year-round use need heavy base rock.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. In areas on south-facing slopes that are droughty in summer, seedling survival can be improved by providing shade for seedlings.

Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

The potential understory plant community on this unit is mainly elk sedge, pinegrass, bluebunch wheatgrass, and Idaho fescue. The production of vegetation suitable for livestock grazing is limited by the density of the tree stand. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Cleared areas of this unit and natural openings in timber stands commonly are used as unimproved pasture.

If this unit is used for pasture, the main limitations are the very slow permeability of the clay subsoil, the seasonal perched water table, and stones on the surface. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the very slow permeability of the clay subsoil, the seasonal perched water table, stones on the surface, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass VIs, nonirrigated.

41D-Lookout very stony silt loam, 2 to 20 percent slopes. This moderately deep, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from basalt and volcanic tuff. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly Idaho fescue and bluebunch bluegrass, Elevation is 2,800 to 3,600 feet. The average annual precipitation is about 8 to 12 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 100 to 140 days.

Typically, the surface layer is very dark grayish brown very stony silt loam about 9 inches thick. The upper 8 inches of the subsoil is dark brown cobbly clay. The lower 4 inches is dark yellowish brown, calcareous clay. The substratum is dark yellowish brown, calcareous loam about 3 inches thick over an indurated hardpan that is cemented with silica and lime and is about 21 inches thick. Basalt is at a depth of 45 inches. Depth to the hardpan ranges from 20 to 40 inches. Depth to bedrock ranges from 40 to 60 inches:

Included in this unit are small areas of Encina and Ruckles soils. Also included are small areas of Rock outcrop.

Permeability of this Lookout soil is moderate to a depth of 9 inches and slow below this depth. Available water capacity is about 3 to 5 inches. Water supplying capacity is 5 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock

grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of the unit for range seeding is poor. The main limitations are stones on the surface and the steepness of slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Grazing should be delayed until the soil in the unit has drained sufficiently and is firm enough to withstand trampling by livestock.

This unit is poorly suited to homesite or recreational development. The main limitations are shallow depth to bedrock and to the hardpan, shrinking and swelling of the soil, low soil strength, and slope.

This map unit is in capability subclass VIs, nonirrigated.

42C-McMurdie silt loam, bedrock substratum, 2 to 15 percent slopes. This deep, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,600 to 4,000 feet. The average annual precipitation is about 17 to 25 inches, the average annual air temperature is 46 to 52 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is black silt loam about 8 inches thick. The next layer is a buried subsoil. The upper 20 inches of the buried subsoil is dark brown clay. The lower 22 inches is dark brown, calcareous silty clay loam. Basalt is at a depth of 50 inches. Depth to bedrock ranges from 40 to 60 inches.

Included in this unit are small areas of Palouse, Ramo, Ukiah, and Watama soils. Also included are small areas of McMurdie soils that are more steeply sloping than this McMurdie soil.

Permeability of this McMurdie soil is slow. Available water capacity is about 6 to 10 inches. Water supplying capacity is 11 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used primarily for crops, mainly wheat and alfalfa (fig. 5). It is also used as rangeland and for wildlife habitat.

Figure 5.-Wheat being harvested on McMurdie silt loam, bedrock substratum, 2 to 15 percent slopes.

This unit is suited to cultivated crops. It is limited mainly by slow permeability and the hazard of erosion. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Range seeding is a suitable practice if the range vegetation is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is poorly suited to homesite or recreational development. The main limitations are slow permeability, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass IIIe, nonirrigated.

42D-McMurdie silt loam, bedrock substratum, 15 to 25 percent slopes. This deep, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,600 to 4,000 feet. The average annual precipitation is about 17 to 25 inches, the average annual air temperature is 46 to 52 degrees F, and the average frost-free period is 120 to 160 days.

Typically, the surface layer is black silt loam about 8 inches thick. The next layer is a buried subsoil. The upper 20 inches of the buried subsoil is dark brown clay. The lower 22 inches is dark brown, calcareous silty clay loam. Basalt is at a depth of 50 inches. Depth to bedrock ranges from 40 to 60 inches.

Included in this unit are small areas of Palouse, Ramo, Ukiah, and Watama soils. Also included are small areas of McMurdie soils that are less steeply sloping than this McMurdie soil.

Permeability of this McMurdie soil is slow. Available water capacity is about 6 to 10 inches. Water supplying capacity is 10 to 15 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used primarily for crops, mainly wheat, peas, and alfalfa. Some areas are used as rangeland and for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by slow permeability and the hazard of erosion. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Range seeding is a suitable practice if the range vegetation is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is poorly suited to homesite or recreational development. The main limitations are slow permeability, shrinking and swelling of the soil, low soil strength, and slope.

This map unit is in capability subclass IVe, nonirrigated.

43C-North Powder loam, 2 to 15 percent slopes. This moderately deep, well drained soil is on uplands. It formed in colluvium and residuum derived dominantly from granitic rock. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly bunchgrasses. Elevation is 2,200 to 3,600 feet. The average annual precipitation is about 11 to 14 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 110 to 130 days.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is brown clay loam about 12 inches thick. The substratum is yellowish brown loam about 5 inches thick. Weathered granitic bedrock is at a depth of 25 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Encina and Ruckles soils. Also included are small areas of rock outcrops and a soil that is similar to this North Powder soil but is shallower to bedrock.

Permeability of this North Powder soil is moderately slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 5 to 9 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less

preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Range seeding is a suitable practice if the range vegetation is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both. Areas of this unit that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is poorly suited to homesite or recreational development. The main limitations are shallow depth to rock, moderately slow permeability, and slope.

This map unit is in capability subclass VIe, nonirrigated.

44C-Olot silt loam, 2 to 12 percent slopes. This moderately deep, well drained soil is on ridgetops on mountainous uplands. It formed in volcanic ash and loess deposited over a soil derived dominantly from basalt. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 18 to 35 inches, the average annual air temperature is 42 to 46 degrees F, and the average frost-free period is 30 to 90 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 1 inch thick. The surface layer is dark yellowish brown silt loam about 6 inches thick. The subsoil is yellowish brown silt loam about 13 inches thick. The next layer is a buried subsoil of strong brown extremely cobbly silty clay loam about 11 inches thick. Fractured basalt is at a depth of about 30 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Kamela, Klicker, Loneridge, and Tolo soils. Also included are small areas of Olot soils that are more steeply sloping than this Olot soil.

Permeability of this Olot soil is moderate to a depth of 19 inches and moderately slow below this depth. Available water capacity is about 4 to 8 inches. Water supplying capacity is 13 to 17 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

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

This unit is well suited to the production of Douglas-fir and western larch. The site index for Douglas-fir ranges from 70 to 75. On the basis of a site index of 73 (4), the potential production per acre of wood fiber is 4,080 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 44,640 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for western larch ranges from 55 to 59. On the basis of a site index of 57 (6), the potential production per acre of merchantable timber is 64,440 board feet (Scribner rule) from an even-aged, fully stocked stand of trees 170 years old.

The main concerns in producing and harvesting timber on this unit is to disturb the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods this material is easily detached, and operating equipment on the unit causes dustiness.

Proper design of road drainage systems and care in the placement of culverts help to control erosion on this unit. Spoil from excavations is subject to rill and gully erosion and to sloughing.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

If this unit is used for recreational development, the main limitations are depth to rock and dustiness in summer. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitation is depth to rock.

This map unit is in capability subclass IVe, nonirrigated.

45E-Olot stony silt loam, 12 to 35 percent slopes. This moderately deep, well drained soil is dominantly on north- and east-facing slopes of mountainous uplands. It formed in volcanic ash and loess deposited over a soil derived dominantly from basalt. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 18 to 35 inches, the average annual air temperature is 42 to 46 degrees F, and the average frost-free period is 30 to 90 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 1 inch thick. The surface layer is dark yellowish brown stony silt loam about 6 inches thick. The subsoil is yellowish brown silt loam about 13 inches thick. The next layer is a buried subsoil of strong brown extremely cobbly silty clay loam about 11 inches thick. Fractured basalt is at a depth of about 30 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Kamela, Klicker, Loneridge, and Tolo soils. Also included are small areas of nonstony Olot soils that are more steeply sloping and less steeply sloping than this Olot soil.

Permeability of this Olot soil is moderate to a depth of 19 inches and moderately slow below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 13 to 17 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

This unit is well suited to the production of Douglas-fir and western larch. The site index for Douglas-fir ranges from 70 to 75. On the basis of a site index of 73 (4), the potential production per acre of wood fiber is 4,080 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 44,640 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for western larch ranges from 55 to 59. On the basis of a site index of 57 (6), the potential production per acre of merchantable timber is 64,440 board feet (Scribner rule) from an even-aged, fully stocked stand of trees 170 years old.

The main concerns in producing and harvesting timber on this unit is to disturb the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods this material is easily detached, and operating equipment on the unit causes dustiness.

Conventional methods of harvesting trees can be used in the more gently sloping areas of this unit but are difficult to use in the steeper areas. Also, stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Proper design of road drainage systems and care in the placement of culverts help to control erosion: Spoil from excavations is subject to rill and gully erosion and to sloughing.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

If this unit is used for recreational development, the main limitations are stones on the surface, depth to rock, steepness of slope, and dustiness during the dry summer months. Steepness of slope limits the use of areas of this soil mainly to a few paths and trails, which should extend across the slope. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitations are depth to rock and steepness of slope.

This map unit is in capability subclass VIe, nonirrigated.

45F-Olot stony silt loam, 35 to 65 percent slopes. This moderately deep, well drained soil is dominantly on north- and east-facing slopes of mountainous uplands. It formed in volcanic ash and loess deposited over a soil derived dominantly from basalt. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 18 to 35 inches, the average annual air temperature is 42 to 46 degrees F, and the average frost-free period is 30 to 90 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 1 inch thick. The surface layer is dark yellowish brown stony silt loam about 13 inches thick. The subsoil is yellowish brown silt loam about 11 inches thick. The next layer is a buried subsoil of strong brown extremely cobbly silty clay loam about 11 inches thick. Fractured basalt is at a depth of about 30 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone, Bocker, Kamela, Klicker, Loneridge, and Tolo soils. Also included are small areas of Olot soils that are less steeply sloping than this Olot soil.

Permeability of this Olot soil is moderate to a depth of 19 inches and moderately slow below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 13 to 16 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is well suited to the production of Douglas-fir and western larch. The site index for Douglas-fir ranges from 70 to 75. On the basis of a site index of 73 (4), the potential production per acre of wood fiber is 4,080 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 44,640 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for western larch ranges from 55 to 59. On the basis of a site index of 57 (6), the potential production per acre of merchantable timber is 64,440 board feet (Scribner rule) from an even-aged, fully stocked stand of trees 120 years old.

The main concerns in producing and harvesting timber on this unit are steepness of slope and disturbing the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods this material is easily detached, and operating equipment on the unit causes dustiness.

The steepness of slope limits the kinds of equipment that can be used in forest management on this unit. The high-lead logging method is more efficient than most other methods and is less damaging to the soil surface. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. Trees commonly are subject to windthrow during periods when the soil is excessively wet and winds are strong.

This unit is poorly suited to recreational development. Steepness of slope limits the use of areas of the unit mainly to a few paths and trails, which should extend across the slope. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitations are steepness of slope and depth to bedrock.

This map unit is in capability subclass VIIe, nonirrigated.

46B-Palouse silt loam, 0 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in a thick mantle of loess. Some volcanic ash is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,500 feet. The average annual precipitation is about 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is black silt loam about 20 inches thick. The upper 18 inches of the subsoil is very dark brown silt loam. The lower 22 inches is dark brown silty clay loam and silt loam. The substratum to a depth of 80 inches or more is brown silt loam.

Included in this unit are small areas of Alicel, Imbler, Lookingglass, McMurdie, and Wolot soils. Also included are small areas of more steeply sloping Palouse soils.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 13 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used primarily for crops, mainly wheat, peas, and grass seed. It is also used for wildlife habitat.

This unit is well suited to cultivated crops. It has few limitations. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

If this unit is used for recreational development, the main limitation is dustiness during the dry summer months.

Population growth has resulted in increased construction of homes on this unit. The unit has few limitations for homesite development.

This map unit is in capability subclass IIe, nonirrigated.

46D-Palouse silt loam, 5 to 20 percent slopes. This deep, well drained soil is on uplands. It formed in a thick mantle of loess. Some volcanic ash is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,500 feet. The average annual precipitation is about 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is black silt loam about 20 inches thick. The upper 18 inches of the subsoil is very dark brown silt loam. The lower 22 inches is dark brown silty clay loam and silt loam. The substratum to a depth of 80 inches or more is brown silt loam.

Included in this unit are small areas of Alicel, Imbler, Lookingglass, McMurdie, and Wolot soils. Also included are small areas of Palouse soils that are more steeply sloping or less steeply sloping than this Palouse soil.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 13 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used primarily for crops, mainly wheat, peas, and grass seed. It is also used for cherry orchards and for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by steepness of slope. Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways. All tillage should be on the contour or across the slope.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Grain and grasses respond to nitrogen, and legumes respond to phosphorus, boron, and sulfur.

This unit is suited to homesite development. The main limitation, in places, is steepness of slope.

This map unit is in capability subclass IIIe, nonirrigated.

46E-Palouse silt loam, 20 to 45 percent slopes. This deep, well drained soil is on uplands. It formed in a thick mantle of loess. Some volcanic ash is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses. Elevation is 2,800 to 3,500 feet. The average annual precipitation is about 18 to 24 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 130 to 150 days.

Typically, the surface layer is black silt loam about 20 inches thick. The upper 18 inches of the subsoil is very dark brown silt loam. The lower 22 inches is dark brown silty clay loam and silt loam. The substratum to a depth of 80 inches or more is brown silt loam.

Included in this unit are small areas of Lookingglass, McMurdie, and Wolot soils. Also included are small areas of Palouse soils that are less steeply sloping than this Palouse soil.

Permeability of this Palouse soil is moderate. Available water capacity is about 11 to 13 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly as rangeland. It is also used for some cultivated crops and for wildlife habitat.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly

bluebunch wheatgrass and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is fair. The main limitation is steepness of slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This unit is poorly suited to cultivated crops. It is limited mainly by steepness of slope and the high hazard of erosion.

This unit is poorly suited to homesite or recreational development. The main limitation is steepness of slope.

This map unit is in capability subclass IVe, nonirrigated.

47B-Phys silt loam, 1 to 5 percent slopes. This deep, well drained soil is on alluvial fans. It formed in mixed alluvium derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,700 to 3,400 feet. The average annual precipitation is about 16 to 21 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is very dark brown silt loam about 11 inches thick. The subsoil is very dark brown very cobbly clay loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown extremely cobbly loam.

Included in this unit are small areas of Conley, Gwinly, and Ramo soils. Also included are small areas of Phys gravelly silt loam and Phys soils that have a silty clay loam surface layer.

Permeability of this Phys soil is moderately slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 10 to 14 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used primarily for crops, mainly wheat, barley, and alfalfa. It is also used for hay and pasture and for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by rock fragments in the soil and droughtiness. Irrigation, where feasible, is required for maximum production of most crops. Because the soil in this unit is droughty, light and frequent applications of irrigation water are most effective. Crop residue left on or near the surface helps to conserve moisture and maintain tilth.

This unit is suited to hay and pasture. The main limitations are rock fragments in the soil and droughtiness. Irrigation, where feasible, is required for maximum production of hay crops. Because the soil in this unit is droughty, light and frequent applications of irrigation water are needed. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Range seeding is suitable if the range is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is suited to homesite or recreational development. The main limitations are the rock fragments in the soil, shrinking and swelling of the soil, and frost action potential.

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

48B-Phys gravelly silt loam, 1 to 5 percent slopes. This deep, well drained soil is on alluvial fans. It formed in mixed alluvium derived dominantly from basalt and andesite. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,700 to 3,400 feet. The average annual precipitation is about 16 to 21 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is very dark brown gravelly silt loam about 11 inches thick. The subsoil is very dark brown very cobbly clay loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown extremely cobbly loam (fig. 6).

Included in this unit are small areas of Conley, Gwinly, and Ramo soils. Also included are small areas of Phys silt loam.

Permeability of this Phys soil is moderately slow. Available water capacity is about 4 to 6 inches. Water supplying capacity is 9 to 13 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly for hay and pasture and as rangeland. It is also used for some cultivated crops and for wildlife habitat.

This unit is suited to hay and pasture. The main limitations are the rock fragments on the surface and in the soil and droughtiness. Irrigation, where feasible, is required for maximum production of hay crops. Because the soil in this unit is droughty, light and frequent applications of irrigation water are needed. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

Figure 6.-Profile of Phys gravelly silt loam, 1 to 5 percent slopes.

This unit is suited to cultivated crops. It is limited mainly by rock fragments on the surface and in the soil and droughtiness. Irrigation, where feasible, is required for maximum production of most crops. Because the soil in this unit is droughty, light and frequent applications of irrigation water are most effective. Crop residue left on or near the surface helps to conserve moisture and maintain tilth.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Range seeding is suitable if the range is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is suited to homesite or recreational development. The main limitations are the rock fragments in the soil, shrinking and swelling of the soil, and frost action potential.

This map unit is in capability subclass IVs, nonirrigated.

49-Pits, gravel. This map unit consists of open excavations from which the surface layer and, commonly, the underlying material have been removed, exposing either rock or other material that supports few if any plants. Gravel pits either have been blasted out of hard basalt or have been excavated in gravelly and cobbly glacial outwash.

This map unit has not been assigned a capability classification.

50C-Ramo silty clay loam, 2 to 15 percent slopes. This deep, well drained soil is on foot slopes and alluvial fans. It formed in alluvium and colluvium derived dominantly from basalt. Some loess is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,800 feet. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is very dark brown heavy silty clay loam about 8 inches thick. The next layer is a buried subsoil about 47 inches thick. The upper 32 inches of the buried subsoil is dark reddish brown gravelly clay. The lower 15 inches is reddish brown gravelly silty clay loam.

Included in this unit are small areas of Conley, Lookingglass, Ukiah, and Watama soils. Also included are small areas of Ramo very stony silty clay loam and Ramo soils that are more steeply sloping than this Ramo soil.

Permeability of this Ramo soil is slow. Available water capacity is about 5 to 7 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used primarily for crops, mainly alfalfa, wheat, and cherries. Areas not in cultivation provide good wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the slow permeability of the subsoil and the

moderate hazard of erosion. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Crop residue left on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This unit is suited to hay and pasture. The main limitations are the slow permeability of the subsoil and the low available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Seedbed preparation should be on the contour or across the slope where practical.

This unit is poorly suited to homesite or recreational development. The main limitations are the shrinking and swelling of the soil and slow permeability.

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

50D-Ramo silty clay loam, 15 to 35 percent slopes. This deep, well drained soil is on foot slopes and alluvial fans. It formed in alluvium and colluvium derived dominantly from basalt. Some loess is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs: Elevation is 2,800 to 3;800 feet. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is very dark brown heavy silty clay loam about 8 inches thick. The next layer is a buried subsoil about 47 inches thick. The upper 32 inches of the buried subsoil is dark reddish brown gravelly clay. The lower 15 inches is reddish brown gravelly silty clay loam.

Included in this unit are small areas of Conley, Lookingglass, Ukiah, and Watama soils. Also included are small areas of Ramo very stony silty clay loam and Ramo soils that are less steeply sloping than this Ramo soil.

Permeability of this Ramo soil is slow. Available water capacity is about 5 to 7 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

This unit is used primarily for crops, mainly alfalfa, wheat, and cherries. Areas not in cultivation are used as rangeland and also provide good wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the slow permeability of the subsoil and the moderate to high hazard of erosion. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Crop residue left on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This unit is suited to hay and pasture. The main limitations are the slow permeability of the subsoil and the low available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Seedbed preparation should be on the contour or across the slope where practical.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

Range seeding is suitable if the range is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

This unit is poorly suited to homesite or recreational development. The main limitations are shrinking and swelling of the soil, slow permeability, and slope.

This map unit is in capability subclass IVe, nonirrigated.

51D-Ramo very stony silty clay loam, 2 to 20 percent slopes. This deep, well drained soil is on foot slopes and alluvial fans. It formed in alluvium and colluvium derived dominantly from basalt. Some loess is in the surface layer. The native vegetation is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,800 feet. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is black very stony silty clay loam about 10 inches thick. The subsoil is very dark brown heavy silty clay loam about 8 inches thick. The next layer is a buried subsoil about 47 inches thick. The upper 32 inches of the buried subsoil is dark reddish brown gravelly clay. The lower 15 inches is reddish brown gravelly silty clay loam.

Included in this unit are small areas of Lookingglass, Starkey, and Ukiah soils. Also included are small areas of nonstony Ramo soils.

Permeability of this Ramo soil is slow. Available water capacity is about 5 to 7 inches. Water supplying capacity is 12 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is moderate.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho

fescue and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitation is the stones on the surface.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

This unit is poorly suited to homesite or recreational development. The main limitations are shrinking and swelling of the soil, slow permeability, stones on the surface, and slope.

This map unit is in capability subclass Vls, nonirrigated.

52C-Ramo-Conley silty clay loams, 2 to 12 percent slopes. This map unit is on foot slopes and fans. The native vegetation is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,800 feet. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

This unit is 40 percent Ramo silty clay loam, 35 percent Conley silty clay loam, and 25 percent included soils. The Ramo soil has slope of 2 to 12 percent; the Conley soil, 2 to 5 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Gwinly, Lookingglass, Starkey, and Ukiah soils. Also included are small areas of Ramo and Conley soils that are more steeply sloping than these Ramo and Conley soils.

The Ramo soil is deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt. Some loess is in the surface layer. Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is very dark brown heavy silty clay loam about 8 inches thick. The next layer is a buried subsoil about 47 inches thick. The upper 32 inches of the buried subsoil is dark reddish brown gravelly clay. The lower 15 inches is reddish brown gravelly silty clay loam.

Permeability of the Ramo soil is slow. Available water capacity is about 5 to 7 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Conley soil is deep and somewhat poorly drained. It formed in mixed alluvial and lacustrine deposits derived dominantly from basalt, granite, and argillite. Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is dark gray silt loam about 3 inches thick. The subsoil is very dark gray clay about 37 inches thick. The substratum to a depth of 60 inches or more is dark brown silty clay loam. In some areas the surface layer is silt loam.

Permeability of the Conley soil is very slow. Available water capacity is about 8 to 11 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 18 to 30 inches. Runoff is slow, and the hazard of water erosion is slight. Water is perched above the clay subsoil, at a depth of 18 to 30 inches, in winter and spring.

Most areas of this unit are used for hay and pasture crops, mainly alfalfa. Among the other crops grown are wheat, green peas, and cherries. Some areas are used as rangeland and for wildlife habitat.

This unit is suited to hay and pasture. The main limitations are the slow and very slow permeability of the soils and a seasonal high water table in the Conley soil. To prevent compaction, equipment should not be operated on this unit when the soils are wet. Artificial drainage, where feasible, helps to overcome the limitation of wetness.

Grasses and legumes grow well if adequate fertilizer is used. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to prevent erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are shrinking and swelling of the soils and slow and very slow permeability. The Conley soil is also limited by a seasonal high water table.

This map unit is in capability subclass IIIe, nonirrigated.

53C-Ramo-Conley complex, 2 to 15 percent slopes. This map unit is on foot slopes and fans. The native vegetation is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,800 feet. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

This unit is 40 percent Ramo very stony silty clay loam, 35 percent Conley silty clay loam, and 25 percent included soils. The Ramo soil has slope of 2 to 15 percent; the Conley soil, 2 to 5 percent. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Gwinly, Lookingglass, Starkey, and Ukiah soils. Also included are small areas of nonstony Ramo soils.

The Ramo soil is deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt. Some loess is in the surface layer. Typically, the surface layer is black very stony silty clay loam about 10 inches thick. The subsoil is very dark brown heavy silty clay loam about 8 inches thick. The next layer is a buried subsoil about 47 inches thick. The upper 32 inches of the subsoil is dark reddish brown gravelly clay. The lower 15 inches is reddish brown gravelly silty clay loam.

Permeability of the Ramo soil is slow. Available water

capacity is about 5 to 7 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Conley soil is deep and somewhat poorly drained. It formed in mixed alluvial and lacustrine deposits derived dominantly from basalt, granite, and argillite. Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is dark gray silt loam about 3 inches thick. The subsoil is very dark gray clay about 37 inches thick. The substratum to a depth of 60 inches or more is dark brown silty clay loam. In some areas the surface layer is silt loam.

Permeability of the Conley soil is very slow. Available water capacity is about 8 to 11 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 18 to 30 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. Water is perched above the clay subsoil in winter and spring.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses on the Ramo soil are mainly Idaho fescue and bluebunch wheatgrass. The Conley soil produces plants typical of meadows. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Range seeding is suitable if the range is in poor condition. The main limitations for seeding are the stones on the surface of the Ramo soil, the seasonal perched water table in the Conley soil, and the slow and very slow permeability of the soils. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Grazing should be delayed until the soils have drained sufficiently and are firm enough to withstand trampling by livestock. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

If this unit is used for pasture, the main limitations are the stones on the surface of the Ramo soil, the seasonal perched water table in the Conley soil, and the slow and very slow permeability of the soils. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soils from erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are shrinking and swelling of the soils and slow and very slow permeability. In addition, the Conley soil has a seasonal perched water table and the Ramo soil has stones on the surface.

This map unit is in capability subclass VIs, nonirrigated.

54C-Ramo Variant silt loam, 2 to 12 percent slopes. This moderately deep, well drained soil is on old terraces and fans. It formed in mixed alluvium derived dominantly from basalt, granite, and volcanic tuff. Some loess and volcanic ash is in the surface layer. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,700 to 3,700 feet. The average annual precipitation is 16 to 22 inches, the average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is black heavy silt loam about 15 inches thick. The subsoil is dark brown clay about 15 inches thick. The substratum, to a depth of 37 inches, is strong brown very gravelly clay loam. The next layer is a weakly cemented hardpan that extends to a depth of 60 inches or more. It is very gravelly in the upper part and grades to extremely cobbly sand in the lower part. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Emily, Ramo, and Ukiah soils. Also included are small areas of Ramo Variant soils that have a gravelly surface layer.

Permeability of this Ramo Variant soil is slow. Available water capacity is about 5 to 7 inches. Water supplying capacity is 8 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used primarily for crops, mainly wheat and alfalfa. It is also used for hay and pasture and for wildlife habitat.

If this unit is used for cultivated crops or for hay crops, the main limitations are the restricted rooting depth, slow permeability, and droughtiness. Ripping and shattering the hardpan increases the effective rooting depth and improves internal drainage.

In summer, irrigation is needed for maximum production of most crops. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Returning all crop residue to the soil and using a cropping, system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass.

Population growth has resulted in increased construction of homes on this unit. The main limitations for homesites are shallow depth to the hardpan, slow permeability, and shrinking and swelling of the soil.

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

55D-Rockly extremely stony loam, 2 to 20 percent slopes. This very shallow, well drained soil is on ridgetops and on south- and west-facing side slopes of uplands. It formed in colluvium and residuum derived dominantly from basalt. Some loess and volcanic ash is

in the surface layer. Elevation is 2,600 to 4,600 feet. The average annual precipitation is about 16 to 24 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface layer is very dark brown extremely stony loam about 6 inches thick. The subsoil is dark brown very stony loam about 2 inches thick. Basalt is at a depth of 8 inches. Depth to bedrock ranges from 5 to 12 inches.

Included in this unit are small areas of Gwinly soils and rock outcroppings. Included areas make up about 20 percent of the total acreage.

Permeability of this Rockly soil is moderately slow. Available water capacity is about 0.3 to 1.0 inch. Water supplying capacity is 1 inch to 3 inches. Effective rooting depth is 5 to 10 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and stiff sagebrush. The production of vegetation suitable for livestock grazing is limited by very shallow depth to rock, droughtiness, and extreme stoniness. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is very poor. The main limitations are depth to rock and extreme stoniness. Use of mechanical treatment practices is not practical, because the surface is extremely stony.

The plant community on this unit responds to proper grazing use. Other management practices suitable for use on the unit are deferred grazing and rotation grazing. Livestock grazing should be managed to protect the soil from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce vegetation suitable for grazing.

This unit is poorly suited to homesite or recreational development. The main limitations are depth to rock and extreme stoniness.

This map unit is in capability subclass VIIs, nonirrigated.

56E-Royst very stony silt loam, 7 to 35 percent slopes. This moderately deep, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from volcanic tuff and basalt. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly bunchgrasses and annual forbs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 15 to 25 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface layer is very dark gray very stony silt loam about 8 inches thick. The upper 2 inches of the subsoil is very dark grayish brown gravelly silty clay loam. The next 7 inches is dark brown very gravelly clay. The lower 8 inches is dark brown extremely, cobbly clay. The substratum is very dark grayish brown extremely cobbly clay about 5 inches thick over soft, fractured tuffaceous bedrock. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone and Klicker soils. Also included are small areas of Royst soils that are more steeply sloping than this Royst soil and soils that are similar to this Royst soil but are underlain by harder bedrock.

Permeability of this Royst soil is slow. Available water capacity is about 2 to 7 inches. Water supplying capacity is 8 to 13 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are stones on the surface and slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

This unit is poorly suited to homesite or recreational development. The main limitations are the stones on the surface, shallow depth to rock, shrinking and swelling of the soil, and slope.

This map unit is in capability subclass VIs, nonirrigated.

56F-Royst very stony silt loam, 35 to 70 percent slopes. This moderately deep, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from volcanic tuff and basalt. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly bunchgrasses and annual forbs. Elevation is 3,000 to 5,000 feet. The average annual precipitation is about 15 to 25 inches, the average annual air temperature is 43 to 45 degrees F, and the average frost-free period is 60 to 100 days.

Typically, the surface layer is very dark gray very stony silt loam about 8 inches thick. The upper 2 inches of the subsoil is very dark grayish brown gravelly silty clay loam. The next 7 inches is dark brown very gravelly clay. The lower 8 inches is dark brown extremely cobbly clay. The substratum is very dark grayish brown extremely

cobbly clay about 5 inches thick over soft, fractured tuffaceous bedrock. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Anatone and Klicker soils. Also included are small areas of Royst soils that are less steeply sloping than this Royst soil and soils that are similar to this Royst soil but are underlain by harder bedrock.

Permeability of this Royst soil is slow. Available water capacity is about 2 to 7 inches. Water supplying capacity is 8 to 13 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are stones on the surface and steepness of slope. Slope also limits access by livestock and promotes overgrazing of the less sloping areas.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Use of mechanical treatment practices is not practical, because the surface is stony and the slopes are steep.

This unit is poorly suited to homesite or recreational development. The main limitations are stones on the surface, shallow depth to bedrock, shrinking and swelling of the soil, and steepness of slope.

This map unit is in capability subclass VIIs, nonirrigated.

57C-Ruckles very stony clay loam, 1 to 12 percent slopes. This shallow, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from basalt and volcanic tuff. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,400 to 3,500 feet. The average annual precipitation is about 9 to 14 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark gray very stony clay loam about 2 inches thick. The upper part of the subsoil is very dark gray very stony clay about 2 inches thick. The lower part is dark yellowish brown very cobbly clay about 13 inches thick. Basalt is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are small areas of Encina and Lookout soils. Also included are small areas of Ruckles soils that are more steeply sloping than this Ruckles soil.

Permeability of this Ruckles soil is slow. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 4 to 6 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, Sandberg bluegrass, and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants and stiff sagebrush increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitation is stones on the surface.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This unit is poorly suited to homesite or recreational development. The main limitations are stones on the surface, shallow depth to rock, low soil strength, and shrinking and swelling of the soil.

This map unit is in capability subclass VIIs, nonirrigated.

57E-Ruckles very stony clay loam, 12 to 45 percent slopes. This shallow, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from basalt and volcanic tuff. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly bunchgrasses and perennial shrubs. Elevation is 2,400 to 3,500 feet. The average annual precipitation is about 9 to 14 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark gray very stony clay loam about 2 inches thick. The upper part of the subsoil is very dark gray very stony clay about 2 inches thick. The lower part is dark yellowish brown very cobbly clay about 13 inches thick. Basalt is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are small areas of Encina and Lookout soils. Also included are small areas of Ruckles soils that are more steeply sloping or less steeply sloping than this Ruckles soil.

Permeability of this Ruckles soil is slow. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 4 to 6 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, Sandberg bluegrass, and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants and big sagebrush increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are stones on the surface and slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This unit is poorly suited to homesite or recreational development. The main limitations are stones on the surface, shallow depth to rock, low soil strength, shrinking and swelling of the soil, and slope.

This map unit is in capability subclass VIIs, nonirrigated.

57F-Ruckles very stony clay loam, 45 to 65 percent slopes. This shallow, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from basalt and volcanic tuff. Some loess and volcanic ash is in the surface layer. The native vegetation is mainly bunchgrasses; annual forbs; and perennial shrubs. Elevation is 2,400 to 3,500 feet. The average annual precipitation is about 9 to 14 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 110 to 140 days.

Typically, the surface layer is very dark gray very stony clay loam about 2 inches thick. The upper part of the subsoil is very dark gray very stony clay about 2 inches thick. The lower part is dark yellowish brown very cobbly clay about 13 inches thick. Basalt is at a depth of 17 inches. Depth to bedrock ranges from 10 to 20 inches.

Included in this unit are small areas of Encina and Lookout soils. Also included are small areas of Ruckles soils that are less steeply sloping than this Ruckles soil.

Permeability of this Ruckles soil is slow. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 4 to 6 inches. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are stones on the surface and steepness of slope. Slope also limits access by livestock and promotes overgrazing of the less sloping areas.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This unit is poorly suited to homesite or recreational development. The main limitations are stones on the surface, shallow depth to bedrock, low soil strength, shrinking and swelling of the soil, and slope.

This map unit is in capability subclass VIIs, nonirrigated.

58E-Starkey very stony silt loam, 2 to 35 percent slopes. This shallow, well drained soil is on uplands. It formed in residuum and colluvium derived dominantly from volcanic tuff and basalt. Some loess is in the surface layer. The native vegetation is mainly bunchgrasses and annual forbs. Elevation is 2,800 to 4,000 feet. The average annual precipitation is about 15 to 21 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 80 to 110 days.

Typically, the surface layer is very dark brown very stony silt loam about 7 inches thick. The upper 2 inches of the subsoil is very dark brown cobbly silty clay. The lower 6 inches is dark brown gravelly and very gravelly clay. Partially weathered volcanic tuff is at a depth of 15 inches: Depth to soft bedrock ranges from 10 to 20 inches.

Included in this unit are small areas of Gwinly, Ukiah, and McMurdie soils. Also included are small areas of rock outcroppings.

Permeability of this Starkey soil is slow. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 4 to 9 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. The production of vegetation suitable for livestock grazing is limited by stones on the surface and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are stones on the surface and slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

This unit is poorly suited to homesite or recreational development. The main limitations are stones on the

surface, shallow depth to bedrock, shrinking and swelling of the soil, and slope.

This map unit is in capability subclass VIIs, nonirrigated.

59E-Tolo silt loam, 12 to 35 percent slopes. This deep, well drained soil is on mountainous uplands. It formed in volcanic ash and loess deposited over a soil derived dominantly from loess and basalt. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,000 to 4,200 feet. The average annual precipitation is about 18 to 35 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 2 inches thick. The surface layer is black silt loam about 1 inch thick. The subsoil is dark brown silt loam about 32 inches thick. The next layer is a buried subsoil of dark yellowish brown silty clay loam that grades to silt loam and extends to a depth of 65 inches or more.

Included in this unit are small areas of Anatone, Cowsly, Hall Ranch, Klicker, Loneridge, and Olot soils. Also included are small areas of more steeply sloping Tolo soils.

Permeability of this Tolo soil is moderate to a depth of 33 inches and moderately slow below that depth. Available water capacity is about 18 to 24 inches. Water supplying capacity is 15 to 24 inches. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

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

This unit is well suited to the production of Douglas-fir and western larch. The site index for Douglas-fir ranges from 75 to 85. On the basis of a site index of 80 (4), the potential production per acre of wood fiber is 4,880 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,820 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 110 years old.

The site index for western larch ranges from 64 to 68. On the basis of a site index of 66 (6), the potential production per acre of merchantable timber is 62,360 board feet (Scribner rule) from an even-aged, fully stocked stand of trees 140 years old.

The main concern in producing and harvesting timber on this unit is to disturb the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of the nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods this material is easily detached, and operating equipment on the unit causes dustiness.

Slope and the hazard of erosion are also concerns on this unit. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Proper design of road drainage systems and care in the placement of culverts also help to control erosion. Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand. Conventional methods of harvesting trees can be used on this unit.

If this unit is used for recreational development, the main limitations are steepness of slope and dustiness during the dry summer months. Steepness of slope limits the use of some areas of this unit mainly to a few paths and trails, which should extend across the slope. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is suited to homesite development. The main limitations are slope and low soil strength.

This map unit is in capability subclass VIe, nonirrigated.

59F-Tolo silt loam, 35 to 65 percent slopes. This deep, well drained soil is on mountainous uplands. It formed in volcanic ash and loess deposited over a soil derived-dominantly from loess and basalt. Slopes dominantly face north and east. The native vegetation is mainly coniferous forest and an understory of shrubs, forbs, and grasses. Elevation is 3,000 to 4,200 feet. The average annual precipitation is about 18 to 35 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface is covered with a mat of needles, twigs, and duff about 2 inches thick. The surface layer is black silt loam about 1 inch thick. The subsoil is dark brown silt loam about 32 inches thick. The next layer is a buried subsoil of dark yellowish brown silty clay loam that extends to a depth of about 65 inches or more.

Included in this unit are small areas of Anatone, Cowsly, Hall Ranch, Klicker, Loneridge, and Olot soils. Also included are small areas of less steeply sloping Tolo soils.

Permeability of this Tolo soil is moderate to a depth of 33 inches and moderately slow below that depth. Available water capacity is about 18 to 24 inches. Water supplying capacity is 15 to 22 inches. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

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

This unit is well suited to the production of Douglas-fir and western larch. The site index for Douglas-fir ranges from 75 to 85. On the basis of a site index of 80 (4), the potential production per acre of wood fiber is 4,880 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,820 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 110 years old.

The site index for western larch ranges from 64 to 68. On the basis of a site index of 66 (6), the potential

production per acre of merchantable timber is 62,360 board feet (Scribner rule) from an even-aged, fully stocked stand of trees 140 years old.

The main concerns in producing and harvesting timber on this unit are steepness of slope and disturbing the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods this material is easily detached, and operating equipment on the unit causes dustiness.

The steepness of slope limits the kinds of equipment that can be used in forest management. The high-lead logging method is more efficient than most other methods and is less damaging to the soil surface. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Proper design of road drainage systems and care in the placement of culverts also help to control erosion. Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand.

This unit is poorly suited to recreational development. Steepness of slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

This unit is poorly suited to homesite development. The main limitations are steepness of slope and low soil strength.

This map unit is in capability subclass VIIe, nonirrigated.

60D-Ukiah silty clay loam, 2 to 20 percent slopes. This moderately deep, well drained soil is on uplands. It formed in colluvium and residuum derived dominantly from volcanic tuff. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 3,000 to 4,600 feet. The average annual precipitation is 15 to 21 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 80 to 110 days.

Typically, the surface layer is black silty clay loam about 3 inches thick. The upper 19 inches of the subsoil is black clay that grades to very dark gray clay. The lower 16 inches is dark brown silty clay loam. Volcanic tuff is at a depth of 38 inches. Depth to soft bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Gwinly, Lookingglass, and Starkey soils. Also included are small areas of Ukiah soils that are more steeply sloping than this Ukiah soil.

Permeability of this Ukiah soil is very slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 7 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly as rangeland and for wildlife habitat. It is also used for some cultivated crops, hay, and pasture.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community.

Range seeding is suitable if the range is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Grazing should be delayed until the soil in this unit is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

If this unit is used for cultivated crops, the main limitations are the restricted rooting depth, slow permeability, the hazard of erosion, droughtiness, and a short growing season. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. The risk of sheet and rill erosion on the steeper slopes can be reduced by use of gradient terraces and contour farming.

This unit is poorly suited to homesite or recreational development. The main limitations are shallow depth to rock, shrinking and swelling of the soil, very slow permeability, and low soil strength.

This map unit is in capability subclass IVe, nonirrigated.

61E-Ukiah-Starkey complex, 5 to 40 percent slopes. This map unit is in irregularly shaped areas on uplands. Elevation is 3;000 to 4,600 feet. The average annual precipitation is about 15 to 21 inches, the average annual air temperature is 45 to 50 degrees F, and the average frost-free period is 80 to 110 days.

This unit is about 45 percent Ukiah silty clay loam, 35 percent Starkey very stony silt loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Gwinly and Rockly soils. Also included are small areas of clayey soils that are more than 40 inches deep to bedrock.

The Ukiah soil is moderately deep and well drained. It formed in colluvium and residuum derived dominantly from volcanic tuff. Typically, the surface layer is black silty clay loam about 3 inches thick. The next layer is black clay about 11 inches thick. The upper 8 inches of

the subsoil is very dark gray clay. The lower 16 inches is dark brown silty clay loam. Soft volcanic tuff is at a depth of about 38 inches. Depth to soft bedrock ranges from 20 to 40 inches.

Permeability of the Ukiah soil is very slow. Available water capacity is about 4 to 7 inches. Water supplying capacity is 9 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

The Starkey soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from volcanic tuff and basalt. Typically, the surface layer is very dark brown very stony silt loam about 7 inches thick. The upper 2 inches of the subsoil is very dark brown cobbly silty clay. The lower 6 inches is dark brown gravelly clay. Soft volcanic tuff is at a depth of 15 inches. Depth to soft bedrock ranges from 10 to 20 inches.

Permeability of the Starkey soil is slow. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 7 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

This unit is used as rangeland and for wildlife habitat.

The potential plant community on this unit is mainly Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. On the Starkey soil, the production of vegetation suitable for livestock grazing is limited by shallow rooting depth and the very stony surface layer. The Ukiah soil has few limitations. If the range is overgrazed, the proportion of preferred forage plants on this unit decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are the very stony surface layer of the Starkey soil and slope.

Management practices suitable for use on this unit are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management. Use of mechanical treatment practices on this unit is not practical, because the Starkey soil has a very stony surface and steep slopes. Livestock grazing should be managed to protect the unit from excessive erosion. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce vegetation suitable for grazing. Grazing should be delayed until the soils in the unit are firm and the more desirable forage plants have achieved sufficient growth to withstand grazing.

This unit is poorly suited to homesite or recreational development. The main limitations are stoniness, steepness of slope, slow permeability, and depth to bedrock.

This map unit is in capability subclass Vls, nonirrigated.

62-Umapine silt loam. This deep, somewhat poorly drained soil is on bottom lands and low stream terraces. It formed in mixed alluvium derived dominantly from basalt. Slope is 0 to 3 percent. The vegetation in areas not cultivated is mainly basin wildrye, Indian saltgrass, and greasewood. Elevation is 2,600 to 3,500 feet. The average annual precipitation is 9 to 14 inches, the average annual air temperature is 45 to 54 degrees F, and the average frost-free period is 110 to 150 days.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown very fine sandy loam about 7 inches thick. The upper 9 inches of the underlying material is dark grayish brown very fine sandy loam, the next 16 inches is dark grayish brown silt loam, and the lower part to a depth of 60 inches or more is brown loam.

Included in this unit are small areas of Catherine, La Grande, Veazie, and Wingville soils. Also included are small areas of Umapine soils that have a loam surface layer.

Permeability of this Umapine soil is moderate. Available water capacity is about 7 to 12 inches. Water supplying capacity is 6 to 10 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 60 inches in winter and spring. This soil is subject to occasional, brief periods of flooding in winter and spring.

This unit is used mainly for hay and pasture and for cultivated crops, primarily wheat. It is also used for wildlife habitat.

If this unit is used for hay and pasture, the main limitations are high salt content and wetness. The concentration of salts and alkali in the surface layer limits the production of plants suitable for hay and pasture. Leaching the salts from the surface layer is limited by the high water table. Drainage and irrigation water management reduce the concentration of salts. Salt-tolerant species are most suitable for planting.

Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

Areas of this unit that have been leached of salts and artificially drained are suited to cultivated crops. Soil tests to determine fertilizer requirements, salinity, and sodicity are advisable. Tilth and fertility can be improved by returning crop residue to the soil.

Irrigation is required for maximum production of most crops. Sprinkler and flood irrigation systems are suited to this unit. Irrigation water should be applied at a rate that insures maximum production without increasing runoff and erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the hazard of flooding and wetness.

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

63-Urban land-La Grande complex. This map unit is on alluvial fans and low stream terraces that are protected from normal flooding. Slope is 0 to 2 percent. The vegetation in areas not in urban uses is mainly bunchgrasses and annual forbs. Elevation is 2,200 to 2,400 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 48 to 53 degrees F, and the average frost-free period is 130 to 150 days.

This unit is 60 percent Urban land, 30 percent La Grande silt loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Catherine, Veazie, and Voats soils. Also included are small areas of La Grande soils that are subject to flooding.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

The La Grande soil is deep and moderately well drained. It formed in mixed alluvium derived dominantly from basalt and granite. Typically, the surface layer is black silt loam about 14 inches thick. The upper 7 inches of the subsoil is very dark grayish brown silt loam. The lower 23 inches is dark yellowish brown silty clay loam. The substratum to-a depth of 60-inches or more is multicolored extremely gravelly loam.

Permeability of the La Grande soil is moderate. Available water capacity is about 8to 13 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 30 to 50 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 48 inches in winter and spring.

This unit is used mainly for urban development.

The main limitation for urban development is the seasonal high water table. The risk of flooding has been reduced by modifying the channel of the Grande Ronde River and by constructing dikes.

This map unit is not assigned a capability classification.

64-Urban land-Ramo complex, 2 to 15 percent slopes. This map unit is on foot slopes and fans. The vegetation in areas not in urban use is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,800 to 3,200 feet. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 100 to 150 days.

This unit is 50 percent Urban land, 35 percent Ramo silty clay loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Gwinly, Lookingglass, and Ukiah soils. Also included are small areas of Ramo soils that are more steeply sloping than this Ramo soil.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

The Ramo soil is deep and well drained. It formed in alluvium and colluvium derived dominantly from basalt. Some loess is in the surface layer. Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is very dark brown heavy silty clay loam about 8 inches thick. The next layer is a buried subsoil about 47 inches thick. The upper 32 inches of the buried subsoil is dark reddish brown gravelly clay. The lower 15 inches is reddish brown gravelly silty clay loam.

Permeability of the Ramo soil is slow. Available water capacity is about 5 to 7 inches. Water supplying capacity is 14 to 18 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly for urban development.

This unit is limited for urban development mainly by slow permeability, shrinking and swelling of the soil, low soil strength, and clayey texture. These limitations can be overcome by use of proper design.

This map unit is not assigned a capability classification.

65-Urban land-Veazie complex. This map unit is on bottom lands and low stream terraces that are protected from normal flooding. Slope is 0 to 3 percent. The vegetation in areas not in urban use is mainly grasses, forbs, shrubs, and scattered trees. Elevation is 2,200 to 2,800 feet. The average annual precipitation is 12 1P 25 inches, the average annual air temperature is 45 to 51 degrees F, and the average frost-free period is 50 to 150 days.

This unit is 50 percent Urban land, 30 percent Veazie and Voats soils, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Catherine and La Grande soils. Also included are small areas of soils that are similar to Veazie and Voats soils but are deeper or shallower to gravel.

Urban land consists of areas where the soils are largely covered by concrete, asphalt, buildings, or other impervious surfaces that obscure or alter the soils so that identification is not feasible.

The Veazie soil is moderately deep to gravel and is well drained. It formed in mixed alluvium derived dominantly from basalt, andesite, and granite. Typically, the surface layer is very dark brown loam about 11 inches thick. The subsoil is very dark grayish brown loam about 21 inches thick. The underlying material to a depth of 60 inches or more is very gravelly sand. Depth to stratified sand and gravel ranges from 20 to 40 inches.

Permeability of the Veazie soil is moderate to a depth of 32 inches and very rapid below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 7 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

The Voats soil is shallow to gravel and is well drained. It formed in mixed alluvium derived dominantly from basalt, andesite, and granite. Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is dark brown sandy loam about 6 inches thick. The underlying material to a depth of 60 inches or more is very gravelly sand.

Permeability of the Voats soil is moderate to a depth of 16 inches and very rapid below this depth. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is about 2 to 5 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly for urban development.

The main limitation of this unit for urban development is the hazard of seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. The large amount of coarse fragments in the soil may make excavation difficult.

This map unit is not assigned a capability classification.

66-Veazie-Voats complex. This map unit is on bottom lands and low stream terraces. Slope is 0 to 3 percent. The vegetation in areas not cultivated is mainly grasses, annual forbs, and scattered trees. Elevation is 2,500 to 4,000 feet. The average annual precipitation is about 12 to 25 inches, the average annual air temperature is 45 to 51 degrees F, and the average frost-free period is 50 to 150 days.

This unit is 45 percent Veazie loam, 35 percent Voats fine sandy loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Catherine and La Grande soils. Also included are small areas of soils that are similar to the Veazie and Voats soils but are shallower or deeper to gravel.

The Veazie soil is moderately deep to gravel and is well drained. It formed in mixed alluvium derived dominantly from basalt, andesite, and granite. Typically, the surface layer is very dark brown loam about 11 inches thick. The subsoil is very dark grayish brown loam about 21 inches thick. The substratum to a depth of 60 inches or more is very gravelly sand. Depth to stratified sand and gravel ranges from 20 to 40 inches.

Permeability of the Veazie soil is moderate to a depth of 32 inches and very rapid below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 7 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to brief periods of flooding in winter and spring.

The Voats soil is shallow to gravel and is well drained. It formed in mixed alluvium derived dominantly from basalt, andesite, and granite. Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is dark brown sandy loam about 6 inches thick. The substratum to a depth of 60 inches or more is very dark grayish brown very gravelly sand.

Permeability of the Voats soil is moderate to a depth of 16 inches and very rapid below this depth. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 4 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to brief periods of flooding in winter and spring.

This unit is used mainly for hay and pasture. It is also used for wildlife habitat.

This unit is suited to hay and pasture. The main limitations are the hazard of flooding and low available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This unit is poorly suited to homesite or recreational development. The main limitations are the hazard of flooding and seepage from onsite sewage disposal systems.

This map unit is in capability subclass VIs.

67-Veazie-Voats complex, protected. This map unit is on bottom lands and low stream terraces that are protected from normal flooding. Slope is 0 to 3 percent. The vegetation in areas not cultivated is mainly grasses, forbs, and scattered trees. Elevation is 2,500 to 4,000 feet. The average annual precipitation is 12 to 25 inches, the average annual air temperature is 45 to 51 degrees F, and the average frost-free period is 50 to 150 days.

This unit is 45 percent Veazie loam, 35 percent Voats fine sandy loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Catherine and La Grande soils. Also included are small areas of soils that are similar to these Veazie and Voats soils but are deeper or shallower to gravel.

The Veazie soil is moderately deep to gravel and is well drained. It formed in mixed alluvium derived dominantly from basalt, andesite, and granite. Typically, the surface layer is very dark brown loam about 11 inches thick. The subsoil is very dark grayish brown loam about 21 inches thick. The substratum to a depth of 60 inches or more is very gravelly sand. Depth to stratified sand and gravel ranges from 20 to 40 inches.

Permeability of the Veazie soil is moderate to a depth of 32 inches and very rapid below this depth. Available water capacity is about 3 to 7 inches. Water supplying capacity is 7 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

The Voats soil is shallow to gravel and is well drained. It formed in mixed alluvium derived dominantly from basalt, andesite, and granite. Typically, the surface layer is very dark grayish brown fine sandy loam about 10 inches thick. The subsoil is dark brown sandy loam about 6 inches thick. The substratum to a depth of 60 inches or more is very gravelly sand.

Permeability of the Voats soil is moderate to a depth of 16 inches and very rapid below this depth. Available water capacity is about 1 inch to 3 inches. Water supplying capacity is 4 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly as homesites. It is also used for hay and pasture and for wildlife habitat.

Population growth has resulted in increased construction of homes on this unit. The main limitation for homesite development is the very rapid permeability of the soils. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This unit is suited to hay and pasture. The main limitations are restricted rooting depth and droughtiness. In summer, irrigation is required for maximum production of most crops. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

This map unit is in capability subclass VIs, nonirrigated.

68C-Watama silt loam, moist, 2 to 12 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess and volcanic ash mixed with residuum and colluvium derived dominantly from basalt. The vegetation in areas not cultivated is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,400 to 3,600 feet. The average annual precipitation is 14 to 24 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 120 to 150 days.

Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam about 22 inches thick. Basalt is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are small areas of Gwinly, Lookingglass, Ukiah, and McMurdie soils. Also included are small areas of Watama soils that are more steeply sloping than this Watama soil.

Permeability of this Watama soil is moderately slow. Available water capacity is about 3 to 8 inches. Water supplying capacity is 6 to 14 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used primarily for crops, mainly wheat, barley, and alfalfa. It is also used as rangeland and for wildlife habitat.

This unit is suited to cultivated crops. It is limited mainly by the restricted rooting depth, moderately slow permeability, and the hazard of erosion. Erosion can be reduced if fall grain is seeded early, stubble-mulch tillage is used, and tillage and seeding are on the contour or across the slope. Also, waterways should be shaped and seeded to perennial grass. Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

Range seeding is a suitable practice if the range vegetation is in poor condition. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is suited to homesite and recreational development. The main limitation is the shallow depth to bedrock.

This map unit is in capability subclass IVe, nonirrigated.

69C-Watama-Gwinly complex, 2 to 12 percent slopes. This map unit is on biscuit-scabland uplands. The native vegetation is mainly bunchgrasses, annual forbs, and perennial shrubs. Elevation is 2,400 to 3,600 feet. The average annual precipitation is about 14 to 24 inches, the average annual air temperature is 46 to 50 degrees F, and the average frost-free period is 120 to 150 days.

This unit is 60 percent Watama silt loam, 30 percent Gwinly very cobbly silt loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Rockly and McMurdie soils. Also included are small areas of Watama and Gwinly soils that are more steeply sloping than these Watama and Gwinly soils.

The Watama soil is moderately deep and well drained. It formed in loess and volcanic ash mixed with residuum and colluvium derived from basalt. Typically, the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam about 22 inches

thick. Basalt is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Watama soil is moderately slow. Available water capacity is about 3 to 8 inches. Water supplying capacity is 6 to 10 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

The Gwinly soil is shallow and well drained. It formed in colluvium and residuum derived dominantly from basalt and volcanic tuff. Some loess is in the surface layer. Typically, the surface layer is very dark grayish brown very cobbly silt loam about 4 inches thick. The next layer is very dark grayish brown very cobbly silty clay loam about 3 inches thick. The subsoil is dark brown extremely cobbly clay about 9 inches thick. Basalt is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Gwinly soil is slow. Available water capacity is about 1 inch to 2.5 inches. Water supplying capacity is 5 to 10 inches. Effective rooting depth is 10 to 20 inches. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used as rangeland and for wildlife habitat.

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly Idaho fescue and bluebunch wheatgrass. If the range is overgrazed, the proportion of preferred forage. plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

The suitability of this unit for range seeding is poor. The main limitations are the rock fragments in the Gwinly soil and depth to bedrock. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

This unit is poorly suited to homesite or recreational development. The main limitation is the shallow depth to bedrock.

This map unit is in capability subclass VIs, nonirrigated.

70B-Wilkins silt loam, 1 to 5 percent slopes. This deep, somewhat poorly drained soil is in mountain meadows on uplands. It formed in loess and volcanic ash over alluvium derived dominantly from basalt. The native vegetation is mainly grasses, sedges, and annual forbs. Elevation is 3,200 to 5,000 feet. The average annual precipitation is about 17 to 32 inches, the average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 50 to 100 days.

Typically, the surface layer is very dark gray silt loam about 14 inches thick. The subsurface layer is grayish brown silt loam about 12 inches thick. The next layer is a buried subsoil of very dark grayish brown silty clay that extends to a depth of 60 inches or more.

Included in this unit are small areas of Cowsley and Tolo soils. Also included are small areas of soils that are similar to this Wilkins soil but are more poorly drained.

Permeability of this Wilkins soil is moderate to a depth of 26 inches and very slow below this depth. Available water capacity is about 10 to 12 inches. Water supplying capacity is 10 to 16 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. Water is perched above the buried subsoil in winter and spring.

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

If the range vegetation on this unit is in good or excellent condition, the native grasses are mainly tufted hairgrass, redtop, and bluegrass. Sedges are also important plants on this unit. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases. Therefore, livestock grazing should be managed so that the desired balance of species is maintained in the plant community.

If the range vegetation is seriously deteriorated, seeding is needed. Plants that tolerate wetness should be seeded. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock.

This unit is poorly suited to homesite or recreational development. The main limitations are the very slow permeability, wetness, the hazard of flooding, shrinking and swelling of the soil, and low soil strength.

This map unit is in capability subclass IVw, nonirrigated.

71-Wingville silt loam. This deep, somewhat poorly drained soil is on flood plains and low alluvial fans. It formed in mixed alluvium derived dominantly from basalt and granite. Slope is 0 to 2 percent. The vegetation in areas not cultivated is mainly grasses, forbs, and shrubs. Elevation is 2,200 to 3,600 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 47 to 51 degrees F, and the average frost-free period is 110 to 160 days.

Typically, the surface layer is black silt loam about 24 inches thick. The subsurface layer is very dark brown silt loam about 4 inches thick. The upper 5 inches of the substratum is very dark grayish brown silt loam, the next 6 inches is olive gray silty clay loam, and the lower part to a depth of 60 inches or more is dark olive gray clay.

Included in this unit are small areas of Catherine, Umapine, and Veazie soils. Also included are small areas of Wingville soils that are more steeply sloping or more poorly drained than this Wingville soil.

Permeability of this Wingville soil is moderately slow. Available water capacity is about 9 to 12 inches. Water supplying capacity is 7 to 10 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This unit is used mainly for hay and pasture. It is also used for wheat production and for wildlife habitat.

If this unit is used for hay and pasture, the main limitations are the restricted rooting depth and wetness. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

This unit is poorly suited to homesite or recreational development. The main limitations are the moderately slow permeability, wetness, and the hazard of flooding.

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

72C-Wolot silt loam, 2 to 12 percent slopes. This deep, well drained soil is on uplands. It formed in volcanic ash deposited over a soil that formed in residuum and colluvium derived dominantly from basalt and loess. The vegetation in areas not cultivated is mainly coniferous forest and an understory of grasses, forbs, and shrubs. Elevation is 2,700 to 3,900 feet. The average annual precipitation is about 18 to 25 inches, the average annual air temperature is 45 to 48 degrees F, and the average frost-free period is 100 to 150 days.

Typically, the surface is covered with a mat of duff, needles, and twigs about 1 inch thick. The surface layer is dark brown silt loam about 4 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown silt loam about 7 inches thick. Below this, to ,a depth of 36 inches, is a buried surface layer of very dark grayish brown silt loam. The next layer is a buried subsoil of dark yellowish brown silty clay loam that extends to a depth of 60 inches or more.

Included in this unit are small areas of Gwinly, Lookingglass, and Tolo soils. Also included are small areas of more steeply sloping Wolot soils.

Permeability of this Wolot soil is moderate to a depth of 29 inches and moderately slow below this depth. Available water capacity is about 11 to 24 inches. Water supplying capacity is 13 to 25 inches. Effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate.

This unit is used mainly for timber production. It is also used for some cultivated crops and for wildlife habitat.

This unit is well suited to the production of Douglas-fir and ponderosa pine. The site index for Douglas-fir ranges from 71 to 80. On the basis of a site index of 75 (4), the potential production per acre of wood fiber is 4,480 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,040 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The site index for ponderosa pine ranges from 100 to 110. On the basis of a site index of 105 (10), the potential production per acre of wood fiber is 4,480 cubic feet from an even-aged, fully stocked stand of trees 40 years old or 50,040 board feet (Scribner rule) from an even-aged, fully stocked stand of merchantable trees 120 years old.

The main concern in producing and harvesting timber is to disturb the ashy surface layer as little as possible. This layer has exceptionally high available water capacity and contains an appreciable amount of the nutrients necessary for plant growth. During wet periods this ashy material has low strength. During dry periods this material is easily detached, and operating equipment on the unit during these periods causes dustiness. Spoil from excavations is subject to rill and gully erosion and to sloughing.

Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Proper design of road drainage systems and care in the placement of culverts also help to control erosion.

Plant competition delays natural regeneration of trees but does not prevent the eventual development of a fully stocked, normal stand.

Cleared areas of this unit are suited to cultivated crops. The major crops grown are alfalfa hay, winter wheat, and pasture grasses. Rainfall is usually adequate, and irrigation is seldom practiced. Grass hay commonly is cut on pasture before grazing cattle on it.

Returning all crop residue to the soil and using a cropping system that includes grasses, legumes, or grass-legume mixtures help to maintain fertility and tilth. Practices that can be used to control erosion include seeding early in fall, stubble-mulch tillage, and construction of terraces, diversions, and grassed waterways.

This unit is well suited to recreational development. It is limited mainly by dustiness during dry periods. Areas used for recreation can be protected from soil blowing and dust by maintaining plant cover.

Population growth has resulted in increased construction of homes on this unit. The main limitations for homesite development are moderately slow permeability, shrinking and swelling of the soil, and dustiness during dry periods.

This map unit is in capability subclass IIe, nonirrigated.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities,. highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

Jan Anderson, district conservationist, Soil Conservation Service; Ralph Hart and Gordon Cook, county agents, Agricultural Extension Service; and Lloyd German, county executive director, Agricultural Conservation and Stabilization Service, La Grande, Oregon, assisted in preparing this section.

The Union County Area is about 671,300 acres, of which about 170,000 acres is used for crops and pasture. Most of this acreage, or about 100,000 acres, is used for nonirrigated crops. The remaining 70,000 acres is used for irrigated crops.

About 28 percent of the cropland is used for wheat production, 15 percent for barley and oats, 36 percent for hay and pasture, 8 percent for summer fallow, 5 percent for grass seed, and 5 percent for vegetables and fruit.

Nonirrigated cropland is used mainly for wheat, barley, oats, hay, and pasture. The average wheat yields range from 25 to 80 bushels per acre. Wheat usually is planted during the period from September 1 to November 1. Nitrogen and sulfur commonly are applied before planting, and an additional application of nitrogen is made in spring. Phosphorus is applied where soil tests or field trials indicate a probable response. Weeds are controlled by tillage or by use of herbicides, or both. Wheat generally is grown in alternate years under a wheat-fallow cropping system.

In the Elgin area, wheat and peas are sometimes grown in alternate years. Serious water erosion is taking place in this area, especially where a wheat-fallow cropping system is being used on soils that have slopes of 15 to 25 percent. Sheet and rill erosion is most common, but gully erosion is a problem in some places. A major cause of erosion is rapid runoff of water from shallow and very shallow soils above the cropped fields during snowmelt in spring. Diversion ditches along the upper part of the field are successfully used to reduce soil loss where suitable outlets are available. Crop residue utilization, minimum tillage, cross-slope tillage, and stripcropping are other practices that effectively reduce erosion.

Significant sheet and rill erosion is occurring in the North Powder-Telocaset area, where a wheat-fallow cropping system involving clean tillage is practiced during the fallow year. In this area, stubble mulch tillage, cross-slope tillage, and minimum tillage are effectively used to reduce erosion.

Nonirrigated barley production averages 3/4 ton to 3 tons per acre. Both winter barley and spring barley are grown. Winter barley is planted September 1 to October 15. Spring barley is planted March 15 to April 15. The most common fertilizer practice consists of applying nitrogen before planting. Sulfur and phosporus are applied where soil tests or field trials indicate a need. The weed control and erosion control practices used are very similar to those used for wheat. Barley commonly is planted on soils that are moderately affected by salts or that are strongly alkaline, because it is better adapted to these soils than is wheat.

Nonirrigated alfalfa hay production ranges from 1.5 tons to about 4 tons per acre. Phosphorus and sulfur are applied where soil tests or field trials indicate a need. Stands usually need to be reseeded every 5 to 7 years. Soil loss from soil blowing and water erosion is usually within allowable limits.

Nonirrigated grass hay production ranges from 1 ton to 3 tons per acre. Pasture production varies widely, depending on soil characteristics and management.

Nonirrigated oats commonly are grown in the Elgin Area. The fertilizer, weed control, and erosion control practices used are very similar to those used for wheat.

Irrigated cropland is used mainly for hay, pasture, wheat, barley, grass seed, vegetables, and fruit. Sprinkler irrigation is the most common method of applying water. Small, locally important areas are surface irrigated. These areas are used mainly for grass-hay production.

Irrigated alfalfa hay production averages 4 to 7 tons on the deep, well drained soils in the survey area. Stands commonly persist for 5 to 7 years. Sulfur and phosphorus commonly are applied as need is indicated by soil tests and field trials. Soil loss from soil blowing and water erosion is usually within acceptable limits because of the dense plant cover. Good management practices are needed to minimize soil loss.

Average production of grass hay under short-season surface irrigation ranges from 2 to 3 tons per acre. Nitrogen cane applied in spring. Where slopes are less than 3 percent, soil loss generally is within acceptable limits because of the dense plant cover. Where slopes are more than 3 percent, short runs, low water pressure, and contour supply ditches are used to minimize soil loss.

Average wheat production under sprinkler irrigation ranges from 50 to 120 bushels on soils that have minor limitations. Winter wheat is planted September 1 to November 1. Nitrogen, sulfur, and phosphorus usually are applied according to needs as indicated by soil tests or field trials before planting. An additional application of nitrogen may be applied to winter wheat in spring. Weeds are controlled by tillage and by the use of herbicides. Use of crop residue, minimum tillage, and cross-slope tillage effectively reduce soil loss. Serious soil loss from soil blowing can occur in the Hot Lake-Union and the Sand Ridge areas of the Grande Ronde Valley unless good management practices are used. Practices used to reduce soil blowing include stripcropping, minimum tillage, stubble mulch tillage, and windbreak plantings.

Average barley production under sprinkler irrigation ranges from 1 ton to 3 tons per acre. Nitrogen, sulfur, and phosphorus are applied where soil tests or field trials indicate a probable response. The weed control and erosion control practices used are very similar to those used for wheat. Barley is frequently planted on soils that are moderately affected by salts or that are strongly alkaline, because it is better adapted to these soils than is wheat.

Both irrigated and nonirrigated seed crops are grown. Several varieties of bluegrasses and fine-leafed fescues are grown, mainly for turf grass seed production.

Irrigated and nonirrigated cherries are grown in the Summerville and Cove areas.

Irrigated potatoes are grown commercially in the Grande Ronde Valley.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each. crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the

Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s, or c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

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

rangeland

S. Duane Town, range conservationist, Soil Conservation Service, assisted with the preparation of this section.

About 235,000 acres, or 35 percent, of the survey area is rangeland. More than 25 percent of the farm and ranch income is derived from livestock, principally cattle. Cow-calf operations are dominant in the survey area. The average size of ranches is 700 acres.

On many ranches, the forage produced on private rangeland is supplemented by grazing on national forest and private commercial timberland under a permit system that provides for grazing in summer and early in fall. In fall and winter, grain stubble and hay are used to supplement range forage. Creep feeding of calves and yearlings to increase their body weight is practiced on some ranches.

About 40 percent of the rangeland in the area needs improvement. Of this, about 10 percent is in poor or very poor range condition, and plant cover needs to be reestablished on it. Reestablishment of plant cover would increase the amount of usable forage available for livestock by an estimated 8 to 10 times after 1 year to 3 years. About 10 percent of the range is in fair range condition but needs brush management. Brush management would increase usable forage for livestock by an estimated 3 to 4 times in 5 or 6 years. The remaining 20 percent that needs improvement is mostly in fair range condition and does not need brush management. It can be improved through good grazing management. The estimated increase in usable forage for livestock varies with the range site, but generally it can be expected to increase 1.5 to 2.5 times in 3 to 10 years.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; 'thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air dry moisture.

Characteristic vegetation-the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil-is listed by common name. Under composition, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals, the grazing season, and the condition of the plant community.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community as it relates to a specific use.

The most common objective in range management is to manage grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of water erosion and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

woodland management and productivity

Terry Johnson, forester, Soil Conservation Service, assisted with the preparation of this section.

About 37 percent of the survey is woodland. The woodland cover types in the area are interior ponderosa pine, grand fir-larch-Douglas-fir, lodgepole pine, and Engelmann spruce-subalpine fir. These cover types are briefly discussed in the following paragraphs.

The interior ponderosa pine cover type begins at an elevation of 2,700 feet. As available moisture increases, the amount of Douglas-fir in the stand increases.

The grand fir-larch-Douglas-fir cover type is mainly on north- and east-facing slopes, where the soils have a mantle of volcanic ash. Elevations in this area range from 2,700 to 3,900 feet.

The lodgepole pine cover type is commonly on moderately deep or deep soils at elevations above 3,500 feet. It also occurs at elevations of as little as 2,700 feet on soils that have a volcanic ash mantle. As with all temporary cover types, it is associated with a variety of conifers that will eventually replace it.

The Englemann spruce-subalpine fir cover type is on the wetter and colder soils at elevations of 4,000 to 5,500 feet. Western larch is an important species that is associated with this cover type.

Among the woodland products derived from these cover types are lumber, wood chips, posts, poles, and veneer. Ponderosa pine and Douglas-fir are used chiefly for lumber, wood chips, and veneer. The true firs are used mainly for wood chips.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol,* a number; indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority, is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blow down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

woodland understory vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Table 8 shows, for each soil suitable for woodland use, the potential for producing understory vegetation. The total production of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4 1/2 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 8 also lists the common names of the characteristic vegetation on each soil and the percentage composition, by air-dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

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

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The survey area provides excellent opportunities for recreational activities such as hunting, fishing, hiking,

skiing, wild food gathering, and horseback riding. These activities are conducted mainly in the timbered mountains surrounding the Grande Ronde Valley. Facilities for these activities are extensive, and they consist mainly of paths and trails, picnic areas, and campgrounds. Although many of these recreational activities are engaged in on private lands in the area, most of the developed facilities are on adjacent national forest land. Intensive recreational facilities such as playgrounds and ballfields generally are located adjacent to schools and within town limits.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational use by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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

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

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

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

wildlife habitat

Mark Henjum, wildlife biologist, Oregon Department of Fish and Wildlife, and Robert Corthell, biologist, Soil Conservation Service, assisted in the preparation of this section.

The Union County Area provides a diversity of habitats for a wide variety of fish and wildlife species. The Grande Ronde Valley, which comprises general soil map units 1 through 6, is inhabited at various times of the year by many species, including ring-necked pheasant, California quail; mourning dove; Hungarian partridge, geese, ducks, swans, mule deer, white-tailed deer, coyotes, rabbits, beaver, muskrat, mink, weasel, raptors, warmwater gamefish, and many nongame birds and mammals. In recent times, much of the valley floor has been developed for farming by draining wetlands and removing brushy fencerows and woodlots. The crops provide food for upland game birds, but in recent years the loss of cover has resulted in reduced numbers of pheasant, Hungarian partridge, and quail. Drainage of wetlands and removal of riparian vegetation have reduced the habitat available to resident and migratory waterfowl.

Dry foothill and rangeland areas, which comprise general map units 7 and 8, provide habitat for many wildlife species. These areas provide food and cover for a large number of mule deer and Rocky Mountain elk in winter. They also provide habitat for a variety of upland game birds, including blue grouse, ruffed grouse, quail, chukar, Hungarian partridge, sage grouse, numerous rapters, and many species of nongame birds and mammals.

Timbered mountains, which comprise general map units 9, 10, and 11, provide excellent habitat for Rocky Mountain elk, mule deer, black bear, cougar, bobcat, and coyote. Several furbearers, including beaver, pine marten, raccoon, and fisher, use this type of habitat. Blue, ruffed, and Franklin grouse are also present. Rivers and streams in these areas provide critical spawning habitat for Chinook salmon and steelhead and are home for rainbow trout, brook trout, dolly varden, and whitefish.

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

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

Grain and seed crops are domestic grains and other seed-producing annuals planted to produce food for wildlife. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, barley, millet, and sunflower.

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

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are cheatgrass, filaree, goldenrod, beggarweed, and bluebunch wheatgrass.

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

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

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

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

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

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include California quail, pheasant, meadowlark, Canada geese, and coyote.

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

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

Habitat for rangeland wildlife consists of areas of shrubs and native herbaceous plants. Wildlife attracted. to rangeland include mule deer, elk, partridge, quail, meadowlark, several species of rodent, hawks, eagles, coyotes, and badgers.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

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

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

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

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

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

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of

the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet: It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

water management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium.

A high water table affects the amount of usable material. It also affects trafficability.

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

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

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

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

soil properties

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

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

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

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

engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

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

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SPSM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1 -a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent.

Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

Moist bulk density is the weight of soil (oven dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low,* a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high,* more than 6 percent. *Very high,* greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, send, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

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

In table 17, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

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

Table 18 gives the frequency of flooding. Frequency is estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; occasional that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years.

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty

in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

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

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

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

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

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (12). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table Q, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

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

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent,* the suborder of the Entisols that have an aquic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, nonacid, mesic Typic Haplaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (11). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (12). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Alicel series

The Alicel series consists of deep, well drained, undulating soils on valley terraces. These soils formed in mixed eolian material. Slope is 1 to 15 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Alicel loam, 1 to 5 percent slopes, in cropland about 1.2 miles east of Alicel; 113 feet south of Alicel Market Road and 588 feet west of section line in the SE1/4NE1/4 of sec. 8, T. 2 S., R. 39 E.

Ap-0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, very friable,

nonsticky and nonplastic; many very fine roots; many very fine tubular pores; mildly alkaline (pH 7.4); abrupt smooth boundary.

A12-8 to 18 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 7.2); clear smooth boundary.

B1-18 to 31 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 7.2); abrupt smooth boundary.

B2-31 to 47 inches; dark brown (10YR 4/3) clay loam, yellowish brown (10YR 5/4) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; dark organic coatings in some pores; neutral (pH 7.2); abrupt smooth boundary.

IIC-47 to 100 inches; dark yellowish brown (10YR 4/4) fine sandy loam, yellowish brown (10YR 5/4) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine interstitial pores; moderately alkaline (pH 7.9).

The depth to bedrock is 60 inches or more.

The A horizon has value of 2 or 3 when moist and chroma of 1 to 3 when moist or dry. Texture is loam, silt loam, or fine sandy loam.

The B2 horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. Texture is sandy clay loam or clay loam that is 20 to 30 percent clay.

The C horizon has value of 3 to 5 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. Texture is loam, fine sandy loam, or sandy loam.

Anatone series.

The Anatone series consists of shallow, well drained soils on uplands. These soils formed in colluvium and residuum derived from basalt. They have some loess and volcanic ash in the surface layer. Slope is 2 to 65 percent. The mean annual precipitation is about 23 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of an Anatone extremely stony loam in an area of Anatone-Bocker complex, 2 to 35 percent slopes, in the Starkey Experimental Forest and Range, about 20 feet east of the gravel road in the NE1/4SW1/4NW1/4 of sec. 17, T. 4 S., R. 34 E.

A1-0 to 6 inches; dark brown (7.5YR 3/2) extremely stony loam, brown (7.5YR 5/2) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; about 20 percent stones, 10 percent cobbles, and 10 percent pebbles; neutral (pH 6.8); abrupt wavy boundary.

B2-6 to 11 inches; dark brown (7.5YR 3/2) very cobbly loam, brown (7.5YR 5/2) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine tubular pores; about 5 percent stones, 40 percent cobbles, and 10 percent pebbles; neutral (pH 7.0); clear wavy boundary.

C-11 to 16 inches; fractured basalt; material similar to that in the B2 horizon is in the fractures; common fine roots in fractures; clear irregular boundary.

R-16 inches; basalt.

Depth to bedrock ranges from 10 to 20 inches. The solum has hue of 5YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. The control section is silt loam, loam, or silty clay loam. It is 25 to 30 percent clay and 40 to 75 percent rock fragments.

Bocker series

The Bocker series consists of very shallow, well drained; cobbly soils on uplands. These soils formed in residuum and colluvium derived from basalt. Some loess and volcanic ash is in the surface layer. Slope is 2 to 35 percent. The mean annual precipitation is about 23 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of a Bocker very cobbly silt loam in an area of Anatone-Bocker complex, 2 to 35 percent slopes, in the Starkey Experimental Forest and Range, about 15 feet east of the gravel road in the NE1/4SW1/4NW1/4 of sec. 17, T. 4 S., R. 34 E.

A1-0 to 2 inches; dark reddish brown (5YR 3/3) very cobbly silt loam, dark brown (7.5YR 4/4) dry; weak fine granular structure; slightly, hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 25 percent cobbles and 20 percent gravel; slightly acid (pH 6.4); clear smooth boundary.

B2-2 to 7 inches; dark reddish brown (5YR 3/3) very gravelly loam, dark b own (7.5YR 4/4) dry; weak medium and fine subangular blocky structure; slightly hard, friable, lightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; 30 per ent gravel and 15 percent cobbles; slightly acid (pH 6.4); abrupt irregular boundary.

R-7 inches; fractured basalt. I

Depth to bedrock rang s from 4 to 10 inches. The fine earth fraction of the control section is loam or silt loam.

The profile is 35 to 50 percent pebbles, cobbles, and stones.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry, and chroma of 3 or 4 when dry.

The B horizon has hue of 5YR or 7.5YR and chroma of 3 or 4 when dry.

Catherine series

The Catherine series consists of deep, somewhat poorly drained soils on flood plains. These soils formed in mixed alluvium. Slope is 0 to 3 percent. The mean annual precipitation is about 17 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Catherine silt loam, in a cultivated area about 1.5 miles east of Island City, 1,400 feet north and 100 feet east of Pierce Lane Bridge, in the NW1/4SW1/4 of sec. 36, T. 2 S., R. 38 E.

Ap-0 to 8 inches; black (10YR 2/1) heavy silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and irregular pores; slightly acid (pH 6.4); abrupt smooth boundary.

A12-8 to 18 inches; black (10YR 2/1) heavy silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and irregular pores; neutral (pH 6.6); clear smooth boundary.

A13-18 to 30 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; common distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine and very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

AC-30 to 40 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; many fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine and very fine tubular pores; neutral (pH 7.3); clear smooth boundary.

C1-40 to 48 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; many fine distinct yellowish brown (10YR 5/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; mildly alkaline (pH 7.5); abrupt smooth boundary.

IIC2-48 to 60 inches; very dark grayish brown (10YR 3/2) very gravelly silt loam; hard, firm, slightly sticky and slightly plastic; 50 percent pebbles; mildly alkaline (pH 7.5).

The mean annual soil temperature ranges from 47 to 52 degrees F. Bedrock is at a depth of 60 inches or more. The profile is slightly acid to mildly alkaline. Strongly contrasting textures are absent within 40 inches of the surface. The 10- to 40-inch control section is silty clay loam or silt loam and averages 22 to 35 percent clay.

The A horizon has hue of 10YR or 2.5Y. The A1 horizon, to a depth of at least 10 inches, has value of 3 to 5 when dry and 1 to 3 when moist, and it has chroma of less than 2. The lower part of the A1 horizon and the AC horizon have value of 2 or 3 when moist and 4 or 5 when dry, and they have chroma of 2 or less when moist or dry. Mottles are distinct or prominent.

The C horizon has value of 2 to 4 when moist and 4 to 6 when dry, and it has chroma of 2 or less. Below a depth of 40 inches in some pedons are sand, very gravelly sand, or very gravelly medium textured horizons and lenses of volcanic ash.

Conley series

The Conley series consists of deep, somewhat poorly drained soils on alluvial fans and in old lake basins. These soils formed in mixed alluvial and lacustrine material. Slope is 0 to 5 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Conley silty clay loam, 0 to 2 percent slopes, in a cultivated area about 4.5 miles north of Island City, in the SW1/4NE1/4 of sec. 10, T. 2 S., R. 38 E.

Ap-0 to 10 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; weak medium platy structure parting to moderate medium granular; slightly hard, friable, sticky and plastic; many very fine roots; common very fine and fine tubular pores; neutral (pH 6.7); abrupt smooth boundary.

A2-10 to 13 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 6/1) dry; weak medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; few fine iron and manganese concretions 1 to 4 millimeters in diameter; neutral (pH 7.0); gradual smooth boundary.

IIB2t-13 to 19 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; strong medium prismatic structure parting to strong medium blocky; very hard, firm, very sticky and very plastic; common fine roots; many very fine tubular pores; continuous thick clay films; neutral (pH 7.2); gradual smooth boundary.

IIB22t-19 to 26 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; very dark brown (10YR 2/2) coatings on peds; strong medium prismatic structure parting to strong medium blocky; very hard, firm, very sticky and very plastic; few fine roots; common very fine tubular pores; continuous thick clay films; neutral (pH 7.2); gradual smooth boundary.

IIB23t-26 to 37 inches; very dark gray (2.5Y 3/1) clay, gray (2.5Y 5/1) dry; strong medium blocky structure; very hard, firm, very sticky and very plastic; few very fine tubular pores; continuous thick clay films; neutral (pH 7.3); gradual smooth boundary.

IIB24t-37 to 50 inches; very dark grayish brown (10YR 3/2) clay, grayish brown (10YR 5/2) dry; moderate medium blocky structure; hard, firm, very sticky and very plastic; continuous thick clay films; mildly alkaline (pH 7.4); gradual smooth boundary.

IIC-50 to 60 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; massive; hard, firm, sticky and plastic; mildly alkaline (pH 7.4)

Bedrock is at a depth of 60 inches or more. The mollic epipedon ranges from 10 to 15 inches in thickness. The solum is neutral or mildly alkaline.

The Ap horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry.

The A2 horizon has value of 4 when moist and 5 or 6 when dry, and it has chroma of 1 or 2 when moist or dry. Texture is silt loam or silty clay loam. Faint mottles and few to many black concretions are in some pedons.

The B2t horizon has hue of 10YR or 2.5Y, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 1 or 2 when moist or dry. Texture is silty clay or clay that is 40 to 50 percent clay. Some pedons have faint to distinct mottles in the B2t horizon. Some pedons do not have coatings on faces of peds.

The C horizon has hue of 10YR or 2.5Y, and it has value of 3 or 4 when moist and 5 when dry.

Coughanour series

The Coughanour series consists of moderately deep, well drained soils on old fans and low terraces. These soils formed in mixed alluvium derived mainly from loess and volcanic ash deposited over glacial outwash. Slope is 0 to 12 percent. The mean annual precipitation is about 11 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Coughanour silt loam, 2 to 7 percent slopes, in a cultivated field about 2 miles west of the town of North Powder, at the northwest corner of the NE1/4 of sec. 20, T. 6 S., R. 39 E.

A11-0 to 3 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; many fine tubular pores; neutral (pH 7.0); clear smooth boundary.

A12-3 to 10 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; common fine roots; common fine and few medium tubular pores; neutral (pH 7.2); clear smooth boundary.

A3-10 to 18 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; common fine and medium tubular pores; mildly alkaline (pH 7.4); clear wavy boundary.

B21t-18 to 26 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; strong medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine roots; common fine tubular pores; common thin clay films; mildly alkaline (pH 7.4); clear wavy boundary.

B22tca-26 to 32 inches; dark brown (7.5YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; strong medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine tubular pores; common moderately thick clay films; few lime splotches; slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

C1casim-32 to 40 inches; platy hardpan that is strongly cemented with silica and lime; indurated laminar capping on the plates; clear smooth boundary.

C2-40 to 60 inches; dark brown (7.5YR 4/4) sandy loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, friable, nonsticky and nonplastic; few fine tubular pores; 10 percent pebbles, 5 percent cobbles, and 5 percent weakly cemented pebble-sized nodules; slightly effervescent; moderately alkaline (pH 8.0)

The hardpan is at a depth of 20 to 40 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when moist or dry.

The B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist, and chroma of 3 or 4 when moist or dry. The texture ranges from heavy silt loam to silty clay loam that is 24 to 34 percent clay.

The C2 horizon has hue of 7.5YR or 10YR. It averages 0 to 20 percent cobbles and 0 to 40 percent pebbles.

Cowsly series

The Cowsly series consists of deep, moderately well drained soils on mountainous uplands. These soils formed in loess and some volcanic ash overlying older fine textured residuum or colluvium derived from volcanic tuff and basalt. Slope is 2 to 20 percent. The mean annual precipitation is about 23 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Cowsly silt loam, 2 to 12 percent slopes, in a meadow, in the SE1/4NE1/4 of sec. 24, T. 1 N., R. 40 E.

A11-0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak thin platy structure parting to weak fine granular;

slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; slightly acid (pH 6.2); clear wavy boundary.

A12-3 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; slightly acid (pH 6.2); clear wavy boundary.

A13-5 to 15 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 6.6); clear wavy boundary.

A21-15 to 17 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 6.8); clear wavy boundary.

A22-17 to 19 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/1) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; neutral (pH 6.8); abrupt wavy boundary.

IIB21t-19 to 24 inches; dark brown (10YR 3/3) clay, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate fine blocky; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; continuous thick clay films on faces of peds and in pores; tongues of A2 material in cracks in clay; neutral (pH 6.8); clear wavy boundary.

IIB22t-24 to 42 inches; dark brown (10YR 3/3) clay, dark grayish brown (10YR 4/2) dry; very dark gray organic coating on some faces of peds; strong coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; continuous thick clay films on faces of peds and in pores; neutral (pH 6.8); clear wavy boundary.

IIB23t-42 to 60 inches; dark brown (10YR 4/3) cobbly clay, brown (10YR 5/2) dry; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; common thin clay films on faces of peds and in pores; about 15 percent cobbles and 10 percent pebbles; neutral (pH 7.0).

Bedrock is at a depth of 60 inches or more. The argillic horizon is at a depth of 12 to 30 inches.

The A1 horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is 0 to 10 percent stones, 0 to 25 percent cobbles, and 0 to 10 percent pebbles. The A2 horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 1 or 2 when moist or dry. A stone line is at the lower boundary in some pedons.

The IIB21t horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 2 to 4 when moist or dry. Texture is silty clay or clay that is 40 to 60 percent clay. The lower part of the horizon is 0 to 15 percent cobbles and 0 to 10 percent pebbles .

The IIB22t horizon has hue of 10YR to 2.5Y, value of 4 to 6 when moist and 5 to 7 when dry, and chroma of 2 or 3 when moist or dry. Texture is clay loam, silty clay loam, or light clay that is 27 to 45 percent clay. This horizon is 0 to 20 percent cobbles and 0 to 15 percent pebbles.

Emily series

The Emily series consists of deep, well drained soils on upland toe slopes. These soils formed in alluvium and colluvium mixed with loess and volcanic ash. Slope is 2 to 12 percent. The mean annual precipitation is about 23 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Emily silt loam, 2 to 12 percent slopes, in the Lindsay Forest demonstration tract, about 750 feet east along End Road and 205 feet north of road in the SE1/4SW1/4NW1/4 of sec. 22, T. 1 S., R 38 E.

O1-1 inch to 0; duff, needles, twigs, and leaves.

A11-0 to 2 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and common fine roots; common very fine tubular pores; 10 percent pebbles; neutral (pH 6.6); clear smooth boundary.

A12-2 to 6 inches; dark brown (10YR 3/3) silt loam, brown (10YR 4/3) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common very fine and few fine tubular pores; 10 percent pebbles; slightly acid (pH 6.5); clear smooth boundary.

B21-6 to 14 inches; dark brown {10YR 3/3) gravelly light clay loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots and few medium and coarse roots; few very fine tubular pores; 20 percent pebbles; neutral (pH 6.7); clear wavy boundary.

B22-14 to 34 inches; dark brown (10YR 3/3) very cobbly light clay loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; few very fine tubular pores; 20 percent pebbles and 30 percent cobbles; neutral (pH 6.7); clear wavy boundary.

C-34 to 60 inches; dark brown (10YR 3/3) extremely cobbly loam, yellowish brown (10YR 5/4) dry;

massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and few medium roots; 35 percent pebbles and 40 percent cobbles; neutral (pH 6.8)

The weighted average of coarse fragments in the 10- to 40-inch control section ranges from 35 to 60 percent. The mollic epipedon is 20 to 36 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The B horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 2 to 4 when moist or dry. The texture is heavy loam, clay loam, or silty clay loam that is 25 to 35 percent clay and averages 35 to 60 percent pebbles and cobbles.

The C horizon is loam or light clay loam. The content of rock fragments ranges from 40 to 80 percent.

Encina series

The Encina series consists of deep, well drained soils on old, dissected terraces. These soils formed in loess and lacustrine sediment. Slope is 2 to 45 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Encina silt loam, in a cultivated field, at the southwest corner of the SE1/4NE/4NW1/4 of sec. 4, T. 6 S., R. 40 E.

Ap-0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many very fine tubular pores; 5 percent pebbles; neutral (pH 7.2); abrupt smooth boundary.

A12-4 to 8 inches; very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; strong medium and coarse subangular blocky structure; hard, firm, sticky and plastic; many very fine roots, common fine roots, and few medium roots; many very fine and common fine tubular pores; 5 percent pebbles; neutral (pH 7.2); clear smooth boundary.

B21t-8 to 13 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and very plastic; common very fine and fine roots; many very fine tubular pores; many moderately thick clay films on ped faces; 5 percent pebbles; mildly alkaline (pH 7.8); clear smooth boundary.

B22t-13 to 20 inches; dark yellowish brown (10YR 4/4) clay, brown (10YR 5/3) dry; strong medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine and fine roots; many very fine tubular pores; many moderately thick clay films on faces of peds; 5 percent pebbles; moderately alkaline (pH 8.4); clear smooth boundary.

IIB3t-20 to 28 inches; yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; many very fine tubular pores; few thin clay films on faces of peds; weakly calcareous; strongly alkaline (pH 8.6); clear smooth boundary.

IIC1ca-28 to 43 inches; yellowish brown (10YR 5/4) silt loam, very pale brown (10YR 8/4) dry; massive; soft, friable, slightly sticky and slightly plastic; common very fine tubular pores; segregated lime; strongly calcareous; moderately alkaline (pH 8.2); gradual smooth boundary.

IIC2ca-43 to 60 inches; pale yellow (2.5Y 7/4) silt loam, very pale brown (10YR 8/3) dry; massive; soft, friable, nonsticky and nonplastic; few very fine tubular pores; weakly calcareous; moderately alkaline (pH 8.2).

The solum is neutral to strongly alkaline. Reaction increases with depth. Lime is at a depth of 8 to 20 inches.

The A horizon has value of 2 to 4 when moist, and it has chroma of 1 to 3 when moist or dry.

The B2t horizon has value of 3 or 4 When moist and 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry. It is clay or silty clay that is 40 to 50 percent clay and 0 to 15 percent pebbles.

The Cca horizon has value of 4 or 5 when moist and 6 to 8 when dry, and it has chroma of 2 to 4 when moist or dry. It is stratified loam, silt loam, or silty clay loam that is 0 to 25 percent coarse fragments of mixed origin, including diatomite.

Gwinly series

The Gwinly series consists of shallow, well drained soils on uplands. These soils formed in colluvium weathered from basalt, volcanic tuff, and loess over basalt. Slope is 2 to 70 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Gwinly very cobbly silt loam, 12 to 20 percent slopes, in an area of rangeland about 150 feet north of creek, in the SW1/4SE1/4SW1/4 of sec. 26, T. 5 S., R. 40 E.

A1-0 to 4 inches; very dark grayish brown (10YR 3/2) very cobbly silt loam, brown (10YR 5/3) dry; moderate thin platy structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular pores; 5 percent pebbles, 30 percent cobbles, and 10 percent stones; mildly alkaline (pH 7.4); abrupt wavy boundary.

B1-4 to 7 inches; very dark grayish brown (10YR 3/2) very cobbly silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores; 10 percent pebbles, 35 percent cobbles, and 5 percent stones; neutral (pH 7.2); abrupt wavy boundary.
B2t-7 to 16 inches; dark brown (10YR 3/3) extremely cobbly clay, brown (10YR 4/3) dry; moderate medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; continuous thick clay films on ped faces and in pores; 20 percent pebbles and 50 percent cobbles; neutral (pH 7.2); abrupt irregular boundary.
R-16 inches; basalt.

Bedrock is at a depth of 10 to 20 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist and 2 or 3 when dry.

The Bt horizon has hue of 7.5YR or 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. It is 40 to 50 percent clay and about 40 percent coarse fragments, mainly cobbles.

Hall Ranch series

The Hall Ranch series consists of moderately deep, well drained soils on uplands. These soils formed in loess and colluvium weathered from andesite and rhyolite. Slope is 2 to 65 percent. The mean annual precipitation is about 24 inches, and the mean annual air temperature is about 42 degrees F.

Typical pedon of Hall Ranch stony loam, 2 to 35 percent slopes, in an area of woodland, about 2,200 feet north of State Highway 203 along logging road north of Catherine Creek State Park, along west fork of logging road; 560 feet south of gate and 180 feet east of road near center of sec. 6, T. 5 S., R. 41 E.

O1-1 inch to 0; loose litter of needles, twigs, and leaves.
A11-0 to 2 inches; very dark brown (10YR 2/2) stony loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many irregular pores; few stones on surface; neutral (pH 6.6); clear smooth boundary.
A12-2 to 8 inches; very dark brown (10YR 2/2) stony loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine to medium roots; many irregular pores; about 20 percent pebbles; neutral (pH 6.6); gradual smooth boundary.
B21-8 to 17 inches; very dark grayish brown (10YR 3/2) gravelly loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, slightly sticky and slightly plastic; many fine to coarse roots; many very fine tubular pores; about 25 percent pebbles; neutral (pH 6.6); gradual smooth boundary.
B22-17 to 31 inches; dark grayish brown (2.5Y 4/2) gravelly loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine to coarse roots; many very fine tubular pores; about 20 percent pebbles; few small streaks of darker soil material from horizon above; neutral (pH 6.7); clear smooth boundary.
C1-31 to 35 inches; grayish brown (2.5Y 5/2) very cobbly loam, light gray (2.5Y 7/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine to coarse roots; many very fine tubular pores; about 80 percent weathered andesite fragments; neutral (pH 6.6); clear smooth boundary.
C2r-35 inches; platy, soft andesite.

Soft andesite or rhyolitic bedrock is at a depth of 20 to 40 inches. The control section is 15 to 35 percent rock fragments. The base saturation of the upper 30 inches is 60 to 75 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist or dry. It is about 15 to 25 percent rock fragments

The B horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3 when moist or dry. It is 18 to 27 percent clay and about 15 to 30 percent rock fragments, mainly pebbles.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. It is 35 to 80 percent rock fragments 1 inch to 6 inches in diameter.

Helter series

The Helter series consists of deep, well drained soils on mountainous uplands. These soils formed in volcanic ash and some loess over older buried loess and weathered basalt. Slope is 12 to 65 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of Helter silt loam in a wooded area in a road cut southeast of Cricket Flat, in the NW1/4SW1/4NW1/4 of sec. 13, T. 1 S., R. 40 E.

O1-1 inch to 0; needles, twigs, and duff.
A1-0 to 3 inches; very dark brown (10YR 2/2) light silt loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots, common medium roots, and few coarse roots; common fine and very fine continuous tubular pores; medium acid (pH 5.6); clear smooth boundary.

B1-3 to 12 inches; brown (10YR 4/3) light silt loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots, common medium roots, and few coarse roots; common fine and very fine continuous tubular pores; medium acid (pH 5.8); clear smooth boundary.

B2-12 to 22 inches; yellowish brown (10YR 5/6) light silt loam, very pale brown (10YR 7/4) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots, common medium roots, and few coarse roots; many fine and very fine continuous tubular pores; medium acid (pH 5.8); abrupt wavy boundary.

IIB1tb-22 to 33 inches; dark brown (7.5YR 3/4) light silty clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots, common medium roots, and few coarse roots; common fine and medium tubular pores; few thin clay films; 5 percent pebbles; medium acid (pH 5.8); clear wavy boundary.

IIB2tb-33 to 50 inches; dark brown (7.5YR 3/4) silty clay loam, brown (7.5YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few very fine, fine, medium, and coarse roots; common medium tubular pores; continuous thin clay films on faces of peds; 5 percent pebbles; medium acid (pH 6.0); gradual wavy boundary.

II3tb-50 to 56 inches; dark brown (7.5YR 3/4) silty clay loam, brown (7.5YR 5/3) dry; weak coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; few medium tubular pores; continuous thin clay films on faces of peds; 10 percent pebbles; slightly acid (pH 6/2); gradual wavy boundary.

IICb-56 to 63 inches; dark brown (7.5YR 3/4) cobbly silty clay loam, brown (7.5YR 5/3) dry; massive; hard, friable, sticky and plastic; few fine roots; few very fine tubular pores; 10 percent pebbles and 20 percent cobbles; slightly acid (pH 6.2).

The thickness of the ash and the depth to the buried soil range from 20 to 32 inches. The thicker deposits of ash are in concave areas and on north-facing slopes. Bedrock is at a depth of 60 inches or more.

The A horizon has value of 2 to 4 when moist and 5 or 6 when dry, and it has chroma of 2 to 4 when moist or dry.

The B horizon has value of 4 or 5 when moist and 6 or 7 when dry, and it has chroma of 4 to 6 when moist or dry.

The buried B horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It is silt loam or silty clay loam that is 25 to 32 percent clay. Clay films are few to continuous and thin or moderately thin.

The buried C horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry.

Hooly series

The Hooly series consists of deep, somewhat poorly drained soils in old lake basins and on valley floors. These soils formed in loess and volcanic ash over diatomaceous sediment. Slope is 0 to 2 percent. The mean annual precipitation is about 16 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Hooly silt loam, on the east side of Godley Lane, at the southwest corner of the NW1/4NW1/4 of sec. 25, T. 3 S., R. 39 E.

Ap-0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 5/1) dry; weak thin platy structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

A12-3 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 6/1) dry; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common fine and few coarse roots; common fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary..

AC-11 to 17 inches; dark grayish brown (10YR 4/2) silt loam, gray (10YR 6/1) dry; few distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/6) mottles; weak fine granular structure; soft, friable, nonsticky and nonplastic; common fine and few coarse roots; common fine tubular pores; slightly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

IIC1-17 to 21 inches; light brownish gray (10YR 6/2) silt, light gray (10YR 7/1) dry; massive; soft, friable, nonsticky and nonplastic; few fine roots; few fine pores; mildly alkaline (pH 7.4); abrupt wavy boundary.

IIC2-21 to 36 inches; pale brown (10YR 6/3) silt, white (10YR 8/1) dry; massive; slightly hard, firm, nonsticky and nonplastic; few medium vesicular pores; mildly alkaline (pH 7.4); clear wavy boundary.

IIC3-36 to 60 inches; light brownish gray (10YR 6/2) silt; white (10YR 8/1) dry; weak medium and thick platy structure; slightly hard, firm, nonsticky and nonplastic; mildly alkaline (pH 7.6).

The profile is mottled at a depth of 10 to 20 inches. The A horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 1 or 2 when moist or dry. Diatomaceous sediment is at a depth of 10 to 20 inches.

Hoopal series

The Hoopal series consists of moderately deep, somewhat poorly drained soils on old lakebeds and river

bottoms. These soils formed in mixed alluvium containing volcanic ash and loess. They are underlain by a cemented hardpan. Slope is 0 to 2 percent. The mean annual precipitation is about 15 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Hoopal fine sandy loam, in a pasture, 300 feet west of gate in the NE1/4SW1/4 of sec. 19, T. 3 S., R. 39 E.

A11-0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak thin platy structure and weak fine granular; soft, friable, nonsticky and nonplastic; common very fine and few fine roots; many very fine tubular pores and few medium tubular pores; slightly effervescent; strongly alkaline (pH 8.6); clear smooth boundary.

A12-3 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate thin and medium platy structure; slightly hard, friable, nonsticky and nonplastic; few fine and medium roots; common very fine tubular pores; violently effervescent; very strongly alkaline (pH 9.2); clear wavy boundary.

B2-10 to 31 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine and common very-fine tubular pores; violently effervescent; strongly alkaline (pH 9.0); abrupt smooth boundary.

C1casim-31 to 35 inches; dark brown (10YR 3/3) weakly cemented silt loam duripan, brown (10YR 5/3) dry; massive; very hard, extremely firm, nonsticky and nonplastic; common fine tubular pores; violently effervescent; very strongly alkaline (pH 9.2); abrupt smooth boundary.

C2-35 to 60 inches; brown (10YR 5/3) fine sandy loam, pale brown (10YR 6/3) dry; massive; soft, friable, nonsticky and nonplastic; common very fine tubular pores; violently effervescent; very strongly alkaline (pH 9.2).

The percentage of exchangeable sodium in the profile exceeds 15 to a depth of 20 inches and decreases with increasing depth. It is massive or platy and weakly to strongly cemented. The duripan is at a depth of 20 to 40 inches. Bedrock is at a depth of more than 60 inches.

The A horizon has value of 2 or 3 when moist, and it has chroma of 1 or 2 when moist or dry.

The B horizon has value of 3 or 4 when moist, and it has chroma of 2 or 3 when moist or dry. It is silt loam or loam and averages 10 to 18 percent clay and more than 15 percent material coarser than very fine sand.

The C2 horizon is fine sandy loam, loam, or silt loam.

Hoopal Variant

The Hoopal Variant consists of shallow, somewhat poorly drained soils on old lakebeds and river bottoms. These soils formed in mixed alluvium that contains volcanic ash and loess. They are underlain by a cemented hardpan. Slope is 0 to 2 percent. The mean annual precipitation is about 15 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Hoopal Variant silt loam, 100 feet west of Pierce Lane in the SE1/4NE1/4 of sec. 14, T. 3 S., R. 38 E.

A11-0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine tubular pores; violently effervescent; very strongly alkaline (pH 9.2); clear wavy boundary.

A12-3 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate thin and medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; common very fine and few fine tubular pores; violently effervescent; strongly alkaline (pH 9.0); clear wavy boundary.

B21-7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common fine roots; common very fine and fine tubular pores; strongly effervescent; strongly alkaline (pH 8.8); clear wavy boundary.

B22-14 to 18 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; strongly effervescent; strongly alkaline (pH 8.8); abrupt wavy boundary.

C1casim-18 to 24 inches; dark grayish brown (10YR 4/2) indurated duripan; massive; extremely hard, extremely firm; silica laminar capping on surface; strongly effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

C2-24 to 46 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; hard, firm, slightly sticky and slightly plastic; many fine vesicular pores; slightly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C3casim-46 to 60 inches; dark grayish brown (10YR 4/2) strongly cemented duripan; massive; very hard, very firm; slightly effervescent; moderately alkaline (pH 8.2).

The percentage of exchangeable sodium in the profile exceeds 15. The depth to the duripan ranges from 10 to 20 inches.

The A horizon has value of 2 or 3 when moist and 5 or 6 when dry, and it has chroma of 1 or 2 when moist or dry.

The B horizon has value of 3 or 4 when moist and chroma of 2 or 3 when moist or dry. It is silt loam or, loam that is 10 to 17 percent clay.

The duripan is massive or platy. It is indurated in some part and ranges from weakly to strongly cemented in the remaining part.

Hot Lake series

The Hot Lake series consists of deep, somewhat poorly drained soils in old lake basins and on valley floors. These soils formed in loess and volcanic ash over diatomaceous sediment. Slope is 0 to 2 percent. The mean annual precipitation is about 16 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Hot Lake silt loam, in a cultivated area 225 feet south of center of road and 850 feet west of section line, in the NE1/4SE1/4 of sec. 14, T. 3 S., R. 39 E.

Ap1-0 to 6 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; slightly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

Ap2-6 to 10 inches; black (10YR 2/1) silt loam, gray (10YR-5/1) dry; very. weak-fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

A13-10 to 14 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and few medium roots; common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1ca-14 to 19 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine and few fine tubular pores; many fine light gray calcium carbonate accumulations; strongly calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

C2-19 to 27 inches; dark grayish brown (2.5Y 4/2) coarse silt loam, gray (2.5Y 6/1) dry; common fine dark brown (7.5YR 4/4) mottles; massive; slightly hard, friable, nonsticky and nonplastic; common fine roots; many very fine and common fine pores; moderately alkaline (pH 8.4); diffuse smooth boundary.

C3-27 to 39 inches; grayish brown (2.5Y 5/2) very fine sandy loam, light gray (10YR 7/2) dry; common fine dark brown (7.5YR 4/4) mottles; massive; slightly hard, friable, nonsticky and nonplastic; common fine roots; common very fine and few fine pores; moderately alkaline (pH 8.4); abrupt smooth boundary.

IIC4-39 to 48 inches; light brownish gray (10YR 6/2) silt, white (10YR 8/1) dry; common fine dark brown (7.5YR 4/4) mottles; moderate medium platy structure; hard, firm, nonsticky and nonplastic; very few fine roots; very few very fine and fine pores; strongly alkaline (pH 8.8); clear smooth boundary.

IIC5-48 to 60 inches; light brownish gray (10YR 7/2) silt, white (10YR 8/1) dry; massive; hard, firm, nonsticky and nonplastic; strongly alkaline (pH 8.6).

Diatomaceous sediment is at a depth of 20 to 40 inches. It is mildly alkaline to strongly alkaline. Mottles with chroma of 2 or less are within 30 inches of the surface.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. It is 10 to 20 inches thick.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 3 to 5 when moist, and chroma of 1 or 2 when moist or dry. It is 5 to 17 percent clay.

The IIC horizon has hue of 10YR or 2.5Y, value of 6 or 7 when moist, and chroma of 1 or 2 when moist. It is calcareous or noncalcareous. This horizon is more than 80 percent silt and is 3 to 10 percent clay.

Hutchinson series

The Hutchinson series consists of moderately deep, well drained soils on old terraces. These soils formed in loess, volcanic ash, colluvium, and mixed alluvium. Slope is 1 to 20 percent. The mean annual precipitation is about 15 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Hutchinson silt loam, in a cultivated field, in a ditchbank about 70 feet from the center of the road in the NW1/4SW1/4NW1/4 of sec. 30, T. 6 S., R. 39 E.

Ap-0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine tubular pores; neutral (pH 7.0); clear wavy boundary.

A12-7 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common. fine roots; many very fine tubular pores; mildly alkaline (pH 7.4); clear wavy boundary.

A3-11 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine platy structure and weak fine subangular blocky;

slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; mildly alkaline (pH 7.4); clear wavy boundary.

B1-13 to 21 inches; dark brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine and few fine tubular pores; neutral (pH 7.2); clear wavy boundary.

B21t-21 to 24 inches; dark brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine and medium tubular pores; common thin clay films; neutral (pH 7.2); clear wavy boundary.

B22t-24 to 31 inches; dark brown (7.5YR 4/3) clay, brown (7.5YR 5/4) dry; moderate coarse and fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common fine tubular pores; common thin clay films on faces of peds and in pores; few fine streaks of lime; 5 percent rounded pebbles; mildly alkaline (pH 7.8); abrupt wavy boundary.

C1casim-31 to 40 inches; strongly cemented duripan with lime and silica laminar capping; massive; very hard, very firm, nonsticky and nonplastic; 15 percent pebbles; mildly alkaline (pH.7.6); gradual wavy boundary.

IIC2-40 to 60 inches; dark brown (10YR 4/3) extremely cobbly sandy loam; massive; weakly cemented; hard, firm, nonsticky and nonplastic; 40 percent pebbles and 30 percent cobbles; mildly alkaline (pH 7.6).

The duripan is at a depth of 20 to 40 inches. The upper boundary is indurated or has a laminar capping. The duripan is 15 to 35 percent pebbles. Bedrock is at a depth of 60 inches or more.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is 0 to 25 percent pebbles.

The B horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 3 or 4 when moist or dry. It is silty clay loam to clay and averages 35 to 50 percent clay. Clay films in this horizon are common to continuous and thin to thick.

The IIC horizon is 30 to 50 percent pebbles and 15 to 40 percent cobbles.

Hutchinson Variant

The Hutchinson Variant consists of moderately deep, well drained soils on old terraces. These soils formed in mixed alluvium. Some loess and volcanic ash is in the surface layer. Slope is 2 to 35 percent. The mean annual precipitation is about 21 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Hutchinson Variant silt loam, in an area of woodland on the north side of Oregon Route 244, about 1 mile west of the Grande Ronde River Road, in the NE1/4NW1/4SE1/4 of sec. 35, T. 3 S., R. 35 E.

A11-0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; common very fine interstitial pores; 5 percent pebbles; neutral (pH 6.8); clear smooth boundary.

A12-4 to 8 inches; dark brown (10YR 3/3) light silty clay loam, brown (10YR 5/3) dry; weak coarse platy structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; common fine interstitial pores; 5 percent pebbles; neutral (pH 6.8); clear smooth boundary.

A13-8 to 13 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots and few medium roots; common very fine tubular pores; 10 percent pebbles; neutral (pH 6.8); clear smooth boundary.

B2t-13 to 22 inches; brown (7.5YR 4/4) gravelly clay, brown (7.5YR 4/4) dry; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; 15 percent pebbles and 5 percent cobbles; thick continuous clay films on faces of peds; neutral (pH 6.8); clear wavy boundary.

IIC1sim-22 to 31 inches; strong brown (7.5YR 4/6) very gravelly thin platy duripan; massive; weakly cemented, firm, nonsticky and nonplastic; 40 percent pebbles and 20 percent cobbles; laminar capping of silica on rock fragments; neutral (pH 6.8); clear wavy boundary.

IIC2sim-31 to 60 inches; dark brown (7.5YR 3/4) extremely cobbly thin platy duripan; massive; weakly cemented, firm, nonsticky and nonplastic; 35 percent pebbles and 45 percent cobbles; laminar capping of silica on rock fragments; neutral (pH 7.0).

The duripan is at a depth of 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry. It is silt loam or silty clay loam that is 0 to 10 percent pebbles.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 when moist or dry, and chroma of 4 or 5 when moist or dry. It is 40 to 50 percent clay and 15 to 25 percent pebbles and cobbles.

The IIC horizon has hue of 7.5YR or 5YR. It is 75 to 90 percent pebbles and cobbles.

Imbler series

The Imbler series consists of deep, well drained, undulating soils on undulating valley terraces. These soils formed in mixed eolian material weathered mainly from basalt and andesite. Slope is 1 to 5 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Imbler fine sandy loam, 1 to 5 percent slopes, in an area of irrigated and nonirrigated cropland, about 1,280 feet north and 1,400 feet east of the southwest section corner, in the SE1/4SW1/4 of sec. 20, T. 1 S., R. 39 E.

Ap-0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, dark gray (10YR 4/1) dry; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine and fine irregular pores; neutral (pH 6.6); abrupt smooth boundary.

A12-7 to 14 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine and fine irregular pores; neutral (pH 6.8); clear smooth boundary.

AC-14 to 30-inches; dark-brown (10YR 3/3) fine sandy loam, dark brown (10YR 4/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine and fine irregular pores; neutral (pH 6.8); diffuse wavy boundary.

C-30 to 100 inches; dark brown (10YR 4/3) loamy fine sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; common very fine roots to a depth of 72 inches and few roots below; many very fine irregular pores; neutral (pH 7.0).

Bedrock is at a depth of 5 to 20 feet or more. Contrasting textures are at a depth of more than 40 inches. The mollic epipedon is 20 to 36 inches thick.

The A horizon has value of 2 or 3 when moist and 3 or 4 when dry, and it has chroma of 1 or 2 when moist or dry. It is a fine sandy loam or coarse sandy loam. The AC horizon has chroma of 2 or 3 when moist or dry. It is fine sandy loam or sandy loam. Some pedons have a B horizon.

The C horizon has value of 3 or 4 when moist and chroma of 2 or 3 when moist. It is loamy fine sand or fine sandy loam.

Jett series

The Jett series consists of deep, well drained soils on bottom lands. These soils formed in recent mixed alluvium that is high in content of ash. Slope is 0 to 2 percent. The mean annual precipitation is about 16 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Jett silt loam, in a cultivated field, about 80 feet south of fence and 150 feet east of freeway fence, at the northwest corner of sec. 33, T. 5 S., R. 39 E.

Ap-0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine interstitial pores; moderately alkaline (pH 8.4); clear smooth boundary.

A12-10 to 21 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine to medium interstitial pores; moderately alkaline (pH 8.2); gradual wavy boundary.

AC-21 to 25 inches; dark grayish brown (10YR 4/2) silt loam, light grayish brown (10YR 6/2) dry; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and very fine tubular pores; moderately alkaline (pH 8.1); clear wavy boundary.

C1-25 to 40 inches; dark brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine to medium interstitial and tubular pores; moderately alkaline (pH 8.0); clear smooth boundary.

C2-40 to 55 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; hard, firm, slightly sticky and slightly plastic; few fine irregular pores; mildly alkaline (pH 7.8); clear smooth boundary.

C3-55 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; massive; hard, firm, sticky and plastic; mildly alkaline (pH 7.8).

The profile is more than 60 inches deep to gravelly alluvium. The mollic epipedon is 20 inches or more in thickness. The organic matter content of the upper 7 inches is estimated at more than 3.5 percent and decreases irregularly with depth. The profile is mildly alkaline to moderately alkaline throughout. The control section is 18 to 27 percent clay and is less than 15 percent material coarser than very fine sand. The C horizon in some pedons has faint fine mottles below a depth of 40 inches.

Jett soils in this survey are a taxadjunct to the Jett series because they are not effervescent between depths of 10 and 20 inches and receive less precipitation. These differences, however, do not significantly affect use and management.

Kamela series

The Kamela series consists of moderately deep, well drained soils on mountainous uplands. These soils formed in residuum and colluvium derived from basalt, loess, and volcanic ash. Slope is 2 to 35 percent. The mean annual precipitation is about 37 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of Kamela very stony silt loam, 2 to 35 percent slopes, in a wooded area along logging road, in the NE1/4SW1/4NE1/4of sec. 32, T. 3 S., R. 38 E.

O1-2 inches to 0; duff, needles, twigs, and leaves.
A-0 to 6 inches; dark brown (7.5YR 3/3) very stony silt loam, brown (10YR 5/4) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; about 5 percent stones, 10 percent cobbles, and 10 percent pebbles; medium acid (pH 5.8); clear wavy boundary.
B2-6 to 25 inches; dark brown (7.5YR 4/3) very cobbly silt loam, brown (10YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine and fine tubular pores; about 10 percent stones, 35 percent cobbles, and 15 percent pebbles; medium acid (pH 5.8); clear wavy boundary.
R-25 inches; fractured basalt.

Bedrock is at a depth of 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 when moist and 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It is 20 to 27 percent clay.

Klicker series

The Klicker series consists of moderately deep, well drained soils on uplands. These soils formed in residuum and colluvium derived from basalt. Some loess and volcanic ash is in the surface layer. Slope is 2 to 65 percent. The mean annual precipitation is about 24 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Klicker stony silt loam, 2 to 40 percent slopes, in an area of timberland, about 1,400 feet south of northwest section corner, 350 feet southeast of hairpin curve, 125 feet east of fence, and 125 feet south of timber stand on the Starkey Forest and Range Experiment Station; in the SW1/4NW1/4 of sec. 2, T. 4 S., R. 34 E.

O1-3/4 inch to 0; loose litter of fir needles, pine needles, and twigs.
A1-0 to 4 inches; dark reddish brown (5YR 2/2) stony silt loam, reddish brown (5YR 4/3) dry; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many interstitial pores; about 25 percent pebbles, cobbles, and stones; slightly acid (pH 6.2); clear smooth boundary.
A3-4 to 11 inches; dark reddish brown (5YR 2/2) very cobbly silt loam, reddish brown (5YR 4/3) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; about 40 percent pebbles, cobbles, and stones; slightly acid (pH 6.2); gradual smooth boundary.
B1-11 to 18 inches; dark reddish brown (5YR 3/3) very cobbly silt loam, reddish brown (5YR 5/3) dry; weak fine and very fine subangular blocky structure; slightly hard,. friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; about 45 percent pebbles, cobbles, and stones; slightly acid (pH 6.2); gradual smooth boundary.
B21t-18 to 26 inches; dark reddish brown (5YR 3/4) very cobbly clay loam, reddish brown (5YR 5/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; common thin clay films on faces of peds and in pores; 45 percent pebbles, cobbles, and stones; slightly acid (pH 6.2); clear smooth boundary.
B22t-26 to 33 inches; dark reddish brown (5YR 3/4) very cobbly clay loam, reddish brown (5YR 4/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; few very fine tubular pores; many moderately thick clay films on faces of peds and in pores; 60 percent pebbles, cobbles, and stones; few iron and manganese concretions 1/8 inch or less in diameter; slightly acid (pH 6.2); abrupt wavy boundary.
R-33 inches; basalt.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is about 20 to 35 percent pebbles, cobbles, and stones.

The Bt horizon has hue of 5YR to 10YR, value of 3 or 4 when moist and 5 when dry, and chroma of 2 to 4 when moist or dry. It is heavy silt loam, silty clay loam, or clay loam that is 25 to 35 percent clay. This horizon is 35 to 60 percent pebbles, cobbles, and stones.

La Grande series

The La Grande series consists of deep, moderately well drained soils on alluvial fans and low stream terraces. These soils formed in mixed alluvium. Slope is 0 to 2 percent. The mean annual precipitation is about 16 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of La Grande silt loam, in a cultivated area, 575 feet south of the southeast corner of shop building and 47 feet west of north-south field road on Union Experiment Station, in the NW1/4NE1/4 of sec. 24, T. 4 S., R. 39 E.

Ap-0 to 7 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and irregular pores; moderately alkaline (pH 8.0); abrupt smooth boundary.

A12-7 to 14 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure and moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; mildly alkaline (pH 7.8); clear smooth boundary.

B1-14 to 21 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine and common medium tubular pores; few basalt pebbles 1 /2 to 1 inch in diameter; 25 percent krotovinas of material from above horizon; krotovinas are 3 to 6 inches in diameter; mildly alkaline (pH 7.8); clear wavy boundary.

B21-21 to 34 inches; dark yellowish brown (10YR 3/4) silty clay loam, brown (10YR 5/3) dry; many fine distinct dark grayish brown (10YR 4/2) and strong brown (7.5YR 4/6, 4/8) mottles; moderate and weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; many very fine and common medium tubular pores; slightly acid (pH 6.2); gradual smooth boundary.

B22-34 to 44 inches; dark yellowish brown (10YR 3/4) silty clay loam, brown (10YR 5/3) dry; common fine distinct dark grayish brown (10YR 4/2) and strong brown (7.5YR 4/8) mottles; moderate and weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine roots; many very fine and few medium tubular pores; neutral (pH 6.6); clear wavy boundary.

IIC-44 to 60 inches; multicolored extremely gravelly loam; massive; hard, firm, slightly sticky and slightly plastic; many very fine and medium pores; neutral (pH 6.6).

Where not drained, these soils are saturated with water at a depth of 24 to 40 inches for 90 days during winter and spring. The 10- to 40-inch control section is silt loam or silty clay loam and has a weighted average of 22 to 35 percent clay and less than 15 percent material coarser than fine sand.

The A horizon has hue of 10YR or 2.5Y, value of 1 or 2 when moist and 3 or 4 when dry, and chroma of 2 or less when moist or dry. The upper 7 inches is 4 to 7 percent organic matter.

The B horizon has hue of 10YR or 2.5Y, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 2 to 4 when moist or dry. Mottles have chroma of 2 to 8.

The C horizon is stratified sand to loam and is 0 to 70 percent rock fragments.

Loneridge series

The Loneridge series consists of deep, well drained soils on mountainous uplands. These soils formed in residuum and colluvium derived from basalt. Some loess and volcanic ash is in the surface layer. Slope is 12 to 40 percent. The mean annual precipitation is about 40 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Loneridge stony silt loam, 12 to 40 percent slopes, in a wooded area, in a cut on the west side of a gravel road, about 5 miles south of La Grande, in the NW1/4SW1/4 of sec. 33, T. 3 S., R. 38 E.

O1-1 inch to 0; duff, needles, and twigs.

A11-0 to 3 inches; dark brown (10YR 3/3) stony silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 5 percent pebbles and 5 percent cobbles; about 0.05 percent of the surface is covered with stones; slightly acid (pH 6.4); clear wavy boundary.

A12-3 to 16 inches; dark brown (7.5YR 4/3) cobbly silt loam, brown (7.5YR 5/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; 10 percent pebbles and 10 percent cobbles; medium acid (pH 6.0); clear wavy boundary.

B1t-16 to 36 inches; dark brown (7.5YR 4/3) very cobbly silty clay loam, brown (7.5YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine tubular pores; common thin clay films on faces of peds; 20 percent pebbles and 20 percent cobbles; medium acid (pH 5.8); clear wavy boundary.

B2t-36 to 60 inches; dark brown (7.5YR 4/3) very cobbly clay, brown (7.5YR 5/4) dry; strong medium and coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common fine tubular pores; common thin clay films on faces of peds; 25 percent pebbles and 25 percent cobbles; medium acid (pH 5.8).

Base saturation of the profile ranges from 35 to 60 percent.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 2

to 4 when moist or dry. In some pedons as much as 10 inches of volcanic ash is in this horizon. The A horizon is 5 to 10 percent pebbles, 5 to 10 percent cobbles, and 2 to 5 percent stones. From 0.01 to 0.1 percent of the surface commonly is covered with stones.

The B horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry, and chroma of 3 or 4 when moist or dry. It averages 35 to 45 percent clay in the upper part, increasing to 50 percent in the lower part. It is 20 to 30 percent pebbles and 15 to 20 percent cobbles.

Lookingglass series

The Lookingglass series consists of deep, moderately well drained soils on uplands. These soils formed in loess and some volcanic ash overlying older, fine textured residuum or colluvium derived from volcanic tuff and basalt. Slope is 2 to 20 percent. The mean annual precipitation is about 24 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Lookingglass silt loam, 2 to 12 percent slopes, in an area of cropland, about 1,280 feet east and 600 feet south of the northeast section corner, in the NE1/4NW1/4 of sec. 25, T. 1 N., R. 38 E.

Ap-0 to 6 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine to medium irregular and tubular pores; neutral (pH 6.8); abrupt smooth boundary.

A12-6 to 11 inches; dark brown (10YR 3/3) silty clay loam, dark brown (10YR 4/3) dry; weak medium and coarse prismatic structure parting to weak fine subangular blocky; hard, friable, sticky and plastic; many very fine roots; common very fine tubular pores; neutral (pH 6.6); clear smooth boundary.

A21-11 to 16 inches; dark grayish brown (10YR 4/3) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; few distinct dark gray siliceous coatings on peds; neutral (pH 6.6); clear smooth boundary.

A22-16 to 21 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine to medium tubular pores; few black concretions 1 to 3 millimeters in diameter; neutral (pH 6.6); abrupt smooth boundary.

IIB21t-21 to 28 inches; dark brown (10YR 3/3) clay, brown (10YR 4/3) dry; very dark gray organic coatings on faces of peds; moderate coarse prismatic structure parting to strong medium blocky; extremely hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; many black concretions and stains 1 to 3 millimeters in diameter; continuous thick clay films on faces of peds and in pores; neutral (pH 6.6); clear wavy boundary.

IIB22t-28 to 38 inches; dark brown (10YR 3/3) clay, brown (10YR 4/3) dry; dark gray stains on faces of peds; strong coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; many black concretions and stains; continuous thick clay films on faces of peds and in pores; neutral (pH 6.6); gradual wavy boundary.

IIC-38 to 60 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; massive; hard, firm, sticky and plastic; many black concretions and stains; neutral (pH 6.6).

Bedrock is at a depth of 60 to 96 inches or more. The mollic epipedon is 10 to 16 inches thick. The argillic horizon is at a depth of 12 to 30 inches. The profile is slightly acid or neutral.

The A1 horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is 0 to 35 percent cobbles and stones. The A2 horizon has value of 5 or 6 when dry and chroma of 1 or 2 when moist or dry. A stone line is at the lower boundary of some pedons.

The Bt horizon has value of 4 or 5 when dry and chroma of 3 or 4 when moist or dry. It is silty clay loam, silty clay, or clay that is 35 to 50 percent clay and 0 to 15 percent pebbles and cobbles.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 when moist and 6 or 7 when dry, and chroma of 2 or 3 when moist or dry. It is 0 to 45 percent pebbles and ' cobbles below a depth of 40 inches.

Lookout series

The Lookout series consists of moderately deep, well drained soils on uplands. These soils formed in colluvium derived from basalt and volcanic tuff. Some loess and volcanic ash is in the surface layer. Slope is from 2 to 20 percent. The mean annual precipitation is about 10 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Lookout very stony silt loam, 2 to 20 percent slopes, in an area of rangeland, about 270 feet south of the intersection of the road and powerline and 40 feet west of the road, in the NE1/4NW1/4SE1/4 of sec. 2, T. 6 S., R. 39 E.

A11-0 to 4 inches; very dark grayish brown (10YR 3/2) very stony silt loam, light brownish gray (10YR 6/2) dry; moderate thin platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine irregular pores; about 20 percent stones and cobbles; neutral (pH 6.6); clear smooth boundary.

A12-4 to 9 inches; very dark grayish brown (10YR 3/2) stony silt loam, grayish brown (10YR 6/2) dry; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 30 percent stones and cobbles; neutral (pH 6.6); abrupt smooth boundary.
IIB21t-9 to 14 inches; dark brown (10YR 3/3) cobbly clay, brown (10YR 5/3) dry; moderate medium and fine prismatic structure parting to strong fine blocky; very hard, very firm, very sticky and very plastic; common fine roots; common very fine tubular pores; common light gray very fine sand and silt coatings on faces of peds; continuous thick clay films on peds and in pores; about 20 percent flat basalt cobbles at top of horizon; mildly alkaline (pH 7.5); clear smooth boundary.
IIB22t-14 to 17 inches; dark brown (10YR 3/3) clay, brown (10YR 4/3) dry; moderate medium and fine prismatic structure parting to strong fine blocky; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; few light gray very fine sand and silt coatings on faces of peds; continuous thick clay films on faces of peds and in pores; moderately alkaline (pH 8.2); clear smooth boundary.
IIB3tca-17 to 21 inches; dark yellowish brown (10YR 4/4) clay, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few roots; common very fine tubular pores; many moderately thick clay films on faces of peds; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
IIC1ca-21 to 24 inches; dark yellowish brown (10YR 4/4) loam, light yellowish brown (10YR 6/4) dry; massive; hard, friable, slightly sticky and slightly plastic; few roots; common very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.3); abrupt smooth boundary.
IIC2casim-24 to 45 inches; very pale brown (10YR 7/3) silica- and lime-cemented duripan; indurated, with weakly cemented material between plates; laminar coatings on plates; 20 percent rock fragments embedded in the duripan; abrupt wavy boundary.
IIIR-45 inches; basalt.

The duripan is at a depth of 20 to 40 inches. Bedrock is at a depth of 40 to 60 inches. Segregated or disseminated lime is at a depth of 15 to 30 inches. The solum is 5 to 25 percent rock fragments.

The A horizon has value of 3 or 4 when moist and 5 or 6 when dry.

The upper part of the B horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 3 or 4 when moist or dry. It is cobbly clay, clay, or silty clay that is 48 to 60 percent clay. The 11B3 horizon is silty clay loam, clay, or stony clay. Rock fragments are common as a stone line at the top of the 11B2 horizon.

The duripan consists of weakly cemented soil material between indurated lenses. It is about 10 to 25 percent stones, cobbles, and pebbles.

McMurdie series

The McMurdie series consists of deep, well drained soils on uplands. These soils formed in residuum and colluvium derived from basalt and volcanic tuff. Some loess is in the surface layer. Slope is 2 to 25 percent. The mean annual precipitation is about 21 inches, the mean annual air temperature is about 49 degrees F.

Typical pedon of McMurdie silt loam, bedrock substratum, 2 to 15 percent slopes, in a cultivated field, 180 feet east of county road and 60 feet south of private road, in the NW1/4NW1/4NE1/4 of sec. 16, T. 1 N., R. 40 E.

Ap1-0 to 4 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; slightly acid (pH 6.4); abrupt wavy boundary.
Ap2-4 to 8 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure and moderate medium granular; hard, friable, sticky and plastic; common very, fine roots; many very fine tubular pores; slightly acid (pH 6.4); abrupt wavy boundary.
IIB21t-8 to 15 inches; dark brown (10YR 3/3) clay, dark brown (10YR 4/3) dry; very dark brown (10YR 2/2) coatings; strong medium prismatic structure; very hard, firm, very sticky and very plastic; common very fine and fine roots; many very fine and fine tubular pores; continuous thick clay films on faces of peds and in pores; neutral (pH 6.6); gradual wavy boundary.
IIB22t-15 to 24 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; strong coarse angular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; common very fine tubular pores; continuous thick clay films on faces of peds and in pores; mildly alkaline (pH 7.6); gradual wavy boundary.
IIB23t-24 to 28 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; moderate medium angular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; many moderately thick clay films on faces of peds; moderately alkaline (pH 8.0); clear wavy boundary.
IIB31tca-28 to 42 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate medium angular blocky structure; very hard, firm, sticky and plastic; common fine tubular pores; common thin clay films on faces of peds; pockets and streaks of lime; strongly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

IIB32tca-42 to 50 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium angular blocky structure; very hard, firm, slightly sticky and slightly plastic; common fine tubular pores; common thin clay films on faces of peds; accumulated lime; strongly effervescent; moderately alkaline (pH 8.4); abrupt irregular boundary.
IIR-50 inches; basalt; pockets of volcanic tuff are along the upper boundary.

The mollic epipedon is 20 to 30 inches thick. Basalt is at a depth of 40 to 60 inches. Soft, powdery secondary lime is at a depth of 25 to 35 inches.

The A horizon has value of 2 or 3 when moist and 4 when dry, and it has chroma of 1 or 2 when moist or dry.

The Bt horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is heavy silty clay loam or clay that is 35 to 50 percent clay. The lower part of the Bt horizon is 0 to 15 percent rock fragments.

North Powder series

The North Powder series consists of moderately deep, well drained soils on uplands. These soils formed in colluvium and residuum derived from granitic bedrock. Some volcanic ash and loess is in the surface layer. Slope is 2 to 15 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of North Powder loam, 2 to 15 percent slopes, in an area of rangeland, about 3.5 miles northeast of North Powder, on the road to Telocaset, at the southeast corner of the SW1/4SW1/4 of sec. 31, T. 5 S., R. 40 E.

A1-0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 7.2); clear wavy boundary.
B21-8 to 13 inches; brown (10YR 4/3) clay loam, pale brown (10YR 6/3) dry; moderate fine to medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine and fine tubular pores; neutral (pH 7.2); clear wavy boundary.
B22-13 to 17 inches; dark brown (10YR 3/3) clay loam, yellowish brown (10YR 5/4) dry; hard, firm, sticky and plastic; few very fine roots; common fine tubular pores; neutral (pH 7.0); clear wavy boundary.
B3-17 to 20 inches; dark yellowish brown (10YR 4/4) clay loam, yellowish brown (10YR 5/4) dry; massive; hard, firm, sticky and plastic; common fine and very fine tubular pores; about 10 percent pebbles; neutral (pH 6.8); gradual wavy boundary.
C1-20 to 25 inches; yellowish brown (10YR 5/6) loam, brownish yellow (10YR 6/6) dry; massive; hard, firm, slightly sticky and slightly plastic; neutral (pH 6.8); abrupt wavy boundary.
C2r-25 inches; weathered granitic bedrock.

Paralithic contact is at a depth of 20 to 40 inches. Rock outcrop is common. The mollic epipedon is 7 to 10 inches thick.

The A horizon is 0 to 10 percent fine gravel.

The B horizon has value of 3 or 4 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry. It is clay loam, loam, or sandy clay loam and averages 10 to 35 percent clay and more than 15 percent material coarser than very fine sand. The horizon is 0 to 10 percent fine gravel.

The C horizon has value of 4 or 5 when moist and 6 or 7 when dry. It is clay loam, loam, or sandy clay loam.

North Powder soils in this survey area are a taxadjunct to the North Powder series because they are not effervescent in the C horizon and have a mollic epipedon. These differences, however, do not significantly affect use and management.

Olot series

The Olot series consists of moderately deep, well drained soils on mountainous uplands. These soils formed in volcanic ash deposited over a buried soil that formed in residuum and colluvium derived from basalt. Slope is 2 to 65 percent. The mean annual precipitation is about 27 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Olot stony silt loam, in a wooded area, in a road cut near the northern boundary of the Starkey Experimental Forest and Range,' in the NE1/4NE1/4 of sec. 19, T. 3 S., R. 34 E.

O1-1 inch to 0; duff, needles, and twigs.
A11-0 to 2 inches; dark brown (10YR 3/3) stony silt loam, pale brown (10YR 6/3) dry; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots and common fine, medium, and coarse roots; common very fine and few fine discontinuous pores; about 0.06 percent of the surface is covered with stones; neutral (pH 6.6); abrupt smooth boundary.
A12-2 to 6 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots and common fine, medium, and coarse roots; common very fine continuous tubular pores; 5 percent cobbles; neutral (pH 6.6); clear smooth boundary.
B2-6 to 19 inches; yellowish brown (10YR 5/4) silt loam, very pale brown (10YR 7/4) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots and common fine, medium, and coarse roots; many very fine and common fine, medium, and

coarse tubular pores; 5 percent cobbles; slightly acid (pH 6.4); abrupt wavy boundary.

IIB21b-19 to 25 inches; strong brown (7.5YR 4/6) extremely cobbly light silty clay loam, light yellowish brown (10YR 6/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots and few coarse roots; common fine continuous tubular pores; 40 percent cobbles and 25 percent pebbles; slightly acid (pH 6.2); clear irregular boundary.

IIB22b-25 to 30 inches; dark yellowish brown (10YR 4/4) extremely cobbly light silty clay loam, light yellowish brown (10YR 6/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine, medium, and coarse roots; common fine continuous tubular pores; 60 percent cobbles and 15 percent pebbles; slightly acid (pH 6.2); clear wavy boundary.

IIIR-30 inches; fractured basalt.

As much as 0.1 percent of the surface is covered with stones. These soils have a moist bulk density of 0.85 gram per cubic centimeter or less in the ash mantle. The ash is 14 to 24 inches thick. Bedrock is at a depth of 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 to 7 when dry, and chroma of 3 or 4 when moist or dry.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5 when moist and 6 or 7 when dry, and chroma of 3 to 5 when moist or dry.

The buried IIB horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 to 7 when dry, and chroma of 4 to 6 when moist or dry. It is silt loam or silty clay loam and is 25 to 35 percent clay. This horizon is 40 to 60 percent cobbles, 15 to 25 percent pebbles, and 0 to 5 percent stones.

Palouse series

The Palouse series consists of deep, well drained soils on uplands. These soils formed in loess. Slope is 0 to 45 percent. The mean annual precipitation is about 21 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Palouse silt loam, in a cultivated field, next to the highway fence and 20 feet west of a power pole, in the NE1/4NW1/4 of sec. 12, T. 1 N., R. 39 E.

A1-0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak thin platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; neutral (pH 6.6); clear smooth boundary.

A3-7 to 20 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium and coarse platy structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; neutral (pH 6.6); gradual smooth boundary.

B11-20 to 28 inches; very dark brown (10YR 2/2) silt loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; neutral (pH 6.8); gradual wavy boundary.

B12-28 to 38 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2), dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; common fine roots; common fine and medium tubular pores; neutral (pH 6.8); gradual smooth boundary.

B2-38 to 50 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, firm, sticky and plastic; many fine roots; common fine and medium tubular pores; gray coatings on ped faces; neutral (pH 6.6); gradual smooth boundary.

B3-50 to 60 inches; dark brown (10YR 3/3) silt loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and medium tubular pores; neutral (pH 6.6); gradual smooth boundary.

C-60 to 80 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few medium tubular pores; neutral (pH 6.6).

The solum is 40 to 60 inches thick or more. Bedrock is at a depth of 60 inches or more. The mollic epipedon is 20 to 60 inches thick.

The A horizon has chroma of 1 or 2 when moist or dry.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry. The 10- to 40-inch control section is silt loam or light silty clay loam and is 20 to 30 percent clay.

The C horizon has value of 3 to 5 when moist and 4 to 6 when dry, and it has chroma of 3 or 4 when moist or dry.

Phys series

The Phys series consists of deep, well drained soils on fans. These soils formed in mixed alluvium. Slope is 1 to 5 percent. The mean annual precipitation is about 19 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Phys gravelly silt loam, 1 to 5 percent slopes, in a cultivated field, on the Ladd Marsh Wildlife Management Area, 400 feet north of the center of sec. 1, T. 4 S., R. 38 E.

Ap-0 to 7 inches; very dark brown (10YR 2/2) gravelly silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, friable, sticky and plastic; many very fine and fine roots; many very fine tubular pores; 15 percent pebbles and 5 ,percent cobbles; slightly acid (pH 6.4); clear smooth boundary.

A12-7 to 11 inches; very dark brown (10YR 2/2) gravelly silt loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; 15 percent pebbles and 5 percent cobbles; slightly acid (pH 6.4); clear smooth boundary.

B1-11 to 16 inches; very dark brown (10YR 2/2) very cobbly clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine tubular pores; 15 percent pebbles, 20 percent cobbles, and 5 percent stones; neutral (pH 6.6); clear smooth boundary.

B2t-16 to 21 inches; dark brown (10YR 3/3) very cobbly clay loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; many thin clay films on faces of peds; 15 percent pebbles, 25 percent cobbles, and 5 percent stones; neutral (pH 6.8); clear smooth boundary.

C-21 to 60 inches; dark brown (10YR 4/3) extremely cobbly loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; 20 percent pebbles, 40 percent cobbles, and 10 percent stones; neutral (pH 6.8).

Bedrock is at a depth of 60 inches or more. The mollic epipedon is 12 to 20 inches thick.

The A horizon has value of 2 or 3 when moist and 3 or 4 when dry, and it has chroma of 1 or 2 when moist or dry. It is 10 to 25 percent pebbles, 0 to 10 percent cobbles, and 0 to 5 percent stones.

The Bt horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is 27 to 35 percent clay and 35 to 60 percent rock fragments, of which 10 to 25 percent is pebbles, 20 to 35 percent is cobbles, and 0 to 10 percent is stones.

The C horizon is 50 to 80 percent rock fragments, of which 10 to 30 percent is pebbles, 30 to 50 percent is cobbles, and 0 to 20 percent is stones.

Ramo series

The Ramo series consists of deep, well drained soils on upland foot slopes. These soils formed in mixed alluvium and colluvium derived from basalt. Some loess is in the surface layer. Slope is 2 to 35 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Ramo silty clay loam, 2 to 15 percent slopes, in a pasture, 20 feet east of High Valley Road and 160 feet north of old house, in the NW1/4NW1/4 of sec. 2, T. 4 S., R. 40 E.

Ap1-0 to 3 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; neutral (pH 6.8); abrupt smooth boundary.

Ap2-3 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong very fine subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; neutral (pH 6.8); clear smooth boundary.

B1-10 to 18 inches; very dark brown (10YR 2/2) heavy silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine roots; many very fine tubular pores; neutral (pH 7.0); abrupt smooth boundary.

IIB21tb-18 to 30 inches; dark reddish brown (5YR 3/4) gravelly clay, reddish brown (5YR 4/3) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; common very fine roots; many very fine tubular pores; many thin clay films in pores and on faces of peds; 20 percent weathered soft pebbles; neutral (pH 7.2); clear smooth boundary.

IIB22tb-30 to 50 inches; reddish brown (5YR 4/4) gravelly clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; common very fine roots; many very fine tubular pores; continuous thick clay films on faces of peds; 25 percent weathered soft pebbles; neutral (pH 7.2); clear smooth boundary.

IIB3b-50 to 65 inches; reddish brown (5YR 4/4) gravelly silty clay loam, yellowish red (5YR 5/6) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine tubular pores; 5 percent black stains on faces of peds; 20 percent weathered pebbles; neutral (pH 7.2).

The solum is more than 40 inches thick. Bedrock is at a depth of more than 60 inches. The mollic epipedon is 10 to 20 inches thick. A stone line is between the A horizon and the buried soil in some pedons.

The A horizon has value of 2 or 3 when moist and 3 or 4 when dry, and it has chroma of 1 or 2 when moist or dry. It is 0 to 20 percent stones and cobbles and 0 to 10 percent pebbles. From 0 to 3 percent of the surface is covered with stones.

The Bt horizon has hue of 5YR to 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry. It is heavy silty clay loam or clay and is 35 to 45 percent clay. The horizon is 15 to 35 percent pebbles, cobbles, and stones of hard basalt and soft tuff.

Ramo Variant

The Ramo Variant consists of moderately deep, well drained soils on old terraces. These soils formed in mixed alluvium. Some loess is in the surface layer. Slope is 2 to 12 percent. The mean annual precipitation is about 19 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Ramo Variant silt loam, 2 to 12 percent slopes, in a cultivated field, about 120 feet east of Mt. Glenn Road, about one-fourth mile north of its intersection with Booth Lane, in the NW1/4SW1/4NE1/4 of sec. 28, T. 2 S., R. 38 E.

Ap1-0 to 10 inches; black (10YR 2/1) heavy silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine irregular pores; 5 percent pebbles; slightly acid (pH 6.4); clear smooth boundary.

A12-10 to 15 inches; very dark grayish brown (10YR 3/2) heavy silt loam, dark grayish brown (10YR 4/2) dry; weak thin platy structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine irregular pores; neutral (pH 6.6); clear wavy boundary.

IIB21t-15 to 22 inches; dark brown (10YR 3/3) clay, brown (10YR 4/3) dry; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; very hard, firm, sticky and plastic; many fine and medium roots; common fine tubular pores; 5 percent pebbles; common thin clay films on faces of peds; neutral (pH 6.8); gradual wavy boundary.

IIB22t-22 to 30 inches; dark yellowish brown (10YR 4/4) clay, dark yellowish brown (10YR 4/4) dry; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; very hard, very firm, very sticky and very plastic; many fine and medium roots; common fine tubular pores; 5 percent pebbles; continuous thick clay films on faces of peds; neutral (pH 7.0); clear wavy boundary.

IIIC1ca-30 to 37 inches; strong brown (7.5YR 4/6) very gravelly clay loam, strong brown (7.5YR 5/6) dry; massive; hard, firm, sticky and plastic; common fine roots; few fine irregular pores; 35 percent pebbles and 15 percent cobbles; carbonate coatings on rock fragments; violently effervescent; neutral (pH 7.2); clear wavy boundary.

IIC2casim-37 to 50 inches; strong brown (7.5YR 4/6) very gravelly thin platy weakly silica- and lime-cemented duripan; massive; firm, nonsticky and nonplastic; few fine roots; lenses of carbonate; 45 percent pebbles and 20 percent cobbles; laminar capping of silica on rock fragments; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

IIIC3casim-50 to 60 inches; strong brown (7.5YR 5/6) extremely cobbly sand; massive; hard, firm, nonsticky and nonplastic; lenses of carbonate; 35 percent pebbles and 45 percent cobbles; laminar capping of silica on rock fragments; violently effervescent; moderately alkaline (pH 8.0).

The duripan is at a depth of 20 to 40 inches.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 to 3 when moist or dry. It is 0 to 15 percent pebbles. The lower part of the A horizon is heavy silt loam or silty clay loam.

The IIBt horizon has value of 3 or 4 when moist and 3 to 5 when dry, and it has chroma of 3 or 4 when moist or dry. It is 40 to 50 percent clay and 0 to 10 percent pebbles.

The IIIC horizon is 35 to 60 percent pebbles and cobbles.

Rockly series

The Rockly series consists of very shallow, well drained soils on uplands. These soils formed in residuum and colluvium derived from basalt. Some loess and volcanic ash is in the surface layer. Slope is 2 to 70 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of a Rockly extremely stony loam in an area of Gwinly-Rockly complex, 5 to 40 percent slopes, used as rangeland, about 20 feet north of old logging road, in the NE1/4SW1/4 of sec. 12, T. 1 N., R. 38 E.

A1-0 to 6 inches; very dark brown (10YR 2/2) extremely stony loam, dark brown (10YR 4/2) dry; weak thin platy structure and weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine and medium tubular pores; 15 percent pebbles, 15 percent cobbles, and 20 percent stones; mildly alkaline (pH 7.4); clear smooth boundary.

B2-6 to 8 inches; dark brown (10YR 3/3) very stony loam, dark brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine and medium tubular pores; 10 percent pebbles, 20 percent cobbles, and 25 percent stones; neutral (pH 7.2); abrupt wavy boundary.

IIR-8 inches; basalt.

Bedrock is at a depth of 5 to 12 inches. The textural control section is loam or clay loam that is 20 to, 30 percent clay. It averages 35 to 60 percent rock fragments, of which 15 to 50 percent is pebbles and 15 to 45 percent is cobbles and stones. The profile is neutral to slightly acid.

The A horizon has hue of 5YR to 10YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 2 or 3 when moist or dry.

The B2 horizon has hue of 5YR to 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry.

Royst series

The Royst series consists of moderately deep, well drained soils on mountainous uplands. These soils formed in residuum and colluvium derived from volcanic tuff and basalt. Some loess and volcanic ash is in the surface layer. Slope is 7 to 70 percent. The mean annual precipitation is about 20 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Royst very stony silt loam, 7 to 35 percent slopes, in an area of rangeland above Ramo Flat, in the NW1/4SW1/4NW1/4 of sec. 10, T. 5 S., R. 40 E.

A1-0 to 8 inches; very dark gray (10YR 3/1) very stony silt loam, dark gray (10YR 4/1) dry; strong fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular pores; 10 percent pebbles, 15 percent stones, and 10 percent cobbles; neutral (pH 7.0); clear wavy boundary.

B1-8 to 10 inches; very dark grayish brown (10YR 3/2) gravelly silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common very fine tubular pores; 30 percent pebbles; neutral (pH 6.8); abrupt wavy boundary.

B2t-10 to 17 inches; dark brown (10YR 3/3) very gravelly clay, brown (10YR 4/3) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; few fine tubular pores; many thin clay films on faces of peds and in pores; 40 percent pebbles and 20 percent cobbles; neutral (pH 7.0); clear wavy boundary.

B3t-17 to 25 inches; dark brown (10YR 3/3) extremely cobbly clay, brown (10YR 4/3) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many moderately thick clay films on faces of peds and in pores; 55 percent cobbles and 20 percent pebbles; neutral (pH 7.2); clear wavy boundary.

C1-25 to 30 inches; very dark grayish brown (10YR 3/2) extremely cobbly clay, grayish brown (10YR 5/2) dry; massive; hard, firm, sticky and plastic; 90 percent fractured soft bedrock with clay in cracks; neutral (pH 7.2); clear wavy boundary.

Cr-30 inches; soft fractured tuffaceous bedrock.

Bedrock is at a depth of 20 to 40 inches. The mollic epipedon is 20 to 30 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 or 2 when moist or dry. It is 5 to 20 percent pebbles and 15 to 25 percent cobbles and stones.

The B2t horizon has value of 2 to 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry. It is silty clay loam or clay and has 35 to 45 percent clay. This horizon is 20 to 40 percent pebbles and 20 to 35 percent cobbles and stones.

The C horizon has value of 3 or 4 when moist and 4 or 5 when dry, and it has chroma of 2 to 4 when moist or dry.

Ruckles series

The Ruckles series consists of shallow, well drained soils on uplands. These soils formed in colluvium and residuum derived from basalt and volcanic tuff. Some loess and volcanic ash is in the surface layer. Slope is 1 to 65 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Ruckles very stony clay loam, in an area of rangeland, about 300 yards west of the road at the northeast corner of the NE1/4SW1/4 of sec. 29, T. 5 S., R. 40 E.

A1-0 to 2 inches; very dark gray (10YR 3/1) very stony clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 15 percent stones, 10 percent cobbles, and 10 percent pebbles; neutral (pH 7.2); abrupt smooth boundary.

B1-2 to 4 inches; very dark gray (10YR 3/1) very stony clay, dark grayish brown (10YR 4/2) dry; moderate medium and coarse subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; 10 percent stones, 15 percent cobbles, and 15 percent pebbles; neutral (pH 7.0); abrupt smooth boundary.

B21t-4 to 8 inches; very dark grayish brown (10YR 3/2) very cobbly clay, dark grayish brown (10YR 4/2) dry; moderate coarse subangular blocky. structure; slightly hard, firm, slightly sticky and plastic; common very fine and fine roots; common very fine tubular pores; continuous moderately thick clay films on faces of peds and in pores; 5 percent stones, 20 percent cobbles, and 20 percent pebbles; mildly alkaline (pH 7.6); clear smooth boundary.

B22t-8 to 13 inches; dark yellowish brown (10YR 3/4) very cobbly clay, dark yellowish brown (10YR 4/4) dry; strong coarse prismatic structure; hard, very firm, very sticky and very plastic; few fine roots; common very fine tubular pores; continuous thick clay films on faces of peds and in pores; 5 percent stones, 25 percent cobbles, and 20 percent pebbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

B3t-13 to 17 inches; dark yellowish brown (10YR 4/4) very cobbly clay, dark yellowish brown (10YR 4/4)

dry; weak fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common very fine irregular pores; few thin clay films on faces of peds and in pores; 15 percent stones, 35 percent cobbles, and 20 percent pebbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

R-17 inches; basalt.

Bedrock is at a depth of 10 to 20 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 1 or 2 when moist or dry. It is 35 to 55 percent rock fragments.

The B2t horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 to 4 when moist or dry. It is 50 to 60 percent clay and 40 to 80 percent rock fragments.

Starkey series

The Starkey series consists of shallow, well drained soils on uplands. These soils formed in residuum and colluvium derived from volcanic tuff and basalt. Some loess is in the surface layer. Slope is 2 to 40 percent. The mean annual precipitation is about 18 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Starkey very stony silt loam, 2 to 35 percent slopes, in an area of rangeland, 4 miles south of the town of Hilgard, 15 feet east of Whiskey Creek Road, in the NW1/4NW1/4SW1/4SE1/4 of sec. 17, T. 3 S., R. 37 E.

A11-0 to 3 inches; very dark brown (10YR 2/2) very stony silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine tubular pores; about 15 percent stones and 20 percent cobbles; neutral (pH 7.2); clear smooth boundary.

A12-3 to 7 inches; very dark brown (10YR 2/2) very cobbly silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine tubular pores; about 50 percent cobbles and 5 percent stones; neutral (pH 7.2); clear smooth boundary.

B1-7 to 9 inches; very dark brown (10YR 2/2) cobbly silty clay, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to weak very fine subangular blocky; hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; about 20 percent cobbles and 10 percent pebbles; mildly alkaline (pH 7.4); abrupt smooth boundary.

IIB21t-9 to 12 inches; dark brown (10YR 3/3) gravelly clay, brown (7.5YR 4/3) dry; moderate fine prismatic structure parting to strong fine angular blocky; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; continuous moderately thick clay films on faces of peds and in pores; about 25 percent pebbles and 5 percent cobbles; mildly alkaline (pH 7.6); clear smooth boundary.

IIB22t-12 to 15 inches; dark brown (10YR 4/3) very gravelly clay, brown (10YR 5/3) dry; moderate fine angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; about 50 percent angular pebbles; mildly alkaline (pH 7.6); clear smooth boundary.

IICr-15 inches; partially weathered volcanic tuff; can be cut with spade with difficulty.

Depth to paralithic contact ranges from 10 to 20 inches. From 5 to 15 percent of the surface is covered with stones and cobbles.

The A horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The B2t horizon has hue of 7.5YR or 10YR, value of 3 or 4 when moist and 4 or 5 when dry, and chroma of 3 or 4 when moist or dry. It is 50 to 60 percent clay and 35 to 60 percent rock fragments.

Tolo series

The Tolo series consists of deep, well drained soils on mountainous uplands. These soils formed in silty volcanic ash deposited over an older, buried soil that formed in loess and colluvium derived from basalt. Slope is 12 to 65 percent. The mean annual precipitation is about 27 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Tolo silt loam, in a wooded area, about 14 miles northeast of Elgin, in the SW1/4SW1/4 of sec. 3, T. 2 N., R. 40 E.

O1-2 inches to 0; duff, needles, and twigs.

A1-0 to 1 inch; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many fine interstitial pores; many white fungial mycelia; common charcoal fragments 1 to 2 millimeters across; neutral (pH 6.6); abrupt smooth boundary.

B21-1 inch to 4 inches; dark brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; massive; soft, very friable, nonsticky and nonplastic; many fine roots; common very fine tubular pores; common charcoal fragments 1 to 2 millimeters across; slightly acid (pH 6.2); abrupt smooth boundary.

B22-4 to 18 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; common very fine irregular pores; few charcoal fragments 1 to 2 millimeters across; slightly acid (pH 6.2); gradual smooth boundary.

B23-18 to 33 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; massive; slightly hard, very friable, nonsticky and nonplastic; many fine roots; many very fine tubular pores; band of clay film 2 to 3 millimeters thick at the lower boundary; medium acid (pH 6.0); abrupt wavy boundary.
IIB1tb-33 to 37 inches; dark yellowish brown (10YR 4/4) silt loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; few thin clay films on faces of peds and in pores; common white fungial mycelia on faces of peds; medium acid (pH 6.0); clear wavy boundary.
IIB21tb-37 to 41 inches; dark yellowish brown (10YR 4/4) silty clay loam, brown (10YR 5/3) dry; weak medium and coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, firm, sticky and plastic; many fine roots; many very fine tubular pores; thin continuous clay films; common white fungial mycelia. on faces of peds; slightly acid (pH 6.2); gradual smooth boundary.
IIB22tb-41 to 51 inches; dark yellowish brown (10YR 4/4) silty clay loam, pale brown (10YR 6/3) dry; weak medium and coarse prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine roots; many very fine and common fine tubular pores; continuous thin clay films on faces of peds and in pores; slightly acid (pH 6.2); gradual smooth boundary.
IIB3tb-51 to 65 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; hard, firm, slightly sticky and slightly plastic; few fine roots; many very fine and common medium tubular pores; few thin clay films; slightly acid (pH 6.2).

Thickness of the ashy mantle and depth to the buried soil range from 20 to 40 inches. The bulk density of the ashy mantle is less than 0.85 gram per cubic centimeter.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 or 5 when dry, and chroma of 1 to 3 when moist or dry.

The B horizon has hue of 10YR or 7.5YR, value of 3 to 5 when moist and 6 or 7 when dry, and chroma of 2 to 4 when moist or dry.

The IIBtb horizon has hue of 10YR or 7.5YR, value of 3 or 4 when moist and 5 or 6 when dry, and chroma of 2 to 4 when moist or dry. It is silt loam or silty clay loam that is 18 to 35 percent clay.

Ukiah series

The Ukiah series consists of moderately deep, well drained soils on uplands. These soils formed in colluvium and residuum derived from volcanic tuff. Some loess is in the surface layer. Slope is 2 to 40 percent. The mean annual precipitation is about 17 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Ukiah silty clay loam, 2 to 20 percent slopes, in an area of rangeland, at the northwest corner of the SW1/4SE1/4 of sec. 17, T. 1 N., R. 40 E.

A11-0 to 3 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong very fine granular structure; hard, firm, sticky and plastic; many very fine roots; many fine tubular pores; slightly acid (pH 6.4); abrupt wavy boundary.
B21t-3 to 14 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; moderate coarse prismatic structure parting to moderate fine blocky; very hard, very firm, very sticky and very plastic; many very fine roots; many fine tubular pores; neutral (pH 6.8); clear smooth boundary.
B22t-14 to 22 inches; very dark gray (10YR 3/1) clay, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate fine blocky; very hard, very firm, very sticky and very plastic; many very fine roots; many very fine tubular pores; many thin clay films on faces of peds and in pores; mildly alkaline (pH 7.4); abrupt smooth boundary.
B3tca-22 to 38 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; very dark gray and black coatings on faces of peds; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; continuous moderately thick clay films on faces of peds and in pores; few very fine roots; common very fine tubular pores; segregated lime; strongly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
Cr-38 inches; volcanic tuff.

The mollic epipedon is 15 to 24 inches thick. Paralithic contact is at a depth of 20 to 40 inches. During summer in most years cracks at least 1 centimeter wide extend from the surface to a depth of 20 inches or, in cultivated areas, to the base of the Ap horizon.

The A horizon has value of 2 or 3 when moist and 4 when dry, and it has chroma of 1 or 2 when moist or dry.

The B21t horizon has value of 2 or 3 when moist. The B2t horizon has chroma of 1 to 3 when moist or dry. It is 50 to 60 percent clay and 0 to 15 percent rock fragments.

Umapine series

The Umapine series consists of deep, somewhat poorly drained soils on bottom lands and low terraces. These soils formed in mixed alluvium. Slope is 0 to 2 percent. The mean annual precipitation is about 11 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Umapine silt loam, in a pastured area, about 20 feet north of a fence, in the SE1/4NW1/4NW1/4 of sec. 12, T. 6 S., R. 39 E.

A1ca-0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; moderate medium platy structure; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine tubular pores; strongly effervescent; very strongly alkaline (pH 9.2); clear smooth boundary.

ACca-8 to 15 inches; dark grayish brown (10YR 3/2) very fine sandy loam, light brownish gray (10YR 6/2) dry; weak thin platy structure; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine tubular pores; strongly effervescent; very strongly alkaline (pH 9.4); clear smooth boundary.

C1ca-15 to 24 inches; dark grayish brown (10YR 4/2) very fine sandy loam, light brownish gray (10YR 6/2) dry; few fine faint mottles; moderate thin to medium platy structure; hard, firm, nonsticky and nonplastic; few very fine roots; many very fine tubular and vesicular pores; slightly effervescent; strongly alkaline (pH 8.8); clear smooth boundary.

C2ca-24 to 40 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine faint mottles; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine vesicular pores; strongly effervescent; common fine segregated lime; strongly alkaline (pH 8.8); clear smooth boundary.

C3ca-40 to 60 inches; brown (10YR 5/3) loam, very pale brown (10YR 7/3) dry; common fine distinct mottles; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine vesicular pores; violently effervescent; moderately alkaline (pH 8.4).

The upper 40 inches of the profile is strongly alkaline or very strongly alkaline. The percentage of exchangeable sodium exceeds 15 in the upper 20 inches of the profile. Some pedons are noncalcareous to a depth of 10 to 20 inches.

The A horizon has value of 3 to 5 when moist and 5 to 7 when dry, and it has chroma of 1 to 3 when moist or dry.

The C horizon has value of 3 to 5 when moist and 5 to 7 when dry, and it has chroma of 2 or 3 when moist or dry. It is very fine sandy loam, loam, or silt loam.

Veazie series

The Veazie series consists of deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slope is 0 to 3 percent. The mean annual precipitation is about 18 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of a Veazie loam in an area of Veazie-Voats complex, protected, in a cultivated field, about 100 feet north of river and 100 feet west of road, in the SW1/4SW1/4 of sec. 35, T. 2 S., R. 38 E.

Ap1-0 to 5 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many very fine irregular pores; neutral (pH 7.0); clear smooth boundary.

Ap2-5 to 11 inches; very dark brown (10YR 2/2) loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine and medium interstitial pores; neutral (pH 7.0); clear smooth boundary.

B2-11 to 32 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; neutral (pH 7.2); gradual wavy boundary.

IIC-32 to 60 inches; very gravelly sand.

The mollic epipedon is 24 to 36 inches thick. Stratified sand and very gravelly sand are at a depth of 20 to 40 inches.

The A horizon has chroma of 1 or 2 when moist or dry.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The C horizon is stratified sand, gravelly sand, and very gravelly sand.

Voats series

The Voats series consists of deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slope is 0 to 3 percent. The mean annual precipitation is about 18 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of a Voats fine sandy loam in an area of Veazie-Voats complex, protected, in a cultivated area, on the bank of the Grande Ronde River, at the northwest corner of the SW1/4SW1/4SW1/4 of sec. 35, T. 2 S., R. 38 E.

A11-0 to 2 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine tubular pores; 10 percent fine pebbles; neutral (pH 7.0); abrupt wavy boundary.

A12-2 to 5 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/3) dry; strong thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine and few coarse tubular pores; neutral (pH 7.2); abrupt wavy boundary.

A3-5 to 10 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry;

moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine and few coarse tubular pores; neutral (pH 7.2); abrupt wavy boundary.

B2-10 to 16 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; very few very fine roots; mildly alkaline (pH 7.4); abrupt wavy boundary.

IIC-16 to 60 inches; very dark grayish brown (10YR 3/2) very gravelly sand, grayish brown (10YR 5/2) dry; single grain; loose; few very fine roots in upper 10 inches; many pores; neutral (pH 7.2).

The mollic epipedon is 10 to 20 inches thick. Stratified sand and very gravelly sand are at a depth of 10 to 20 inches.

The A horizon has chroma of 1 or 2 when moist or dry. It is 0 to 10 percent pebbles.

The B horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 2 or 3 when moist or dry.

The IIC horizon is sand, gravelly sand, or very gravelly sand. It is 0 to 20 percent cobbles and 35 to 45 percent pebbles.

Watama series

The Watama series consists of moderately deep, well drained soils on uplands. These soils formed in loess and volcanic ash mixed with residuum and colluvium derived from basalt. Slope is 2 to 12 percent. The mean annual precipitation is about 19 inches, and the mean annual air temperature is 48 degrees F.

Typical pedon of Watama silt loam, moist, 2 to 12 percent slopes, in an area of biscuit-scabland used as rangeland, about 75 feet northeast of the southeast corner of the SW1/4SW1/4SE1/4 of sec. 6, T. 1 N., R. 40 E.

A11-0 to 2 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many medium tubular pores; neutral (pH 6.6); abrupt smooth boundary.

A12-2 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to moderate very fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common medium tubular pores; neutral (pH 6.6); gradual wavy boundary.

B21-9 to 16 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common medium tubular pores; neutral (pH 6.8); clear wavy boundary.

B22-16 to 25 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and plastic; few very fine roots; common medium tubular pores; neutral (pH 6.8); clear wavy boundary.

B23-25 to 31 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common medium tubular pores; neutral (pH 6.8); abrupt smooth boundary.

R-31 inches; basalt.

Bedrock is at a depth of 20 to 40 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3 when moist or dry. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3 when moist or dry.

Wilkins series

The Wilkins series consists of deep, somewhat poorly drained soils in concave drainage basins on uplands. These soils formed in loess and volcanic ash over alluvium. Slope is 1 to 5 percent. The mean annual precipitation is about 24 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of Wilkins silt loam, 1 to 5 percent slopes, in a meadow, in the NW1/4SW1/4NW1/4 of sec. 21, T. 2 N., R. 39 E.

A11-0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and interstitial pores; medium acid (pH 6.0); clear smooth boundary.

A12-7 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine tubular and interstitial pores; slightly acid (pH 6.5); clear smooth boundary.

A21-14 to 21 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; weak medium granular structure; soft, friable, nonsticky and nonplastic; common very fine roots; common fine tubular pores; neutral (pH .6.6); abrupt smooth boundary.

A22-21 to 26 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few

medium faint mottles; weak fine subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine roots; common fine and very fine tubular pores; neutral (pH 6.6); abrupt smooth boundary.

IIB21t-26 to 31 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; few very, fine roots; common fine tubular and interstitial pores; common thick clay films on faces of peds; neutral (pH 6.7); clear wavy boundary.

IIB22t-31 to 41 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; common medium faint mottles; strong coarse subangular blocky structure; hard, firm, sticky and plastic; very few fine roots between peds; common very fine tubular and vesicular pores; continuous thick clay film on faces of peds and in pores; neutral (pH 6.8); clear wavy boundary.

IIB3t-41 to 60 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; moderate coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine tubular and vesicular pores; common thin clay films on faces of peds; neutral (pH 6.8).

In same pedons the A2 and IIB horizons have black and red concretions. The profile has faint to distinct mottles below a depth of 20 inches.

The A1 horizon has value of 2 or 3 when moist and 4 or 5 when dry, and it has chroma of 1 or 2 when moist or dry. It is 18 to 27 percent clay. The A2 horizon has chroma of 1 or 2 in more than half of the matrix when moist. It is 4 to 12 inches thick.

The IIB horizon has hue of 10YR or 2.5Y, value of 3 or 4 when moist and 4 to 6 when dry, and chroma of 2 or 3 when moist or dry. It is silty clay or clay and is 50 to 60 percent clay.

Wingville series

The Wingville series consists of deep, somewhat poorly drained soils on alluvial fans and flood plains. These soils formed in alluvium. Slope is 0 to 2 percent. The mean annual precipitation is about 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Wingville silt loam, in an area of pastureland, about 150 feet west of road, near freeway interchange, in the SE1/4SW1/4SE1/4 of sec. 9, T. 6 S., R. 39 E.

A11ca-0 to 14 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; strong fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

A12-14 to 24 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; moderately alkaline (pH 8.2); clear wavy boundary.

AC-24 to 28 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; few faint gray mottles; weak medium platy structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; moderately alkaline (pH 8.0); clear smooth boundary.

C1-28 to 33 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; common faint gray mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; mildly alkaline (pH 7.8); clear wavy boundary.

C2g-33 to 39 inches; olive gray (5Y 4/2) silty clay loam, light gray (5Y 7/1) dry; few distinct dark brown mottles; massive; hard, friable, sticky and plastic; common very fine tubular pores; moderately alkaline (pH 8.0); clear wavy boundary.

C3g-39 to 60 inches; dark olive gray (5Y 3/2) clay, olive gray (5Y 4/2) dry; massive; very hard, very firm, very sticky and very plastic; few very fine tubular pores; moderately alkaline (pH 8.0).

Bedrock is at a depth of 60 inches or more. Depth to the seasonal high water table ranges from 18 to 36 inches. The mollic epipedon is 20 to 30 inches thick. The clay content at a depth of 20 to 40 inches ranges from 18 to 34 percent.

The A horizon has value of 2 or 3 when moist and 3 to 5 when dry, and it has chroma of 1 or 2 when moist or dry.

The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 or 4 when moist and 4 to 7 when dry, and chroma of 1 or 2 when moist or dry. It has few and faint mottles to many and prominent mottles.

Wingville soils in this survey area are a taxadjunct to the Wingville series because they are not effervescent between depths of 10 and 20 inches. This difference, however, does not significantly affect use and management.

Wolot series

The Wolot series consists of deep, well drained soils on uplands. These soils formed in silty volcanic ash deposited over an older, buried soil that formed in loess and colluvium. Slope is 2 to 12 percent. The mean annual precipitation is about 22 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Wolot silt loam, 2 to 12 percent slopes, in a wooded area, near the town of Elgin, at the

southwest corner of the NE1/4SW1/4 of sec. 18, T. 1 N., R. 39 E.

O1-1 inch to 0; duff, needles, and twigs.
A1-0 to 4 inches; dark brown (10YR 3/3) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine interstitial pores; neutral (pH 6.8); clear smooth boundary.
B2-4 to 10 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and few medium roots; many very fine irregular pores; neutral (pH 6.8); clear smooth boundary.
B3-10 to 22 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few medium and coarse roots; many very fine irregular pores; neutral (pH 6.6); clear smooth boundary.
C-22 to 29 inches; brown (10YR 4/3) silt loam, light yellowish brown (10YR 6/4) dry; massive; soft, very friable, nonsticky and nonplastic; common very fine and few medium and coarse roots; few very fine irregular pores; neutral (pH 6.6); clear smooth boundary.
IIA1b-29 to 36 inches; very dark grayish brown (10YR 3/2) silt loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few medium and coarse roots; many very fine irregular pores; neutral (pH 7.0); clear smooth boundary.
IIB1b-36 to 42 inches; dark yellowish brown (10YR 3/4) silty clay loam, pale brown (10YR 6/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few medium and coarse roots; many very fine irregular pores; neutral (pH 7.0); clear smooth boundary.
IIB2tb-42 to 60 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; many very fine irregular pores; common moderately thick clay films on faces of peds; common gray silt coatings on faces of peds; neutral (pH 7.0).

The ashy mantle has a bulk density of less than 0.85 gram per cubic centimeter. Thickness of the ashy mantle and depth to the buried soil range from 22 to 36 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 when moist and 4 to 6 when dry, and chroma of 1 to 3 when moist or dry.

The B horizon has hue of 10YR or 7.5YR, value of 3 to 5 when moist and 6 or 7 when dry, and chroma of 2 to 4 when moist or dry.

The C horizon has value of 3 to 5 when moist and 5 or 6 when dry, and it has chroma of 3 or 4 when moist or dry.

The buried soil has value of 3 or 4 when moist and 4 or 6 when dry, and it has chroma of 2 to 4 when moist or dry. It is silt loam or silty clay loam that is 18 to 35 percent clay and 0 to 20 percent rock fragments.

formation of the soils

Soil is a natural formation on the surface of the earth in which plants grow. It is composed of organic and mineral material. Soils differ in their appearance, composition, management requirements, and productivity in different localities or even within short distances in the same locality. The factors that cause soils to differ are: (1) the relief, or lay of the land, and drainage; (2) the physical and chemical composition of the parent material; (3) the climate under which the soil material has accumulated and existed since accumulation; (4) the biological activity, including plant and animal life in and on the soil; and (5) the length of time the forces of soil formation have acted on the parent material. Each soil is affected by all five factors, but the relative effect and importance of each varies from one soil to another.

parent material

The soils in the survey area formed in (1) residuum and colluvium, (2) volcanic ash from geologically recent volcanic eruptions, (3) lake deposits on basin floors, (4) material transported by water and laid down in varying amounts as unconsolidated deposits of clay, silt, sand, and gravel, and (5) silty and sandy material transported by wind. The soils that formed in residuum and colluvium contain minerals that are similar to those in the original rock. Recent alluvium and some eolian deposits have been mixed so that the mineralogy of the source rocks is no longer distinct.

The size of particles, mineralogy, and thickness of the parent material have greatly influenced the nature of the soils in the area. Some soil characteristics were inherited directly from the parent material. For example, the soils that formed mainly in residuum derived from hard bedrock generally are shallow and stony. The soils that formed in soft volcanic tuff generally are deeper and more clayey. The soils that formed in recent deposits of eolian ash over older soils in woodland areas generally are deeper and have high water holding capacity.

The soils on the mountainous uplands and foothills of the survey area are underlain mainly by basic igneous rock, mainly basalt, and a lesser amount of andesite. The soils that formed in residuum and colluvium derived from these rocks typically are stony and are shallow or moderately deep. Anatone, Klicker, and Loneridge soils are examples of soils that formed in material derived from basalt, and Hall Ranch soils are examples of soils

that formed in material derived from andesite. Some geologically recent loess and volcanic ash generally are mixed into the surface layer of the soils. Interbedded with the basalt and andesite flows are layers of volcanic tuff. The soils that formed in this material generally have a clayey subsoil. In some places colluvial rock fragments of basalt are in the soil profile. Cowsly, Ruckles, Ukiah, and McMurdie soils formed in residuum derived from volcanic tuff and basalt colluvium.

Sometime during the Pleistocene, Grande Ronde and Baker Valleys were inundated by glacial melt water. Silt and clay, suspended in turbulent inflowing water, settled to the lakebeds in the quieter waters. During the Holocene, silty volcanic ash, deposited directly into the lakes or eroded from adjacent hills, also settled to the lakebeds. Diatoms thrived in these lakes, and their remains accumulated as diatomaceous earth. Conley, Hot Lake, and Hoopal are examples of soils that formed in these lacustrine deposits.

In later geological times, a thin mantle of loess was deposited over most of the survey area, modifying the surface layer of most of the soils in the area. Some foothill areas surrounding Grande Ronde Valley have accumulations of loess many feet thick. Palouse and Watama soils formed in this material. Sand-sized particles, also windblown, were deposited as dunes and ridges across the valley floor. Alicel and Imbler soils formed in this material. Volcanic ash of Holocene age mantles parts of the forested uplands. Soils such as Tolo and Hefter formed in ash overlying buried soils.

Recent alluvium has been deposited along present stream and river bottoms. This material ranges from clay to gravel and cobbles in texture. Catherine, La Grande, Veazie, and Voats soils formed in this material.

relief

Relief is the difference in elevation within an area. Features of relief that can modify the effects of other soil-forming factors are gradient of slope, shape of slope, and direction in which slopes face, or aspect. These features affect the rate of runoff, evaporation, internal drainage, soil temperature, and snow cover.

Grande Ronde and Baker Valleys generally are nearly level and have little relief. Local differences in elevation commonly do not exceed 2 or 3 feet. The surface drainage pattern is not well developed, and surface runoff is often very slow or ponded. Most of the soils in these valleys are moderately well drained to poorly drained. Catherine and Wingville soils are examples of somewhat poorly drained soils in this area.

The low foothills and old terraces adjacent to the valley floors have gently sloping to moderately sloping, broad tops and ridges that break to steep side slopes. The surface runoff varies with the slope gradient. Most of these soils are well drained, including the Coughanour and Hutchinson soils. Alluvial fans, pediments, and foot slopes extending from these hills merge with the valley floor. Because of the sharp decrease in slope gradient at the valley floor, material from upslope accumulates on it. Generally, deep soils such as those of the Ramo and Emily series formed here.

The steep, dissected uplands rise abruptly above the low foothills. The uplands have pronounced local relief, very steep side slopes, and narrow to broad, moderately sloping ridges. The soils in these areas, such as those of the Gwinly and Anatone series, generally are shallow and stony, except where volcanic ash and tuff have accumulated. These accumulations are related to slope aspect. Airborne material has been deposited on the north-facing slopes, which are on the downwind side of the mountains, Tolo and Hefter are examples of soils that formed in deep deposits of ash and loess and are dominantly on north-facing slopes.

climate

Climate is perhaps the most influential factor in soil formation (5). It largely determines the nature of the weathering of parent material that occurs. Temperature and precipitation exert a profound influence on the rate at which chemical and physical processes take place, which affects the development of the soil profile. If allowed sufficient time, climatic influences eventually tend to dominate soil formation.

The climate in Union County is continental, with an influence of marine air from the Pacific Ocean. Winters are cool and wet, and summers are warm and dry. The climate varies considerably with latitude, elevation, and aspect. Precipitation generally increases from south to north and from the lower elevations to the higher elevations. It is more effective on north-facing slopes. Temperatures decrease in a similar pattern, with south-facing slopes being significantly warmer than north-facing slopes at the same elevation. A more detailed description of the climate in the survey area is presented in the section "General nature of the survey area."

The differences in climate of the area account for some of the differences in the characteristics of the soils in the area. For example, parent material is most rapidly weathered under warm, moist conditions. Soils on south-facing slopes, being droughty, generally are shallower and more stony than those on north-facing slopes. Differences in precipitation can also account for soil differences. The soils on the forested mountains, where precipitation is higher, are more leached, have lower base saturation, and are more acidic than the drier soils at lower elevations.

Climate also exerts a strong influence on native vegetation. As precipitation increases, the grassland vegetation of the valleys and foothills gives way to coniferous forests. Generally, the accumulation of

organic matter and humus in the soils increases as precipitation increases and temperature decreases.

plant and animal life

Plants and animals, including man, have affected the kinds of soil that formed in the Union County Area. The soil-forming factors of parent material, relief, climate, and time have influenced the kinds of plants and animals that live on and in the soil.

The leaves, stems, twigs, and roots of plants that fall to the soil surface are decomposed by soil organisms such as bacteria and fungi. This decomposed material is mixed into the soil by worms, insects, and small animals. Nutrients for plant growth are thus incorporated into the soil.

Organic matter helps to maintain the structure of the soil and increases its water intake rate and the available water capacity. The biochemical action of organic acids in the soil solution is important in the weathering of parent material.

The soils on valley floors and adjacent terraces in the area formed under a cover of grasses, sedges, and forbs. The thick, dark surface layer of these soils is high in content of organic matter and has high base saturation. The influence of this vegetation is reflected in the La Grande and Catherine soils.

In the foothills, as precipitation increases, grassland vegetation gives way to coniferous forest with an open canopy and an understory of grasses and shrubs. The soils that formed in this area, such as Marley and Kamela, have a dark-colored surface layer but are not so high in content of organic matter and in base saturation as the soils on the valley floor. Soils such as Tolo and Helter formed under dense forest cover, principally in volcanic ash on north- and east-facing slopes. These soils have a much thinner dark-colored surface layer and have an accumulation of organic duff on the surface.

The native vegetation in the survey area originally provided a protective cover on the land surface. After the soils were cleared and tilled by man, the cycle of soil formation under this cover was disrupted and the influence of man began to be reflected in the soil. In many places the soils have been improved through drainage, fertilization, and cultivation. In other places land-use practices have caused a decrease in organic matter content and have increased soil erosion.

time

The effectiveness of climate, relief, and organisms in changing parent material into soil is governed by the time these factors have been active. The degree of profile formation generally indicates the relative age of the soil. Of special importance is the amount of clay that is produced by weathering in the upper part of the soil and that is leached down by percolating water to accumulate in the subsoil. This process of clay accumulation in the subsoil is called illuviation. Ordinarily, a period of a few years to many thousands of years is needed to produce a significant amount of illuviation. On the other hand, darkening of the surface layer by the accumulation of organic matter can occur in a few hundred years. Development of soil structure in the subsoil also can take place in a relatively short time compared with the time required for the accumulation of clay.

The oldest soils in the area are those that formed in residuum and colluvium derived from basalt and volcanic tuff on uplands. Soils such as Gwinly and Klicker have a well developed subsoil with an accumulation of clay.

Many upland soils in the area were buried by a mantle of volcanic ash about 6,500 years ago. This deposition insulated the buried soils from further influence from the soil-forming factors. The ashy material, which seems to weather slowly, has not been in place long enough for much soil weathering to have taken place. For the most part, only a darkening of the upper few inches by organic matter and a slight weathering of the ash have occurred.

The soils on the valley terraces, which formed in Pleistocene alluvial deposits, have been in place long enough for several distinctive horizons to have formed. Soils such as Coughanour and Hutchinson have developed an illuvial clay subsoil and a duripan. These soils, as well as upland soils that were not overburdened with volcanic ash, have had silty loess mixed into the surface layer.

The soil material of the lake basins was deposited sometime in the late Pleistocene. Soils such as Conley and Hoopal have been in place long enough to have developed a clay subsoil and a duripan, respectively.

The youngest soils in the area are those along the flood plains, where sediment is being deposited on the surface at a more rapid rate than clay can accumulate in the subsoil. Catherine and Veazie are soils that have a dark-colored surface layer and that show little or no evidence of development in the subsoil.

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glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as-

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

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

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

Biscuit-scabland. Commonly referred to as patterned land. It consists of round or elongated, erosion-modified mounds ("biscuits") surrounded by shallow soils characterized by stone nets and stone stripes that form distinct patterns on the ground surface ("scabland").

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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

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

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

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

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

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

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

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

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

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.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

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

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.-Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.-Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.-Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.-Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.-Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.-Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.-Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast Intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

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.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

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

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual. The* major horizons of mineral soil are as follows:

O horizon.-An organic layer of fresh and decaying plant residue at the surface of a mineral soil. A horizon.-The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are

Border. -Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.-Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.-Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.-Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).-Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.-Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.-Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance-*few*, *common,* and *many,* size-*fine, medium,* and *coarse;* and contrast-*faint*, *distinct, and* prominent. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15

millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables-hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

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

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

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

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect 'its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity Index. The numerical difference between the. liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes. from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as-

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

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

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

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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 (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Site Index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet:

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na! to Ca!! + Mg!!. The degrees of sodicity are--

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are-*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

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

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

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

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining:

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.