# Foreword

The Soil Survey of Polk County, Oregon, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

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

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

State Conservationist
Soil Conservation Service

# SOIL SURVEY OF POLK COUNTY, OREGON

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POLK COUNTY is in the northwestern part of Oregon (see opposite page). Dallas, the county seat and the largest town, is located in the east-central part of the county. The county is bounded by Yamhill, Tillamook, Lincoln, and Benton Counties. The Willamette River is the eastern boundary. The county extends west from the Willamette River to the crest of the Coast Range. It is in the Willamette River Drainage Basin and the Coast Drainage Basin, which drains into the Pacific Ocean. The county is about 470,400 acres or 735 square miles.

Polk County has a well developed drainage system. The Willamette River Drainage Basin is drained by three major stream systems: Luckiamute River, Rickreall Creek, and South Yamhill River. The Coast Drainage Basin is drained by the Siletz River.

The eastern part of the county is on the main valley floor and the alluvial flood plain. Low foothills rise to the west and merge into the forested, mountainous Coast Range in the western part of the county. The mountainous area is mainly at an elevation of about 2,200 feet. Elevations in Polk County range from 125 feet on the flood plain to 3,725 feet on Laurel Mountain in the Coast Range.

The county has a modified marine climate that varies widely from east to west. Westward from the valley floor into the Coast Range, precipitation increases from 40 to 150 inches a year, temperatures decrease, and the growing season shortens. The steep upland and the Coast Range are forested and are managed primarily for timber.

The low foothills and the main valley and the major tributary valleys are in cultivated crops: cereal grain, grass seed, fruit and nut orchards, vegetable crops, and hay.

## General nature of the county

General information about Polk County is given in this section. Settlement and development; transportation, industries, and markets; farming; and climate are described.

### Settlement and development

Polk County was created from Yamhill District on December 23, 1845. It stretched from the present Yamhill County line south to the California border and from the Willamette River west to the Pacific Ocean. This large area was subdivided into other counties in later years, reducing the size of the county to its current 470,400 acres.

Hudson's Bay Company hunters and trappers had penetrated the Willamette Valley as far south as Polk County before 1830. Initial settlement of the Willamette Valley was started by retired employees of the Hudson's Bay Company. People from the eastern United States began settlement of Polk County during the early 1840's; one settlement was near the present site of Dallas. The county seat was located at Dallas in 1850, and a courthouse was completed in 1860. This building was destroyed by fire in 1898, and the present courthouse structure was erected two years later.

Other settlements include Independence, named after Independence, Missouri, and Monmouth, which was founded in 1853 by settlers who had moved there from Monmouth, Illinois. This group of settlers arrived in the Willamette Valley in August 1852, and spent their first winter at a point about 3-1/2 miles northeast of Rickreall. The present Oregon College of Education in Monmouth was originally Monmouth University that was established in 1858.

Various small industries were developed in Polk County during the period of pioneer settlement. Among them were grist

mills, woolen mills, and saw mills. A grist mill was established in Ellendale in the late 1840's, and in 1852 one was established at Falls City and later moved to Rickreall. In 1865, a woolen mill was established at Ellendale at the site of the old grist mill, but it was later destroyed by fire. The first pottery works in the Northwest was established at Buena Vista in 1865. Its early products were housewares; but later, sewer pipe was also produced, a considerable amount of which was shipped to Portland. The oldest business still operating in the county is a tannery that was established in Dallas in 1863.

After the establishment of the Grand Ronde Indian Reservation in 1856, the remnants of the Willamette Valley Indian tribes as well as Indians from other parts of Oregon were settled there. More than 1,000 Indians were on the reservation during the 1860's. Federal control over the remaining reservation land, some 500 acres, was terminated in 1957.

During its pioneer period, river navigation was Polk County's principal means of transport for goods produced in the county and for incoming supplies. River navigation was displaced after 1890 by railroads as the most important means of transporting goods to and from the county although river boats were still operating as late as 1894.

It was during the period of steam navigation that Lincoln attained prominence as a wheat-exporting port on the Willamette River. For a time, Lincoln was second only to Portland among Willamette River ports in the tonnage of wheat it handled. Today only a cluster of houses remains at this community.

Polk County moved into a new era after 1940. The population doubled between 1940 and 1970, increasing from 16,500 to 35,500. The increasing urbanization of the county and the inclusion of West Salem in the Salem metropolitan area is doing much to increase the local economy.

## Transportation, industries, and markets

State highways 18 and 22 are the main east and west highways that intersect in the northern part of the county and extend west to the Pacific Ocean. Highway 18 enters the county from the northeast. Highway 22 extends east through the Willamette Valley and into the Cascade Mountains. State Highway 99W is the main north-south highway; it connects Polk County with Portland to the north and Corvallis and Eugene to the south. State Route No. 223 joins Highway 22 and extends south through the city of Dallas.

An excellent network of improved secondary highways connects all areas of the county. Many timber companies and the U.S. Bureau of Land Management construct and maintain their own road systems in the timbered uplands.

A branch freight line of the Southern Pacific Railroad runs north and south through the eastern part of the county. A spur line extends east, crosses the Willamette River, and connects to the main line at Salem. Other railroads are privately owned by logging and lumber companies and are used to transport logs and finished wood products.

Motor freight service is by commercial trucking companies, and passenger bus service is available to all towns in the county.

Polk County is principally a farming and logging area. Wood and such wood products as plywood, lumber, particle board, and wood specialty products are manufactured locally and are a large part of the income of the county. There are 20 logging contractors in the county, 9 sawmills and planing mills, 4 veneer and plywood plants, and 5 mills producing other wood products. About 1,500 people are employed in the lumber and wood-products industry.

The farming is very diverse. Most of the livestock and farm products are shipped out of the county for processing and marketing. In 1975, there were 1,056 farms in the county, and the average size was 200 acres. About 1,800 people were employed by farming enterprises during the peak season.

## Farming

The open grasslands along the Willamette River and South Yamhill River were the first parts of the county to be settled in the early 1840's. The native grasses furnished forage for livestock. The few crops grown during this period were mostly subsistence crops. As the population of the county increased and outside markets were developed, wheat and other cereal grains became major crops. By 1879, 52,000 acres of wheat were harvested. During the next decade the acreage of wheat was reduced (8), but production doubled because of the introduction of winter varieties.

From 1889 to 1899, the acreage of hops, apples, and peaches increased by 50 percent. Introduction of clover and crop rotations were important advances to a permanent agricultural economy. By the turn of the century the prune industry was established. During this period, dairy products, poultry, nuts, and fruits were the major cash crops. By 1920 the dairy industry was well established; prunes, plums, cherries, and nuts were major crops; and cereal grains increased in acreage. The value of these crops tripled over the previous decade. Crop rotations consisted of grain followed by clover and then a cultivated crop. The 1920 Census of Agriculture reports a total of 1,761 farms in the county. Farms averaged 136 acres. A number of tractors were reported in use during this period.

In recent years, the total number of farms has decreased, but their size is increasing. The present-day agriculture is quite diversified, and the population centers for marketing farm products are easily reached. The favorable climate and wide variety of soils makes the area well suited to a wide range of

crops. Most of the major crops, such as cereal grains, orchards, and grasses are grown on the low foothills and the main valley terrace. Irrigated vegetable and specialty crops such as peppermint, hops, and sugarbeets, are generally grown on the alluvial bottom lands.

## Climate

The climate of Polk County is greatly tempered by winds from the Pacific Ocean. Summers are fairly warm, but hot days are rare. Winters are cool, but snow and freezing temperatures are not common except at the higher elevations. During summer, rainfall is extremely light, so crops growing actively during this period need irrigation. Often several weeks pass without precipitation. During the rest of the year, rains are frequent, especially late in fall and winter.

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

In winter the average temperature is 40 degrees F., and the average daily minimum is 33 degrees. The lowest temperature on record, -2 degrees, occurred at Dallas on December 11, 1972. In summer the average temperature is 63 degrees F., and the average daily maximum is 77 degrees F. The highest temperature, 106 degrees f., was recorded at Dallas on July 19, 1956.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, 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 in the county (fig. 1), about 15 percent usually falls during the period April through September, which includes the growing season for most crops. Two years in ten, the April-September rainfall is less than 6 inches at Dallas, 7 inches at Falls City, and 16 inches at Valsetz. The heaviest 1-day rainfall during the period of record was 7.90 inches at Valsetz on December 22, 1964. Thunderstorms number about 6 each year, 3 of which occur in summer.

Average seasonal snowfall is 10 inches at Dallas, 19 inches at Falls City, and 20 inches at Valsetz. The greatest snow depth in the county at any one time during the period of record was 41 inches at Valsetz. On the average, 6 days have at least 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night in all seasons, and the average at dawn is about 80 percent. The prevailing direction of the wind is from the south. Average windspeed is highest, 9 miles per hour, in January.

In most winters, one or two storms over the whole county bring strong and sometimes damaging winds, and in some years the accompanying heavy rains cause serious flooding. Every few years, in either winter or summer, a large invasion of a continental air mass from the east causes abnormal temperatures. In winter several consecutive days are well below freezing; in summer a week or longer is sweltering.

## How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. 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; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

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

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

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

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

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

## General soil map for broad land-use planning

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

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

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

### Dominantly deep, somewhat excessively drained to poorly drained soils on bottom lands, terraces, and fans

These soils are on bottom lands of the Willamette River and its tributaries and on terraces and fans. Slopes are mainly 0 to 12 percent. Nearly half of the acreage of these soils is well drained, and the rest is somewhat excessively drained to poorly drained. Flooding is a hazard in many places. Some soils have a seasonal high water table. The average annual precipitation mainly ranges from 40 to 60 inches.

There are three map units in this group. Most of the soils are farmed, and many different crops are grown on some of them.

#### 1. Chehalis-Cloquato-Newberg

*Well drained and somewhat excessively drained silty clay loams, silt loams, and sandy loams*

This map unit consists of silty clay loams, silt loams, and sandy loams that formed in mixed alluvium on bottom lands of major streams. It is traversed by overflow channels and sloughs. Most of the soils are flooded every 3 to 5 years (fig. 2). Slopes are 0 to 3 percent. In areas that are not cultivated, the vegetation is mainly Douglas-fir, bigleaf maple, Oregon white oak, snowberry, blackberry, and grasses. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free season is 165 to 210 days. Elevation is 125 to 300 feet.

This map unit makes up about 3 percent of the county. It is about 45 percent Chehalis soils, 20 percent Cloquato soils, 20 percent Newberg soils, and 15 percent Camas, McBee, Wapato, and Pilchuck soils.

Chehalis soils are well drained. The surface layer is very dark grayish brown silty clay loam. The subsoil is dark brown silty clay loam.

Cloquato soils are well drained. The surface layer is dark brown silt loam. The substratum is brown fine sandy loam.

Newberg soils are somewhat excessively drained. The surface layer is very dark grayish brown sandy loam. The substratum is dark yellowish brown fine sandy loam and loamy fine sand.

Ring-necked pheasant, quail, deer, and other wildlife are abundant on these soils. The wooded areas, rivers, and sloughs provide good habitat for all forms of wildlife. Ducks and geese are common late in fall and in winter.

Soils of this map unit are the most intensively farmed in the county. They are used mainly for small grain, orchards, vegetables, and berries. Irrigation water is available from shallow wells, rivers, and streams. A protective cover crop is needed on these soils in winter when most flooding occurs. Chehalis soils compact easily if worked when wet. The soils of this map unit are easy to work and respond to good management.

These soils are poorly suited as sites for building because of flooding.

The major limitations of these soils are frequent flooding and the erosion caused by floodwaters.

#### 2. Waldo-McAlpin

*Poorly drained and moderately well drained silty clay loams*

This map unit consists of silty clay loams that formed in mixed recent alluvium on bottom lands, terraces, and alluvial fans along tributary streams and rivers (fig. 3).

Slopes are 0 to 7 percent. In areas that are not cultivated, the vegetation is ash, Oregon white oak, roses, snowberry, sedges, rushes, and grasses. The average annual precipitation is 40 to 60 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 250 to 450 feet.

This map unit makes up about 5 percent of the county. It is about 55 percent Waldo soils, 25 percent McAlpin soils, and 20 percent Wapato, Cove, Abiqua, Briedwell, and Coburg soils.

Waldo soils are poorly drained. The surface layer is very dark grayish brown silty clay loam; The subsoil is mottled dark gray silty clay.

McAlpin soils are moderately well drained. The surface layer is dark brown silty clay loam. The subsoil is brown and dark brown silty clay loam and silty clay. Distinct mottles are below a depth of 25 inches.

In areas that have not been farmed, food and cover are suitable for quail, ring-necked pheasant, and deer. Food for this wildlife is plentiful on adjacent cultivated soils.

These soils are used mainly for cereal grain, hay, and pasture. The poorly drained Waldo soils are better suited to hay and pasture. Where adequate outlets are available and drainage is installed, all crops presently grown will benefit.

In some suitable areas of this map unit, ponds have been constructed for irrigation and wildlife.

These soils are not well suited to most community development. Most of these soils are in areas zoned for exclusive farm use; therefore, very little urban development has occurred except within community boundaries and adjacent areas.

The major limitations to use are a high winter water table, flooding, and ponded surface water.

### 3. Cove-Bashaw

*Poorly drained silty clay loams*

This map unit consists of silty clay loams that formed in fine textured recent alluvium on bottom lands of tributary streams of the Willamette River. Slopes are 0 to 12 percent. In areas that are not cultivated, the vegetation is ash, cottonwood, roses, sedges, rushes, and grasses. The average annual precipitation is 40 to 60 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 180 to 400 feet.

This map unit makes up about 3 percent of the survey area. It is about 40 percent Cove soils, 35 percent Bashaw soils, and 25 percent Wapato, Dayton, McAlpin, and Coburg soils.

Cove soils are poorly drained. The surface layer is a very dark brown silty clay loam. The subsoil is black and dark gray clay.

Bashaw soils are poorly drained. The surface layer is black silty clay loam. The underlying layer is very dark gray clay.

In areas that are not cultivated, wildlife that prefer wetlands are plentiful and waterfowl are abundant. Pheasant and quail can find adequate food and cover. In winter, these soils are inundated by overflow from streams and runoff from adjacent terraces.

This map unit is used mainly for hay, pasture, grass seed, and spring grain. These soils do not respond well to tile drainage, and suitable outlets are often not available. Open ditch surface drainage is frequently used.

These soils are poorly suited as sites for roads and buildings.

The major limitations are a high water table in winter, flooding, and ponding.

## Dominantly deep, well drained to poorly drained soils on terraces of the Willamette Valley

These soils are on the terrace plain that forms the floor of the Willamette Valley. They are in areas between alluvial soils of the bottom lands and the foothills of the Coast Range. Elevation is 150 to 650 feet. Slopes are mainly 0 to 3 percent, but in some places slopes are as much as 20 percent. About one-third of the acreage of these soils is well drained, and the rest is moderately well drained to poorly drained. The average annual precipitation ranges from 40 to 60 inches.

Four map units are in this group. Most of the soils are farmed, and many different crops are grown, especially on the well drained and moderately well drained soils.

### 4. Malabon-Coburg

*Well drained and moderately well drained silty clay loams*

This map unit consists of silty clay loams that formed in mixed alluvium on terraces along rivers and major streams. Slopes are 0 to 3 percent. In areas that are not cultivated, the vegetation is Douglas-fir, Oregon white oak, roses, snowberry, poison-oak, and grasses. The average annual precipitation is about 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 200 to 300 feet.

This map unit makes up about 2 percent of the county. It is about 45 percent Malabon soils, 35 percent Coburg soils, and 20 percent Willamette, Woodburn, Chehalis, and Amity soils.

Malabon soils are in higher positions on the landscape. They are well drained. The surface layer is very grayish brown silty clay loam, and the subsoil is dark yellowish brown silty clay.

Coburg soils are in slightly lower positions on the landscape than Malabon soils. They are moderately well drained.

The surface layer is very dark grayish brown silty clay loam. The subsoil is dark brown silty clay. Distinct mottles are at a depth below 20 inches.

Food is plentiful for game birds. Quail, ring-necked pheasant, and other small birds are plentiful. Ducks and geese feed on these soils late in fall and early in winter. Deer are seen occasionally.

These soils are used mainly for cereal grain, grass seed, orchards, pasture, and hay. In areas of these soils that are near rivers or streams, irrigation water is available and vegetable crops and other specialty crops are grown.

Most farms in this map unit are large, and community development on these soils is restricted to farm use by zoning, except where these soils are within community boundaries.

Coburg soils have a seasonal high water table in winter and early in spring. Artificial drainage is needed for the best crop returns. Natural drainageways are available for suitable tile drainage outlets. Malabon and Coburg soils, at lower elevations, are subject to occasional flooding and erosion by floodwaters. These soils compact easily if tilled when wet.

### 5. Dayton-Amity-Concord

*Somewhat poorly drained and poorly drained silt loams*

This map unit consists of silt loams that formed in mixed alluvium on alluvial terraces of the Willamette Valley. Slopes are 0 to 3 percent. In areas that are not cultivated, the vegetation is ash, Oregon white oak, wild rose, blackberry, hawthorn, poison-oak, and grasses. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 150 to 300 feet.

This map unit makes up 6 percent of the survey area. It is about 55 percent Dayton soils, 20 percent Amity soils, 10 percent Concord soils, and 15 percent Holcomb, Coburg, and Woodburn soils.

Dayton soils are slightly below Amity soils on the landscape. They are poorly drained. The surface layer is grayish brown silt loam. The subsoil is mottled grayish brown clay and silty clay.

Amity soils are somewhat poorly drained. The surface layer is dark brown silt loam. The subsoil is mottled brown and dark grayish brown silty clay loam.

Concord soils are in the same position as Dayton soils. They are poorly drained. The surface layer is dark grayish brown silt loam. The subsoil is mottled dark grayish brown silty clay.

Abundant food and cover are available for upland game birds. Quail and pheasant are plentiful in most years. Ducks and geese are common late in fall and in winter.

The soils are used mainly for cereal grain, grass seed, hay, and pasture. During the winter, they have a seasonal water table, and water ponds on the surface of the nearly level soils in periods of high precipitation. Drainage is required for optimum crop production. Amity and Concord soils respond well to tile drainage. Dayton soils are difficult to tile drain efficiently. Suitable outlets are not always available in this map unit.

Most of this map unit is in larger farms and is zoned for exclusive farm use; however, some areas are within community boundaries.

Water for irrigation is difficult to obtain in summer. Because of low relief, these soils are poorly suited for pond sites.

These soils have major limitations for community and recreation uses. The main limitation is a seasonal high water table in winter and early in spring.

### 6. Woodburn-Willamette

*Moderately well drained and well drained silt loams*

This map unit consists of silt loams that formed in mixed alluvium on terraces in the Willamette Valley. Slopes are 0 to 12 percent. In areas that are not cultivated, the vegetation is Douglas-fir, Oregon white oak, wild rose, poison-oak, and grasses. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 150 to 300 feet.

This map unit makes up 8 percent of the county. It is about 60 percent Woodburn soils, 15 percent Willamette soils, and 25 percent Amity, Holcomb, Helvetia, Malabon and Santiam soils and Xerochrepts and Haploxerolls.

Woodburn soils are moderately well drained. The surface layer is very dark grayish brown silt loam. The subsoil is dark brown silty clay loam. Distinct mottles are at a depth below 20 to 30 inches.

Willamette soils are well drained. The surface layer is very dark grayish brown silt loam. The subsoil is dark yellowish brown silt loam and dark brown silty clay loam.

Abundant food and cover are available for ring-necked pheasants, quail, doves, and other small birds. Geese that spend the winter in the Willamette Valley feed extensively on these soils.

Most of these soils are in large farms. These soils are used mainly for cereal grain, grass seed, orchards, hay, and pasture. Woodburn soils respond very well to tile drainage, and drainage outlets are available in most areas. Obtaining water for irrigation is a limitation to vegetable and specialty crops. In some suitable areas, ponds have been constructed and are used for irrigation.

These soils are well suited to most community development and recreation uses. Most areas of these soils are zoned for exclusive farm use, however, and very little urban development has occurred except within community boundaries and adjacent areas.

The major limitations are the hazard of erosion and the seasonal high water table in winter on most of the soils.

### 7. Salkum-Briedwell

*Well drained silty clay loams and silt loams*

This map unit consists of silty clay loams and silt loams that formed in gravelly alluvium on terraces along the margins of the foothills above major streams and rivers. Slopes are 0 to 20 percent. In areas that are not cultivated, the vegetation consists of Oregon white oak, Douglas-fir, poison-oak, snowberry, wild rose, and grasses. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 350 to 650 feet.

This map unit makes up about 2 percent of the county. It is about 50 percent Salkum soils, 30 percent Briedwell soils, and 20 percent Abiqua, Malabon, McAlpin, Coburg, and Santiam soils and Xerochrepts and Haploxerolls.

Salkum soils are well drained. The surface layer is a dark reddish brown silty clay loam. The subsoil is reddish brown silty clay. The substratum is yellowish red partly weathered gravel.

Briedwell soils are well drained. The surface layer is dark brown silt loam. The subsoil is dark brown and brown gravelly and very gravelly clay loam. The substratum is reddish brown very gravelly loam (fig. 4).

Quail, ring-necked pheasant, and other small birds and animals are plentiful on this map unit. A few deer are present. The gravelly substratum of these soils is a limitation to ponds.

These soils are used mainly for cereal grain, orchards, grass seed, hay, and pasture. Some areas have been subdivided into small acreage tracts.

These soils generally are suited to homesites. Domestic water supply from wells is limited. Where this map unit is included within and adjacent to community boundaries, much urban development has occurred.

These soils are used mainly for farming, recreation, and community development. The major limitation is the hazard of erosion on steeper slopes.

## Dominantly deep, poorly drained and well drained soils on bottom lands and valley terraces of the Coast Range

These soils are on alluvial bottoms and valley terraces of the Coast Range. Elevation is 350 to 1,200 feet. Slopes are mainly 0 to 7 percent. Nearly two-thirds of the acreage of these soils is poorly drained, and the rest is well drained. The average annual precipitation ranges from 70 to 130 inches.

One These soils are on alluvial bottoms and valley terraces of the Coast map unit is in this group. Most of the soils are used for woodland.

### 8. Brenner-Knappa

*Poorly drained and well drained silt loams*

This map unit consists of silt loams that formed in mixed alluvium on bottom lands and on terraces in the tributary valleys of the Coast Range. In areas that are not cultivated, the vegetation is alder, Douglas-fir, swordfern, brackenfern, and vine maple. The average annual precipitation is 70 to 130 inches, the average annual air temperature is 48 to 53 degrees F, and the frost-free season is 145 to 200 days. Elevation is 350 to 1,200 feet.

This map unit makes up about 1 percent of the county. It is about 65 percent Brenner soils, 30 percent Knappa soils, and 5 percent Xerofluvents.

Brenner soils are on alluvial bottom lands. They are poorly drained. The surface layer is very dark brown silt loam. The subsoil is mottled light gray silty clay.

Knappa soils are on terraces and are higher than Brenner soils. They are well drained. The surface layer is very dark grayish brown silt loam. The subsoil is dark brown and yellowish brown silty clay loam.

Blue grouse, ruffed grouse, and black-tailed deer are numerous, but bear and rabbit are few on this map unit. Fishing is good in the rivers and streams. Parts of this map unit offer good potential for recreation.

Most of the moisture in winter is rain; occasional snowfalls occur, but last only for short periods. Watersupplying capacity is high.

Knappa soils are used dominantly for timber production. The poorly drained Brenner soils support stands of alder, shrubs, rushes, and grasses. The major limitations of Brenner soils are the seasonal high water table and flooding. Knappa soils have only minor limitations for most uses.

In this map unit, Knappa soils are used mainly for Douglas-fir. Brenner soils are not suited to conifers, but Western red alder is occasionally harvested.

Knappa soils are well suited and Brenner soils are poorly suited as sites for roads and buildings.

## Dominantly shallow to deep, well drained to somewhat poorly drained soils on foothills and uplands

These soils are on foothills and uplands along the Willamette Valley and merge into the mountainous Coast Range. Most of these soils have a clayey horizon below the surface layer. Drainage is poor to good. Below these soils is sedimentary rock or basalt bedrock. Slopes are mainly 2 to 75 percent, and are less than 30 percent in about half of the acreage. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches.

Three map units are in this group. The soils are used mainly for farming and woodland. Douglas-fir and Oregon white oak are the dominant trees.

**9. Heim Imick-Steiwer-Hazelair**

*Deep and moderately deep, well drained to somewhat poorly drained silt loams*

This map unit consists of silt loams that formed in colluvium weathered from sedimentary rock. This map unit is on the low foothills that border the Willamette Valley terraces. Slopes are 3 to 50 percent. In areas that are not cultivated, the vegetation consists of Oregon white oak, poison-oak, wild rose, snowberry, grasses, and forbs. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 49 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 250 to 400 feet.

This map unit makes up about 7 percent of the county. It is about 40 percent Helmick soils, 20 percent Steiwer soils, 15 percent Hazelair soils, and 25 percent Chehulpum, Willakenzie, Bellpine, Salkum, and Suver soils.

Helmick soils are deep and somewhat poorly drained. The surface layer is dark brown silt loam. The subsoil is dark brown silty clay. The substratum is mottled gray clay.

Steiwer soils are moderately deep over sedimentary bedrock and are well drained. The surface layer is very dark grayish brown silt loam. The subsoil is dark brown silty clay loam.

Hazelair soils are moderately deep over sedimentary bedrock and are moderately well drained to somewhat poorly drained. The surface layer is very dark grayish brown silt loam. The subsoil is very dark grayish brown silty clay loam. The substratum is mottled grayish brown clay (fig. 5).

Quail, ring-necked pheasant, doves, and other small game birds and animals are plentiful. Seed and grain crops provide an excellent source of feed. The trees and shrubs in uncultivated areas furnish suitable cover for wildlife. Deer are seen occasionally.

Soils in this map unit are used principally for cereal grain, hay, and pasture. Douglas-fir is not well suited to most of these soils. Many ponds have been constructed for limited irrigation, livestock watering, and wildlife. The soils are also used for recreation and water supply.

Most of these soils have major limitations for homesites, roads and trails because of impeded drainage and the clayey subsoil. Ground water for domestic water supply is very limited. Other limitations are the steep slopes, hazard of erosion, and shallowness of the soils.

**10. Bellpine-Suver-Rickreall**

*Moderately deep, deep, and shallow, well drained to somewhat poorly drained silty clay loams*

This map unit consists of silty clay loams that formed in colluvium weathered from sedimentary rock. It is on the low, rolling foothills on relatively stable landscape that borders the Willamette Valley. Slopes are 3 to 75 percent. In areas that are not cultivated, the vegetation consists of Oregon white oak, Douglas-fir, poison-oak, snowberry, wild rose, and grasses. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free season is 165 to 210 days. Elevation is 275 to 800 feet.

This map unit makes up about 12 percent of the county. It is about 50 percent Bellpine soils, 15 percent Suver soils, 10 percent Rickreall soils, and 25 percent Hazelair, Helmick, Dupee, Steiwer, and Willakenzie soils.

Bellpine soils are moderately deep over sedimentary bedrock and are well drained. The surface layer is dark reddish brown silty clay loam. The subsoil is dark reddish brown and yellowish red clay.

Suver soils are deep over sedimentary bedrock and are somewhat poorly drained. The surface layer is dark brown silty clay loam. The subsoil is reddish brown clay. The substratum is olive gray and pale brown clay. Weathered bedrock is at a depth below 42 inches.

Rickreall soils are shallow over sedimentary bedrock and are well drained. The surface layer is dark reddish brown silty clay loam. The subsoil is a yellowish red and reddish brown clay. Weathered bedrock is at a depth below 17 inches.

Quail, ring-necked pheasants, and other small birds and animals are plentiful. Wildlife can find abundant food and cover in this map unit. Deer are seen occasionally. Some ponds provide limited habitat for waterfowl.

These soils are used mainly for cereal grain, grass seed, hay, and pasture. Some areas of this map unit have been subdivided into small tracts. Domestic water supply from wells in these areas is very limited.

These soils generally have severe limitations for homesites. Some areas are suitable for small ponds for irrigation, livestock water, and wildlife.

The major limitations are the steep slopes, hazard of erosion, and drainage characteristics of some of the soils.

**11. Jory-Nekia**

*Deep and moderately deep, well drained silty clay loams*

This map unit consists of silty clay loams that formed in colluvium weathered from basic igneous rock on foothills and uplands above the margin of the Willamette Valley. Slopes range from 2 to 50 percent. In areas that are not cultivated, the native vegetation is mainly Oregon white oak, Douglas-fir, and bigleaf maple. Poison-oak, wild rose, snowberry, trailing blackberry, and grasses are the principal understory species. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 49 to 54 degrees F, and the frost-free season is 165 to 200 days. Elevation is 250 to 1,200 feet.

This map unit makes up about 8 percent of the county. It is about 50 percent Jory soils, 30 percent Nekia soils, and 20 percent Ritner, Witzel, Bellpine, and Steiwer soils.

Jory soils are deep and well drained. The surface layer is dark reddish brown silty clay loam. The subsoil is reddish brown clay.

Nekia soils are moderately deep over bedrock and well drained. The surface layer is dark reddish brown silty clay loam. The subsoil is dark reddish brown clay. Fractured basalt is at a depth below 25 inches.

Quail, ring-necked pheasant, and other small birds are plentiful. Seed and grain crops provide an excellent source of feed. The trees and shrubs in uncultivated areas furnish excellent cover for wildlife. Deer are seen occasionally.

These soils are used mainly for cereal grain, orchards, hay, pasture, and woodland. Many areas have been subdivided for homesites and small-acreage hobby farms; however, domestic water supply from wells is limited in much of these areas. Some areas are suitable for small ponds for irrigation, livestock watering, and wildlife.

The major limitations are the steep slopes, hazard of erosion, and shallowness of the soils.

### Dominantly deep and moderately deep, well drained soils on mountainous uplands

These soils are in the western part of Polk County, mainly on broad ridges and long, steep slopes dissected by numerous streams. In more than half of the acreage, slope is more than 25 percent. Elevation is 700 to 2,600 feet. The average annual precipitation is 60 to 130 inches. Erosion is a major hazard.

Four map units are in this group. These soils mainly are used for timber. Douglas-fir is the principal tree species. Because of high precipitation, the soils are a major source of water supply.

### 12. Peavine-Honeygrove-McDuff

*Deep and moderately deep, well drained silty clay loams*

This map unit consists of silty clay loams that formed in colluvium weathered from sedimentary rock. This map unit generally is on broad, low ridges that have moderately steep to very steep mountain side slopes in the Coast Range. Slopes range from 2 to 75 percent. Douglas-fir, hemlock, and western redcedar are the main trees, and there are alders in drainageways and on lower slopes. The understory is salal, brackenfern, oceanspray, vine maple, and hazelnut. The average annual precipitation is 60 to 90 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free season is 160 to 210 days. Elevation is 700 to 1,400 feet.

This map unit makes up about 8 percent of the county. It is about 35 percent Peavine soils, 25 percent Honeygrove soils, 25 percent McDuff soils, and 15 percent Blachly, Kilowan, Apt, Klickitat, and Cumley soils,

Peavine soils are moderately deep and well drained. The surface layer is dark brown silty clay loam. The subsoil is yellowish red silty clay. Weathered bedrock is at a depth below 30 inches.

Honeygrove soils are deep and well drained. The surface layer is dark reddish brown silty clay loam. The subsoil is reddish brown and yellowish red clay and silty clay.

McDuff soils are moderately deep and well drained. The surface layer is very dark brown silty clay loam. The subsoil is dark brown and dark yellowish brown silty clay. Weathered bedrock is at a depth below 38 inches.

These soils are used for timber production. They have a high potential for timber production if forest management is good. Most of this map unit is in large tracts owned by private timber companies and the Federal government.

None of these soils are used -for cultivated crops. The nights are cool enough to delay the maturing of crops before the fall rains.

Deer and grouse are plentiful in this map unit. Fishing is good in the streams and rivers. This map unit has an excellent network of roads and is easily accessible. Areas of this map unit are often closed to the public if the potential for forest fires is high.

Some moisture that falls in the winter is snow, which melts within a short period. The water-supplying capacity of the soils is high.

Suitable rock for road construction is not abundant in this map unit. Roads are difficult to build on the Peavine and McDuff soils. The need for road-base stabilization is high on Honeygrove soils.

The major limitations are the steep slopes, hazard of erosion, and trafficability concerns.

### 13. Blachly-Kilowan

*Deep and moderately deep, well drained silty clay loams and gravelly silty clay loams*

This map unit consists of deep and moderately deep silty clay loams that formed in mixed material weathered from sedimentary and basic igneous rock. It is on broad, undulating uplands and steep side sloes of mountains in the Coast Range. Slopes range from 3 to 75 percent. The natural vegetation is Douglas-fir, hemlock, and western red cedar. Alder is on lower side slopes and in drainageways. The understory is vine maple, sword fern, salal, brackenfern, and trailing blackberry. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free season is 160 to 200 days. Elevation is 700 to 1,400 feet.

This map unit makes up about 4 percent of the county. It is about 60 percent Blachly soils, 30 percent Kilowan soils, and 10 percent Klickitat, Hembre, and Marty soils.

Blachly soils are deep and well drained. The surface layer is dark reddish brown silty clay loam. The subsoil is reddish brown silty clay.

Kilowan soils are moderately deep over weathered sedimentary bedrock and are well drained. The surface layer is dark reddish brown gravelly silty clay loam. The subsoil is yellowish red silty clay. Weathered bedrock is at a depth below 24 inches.

These soils have moderate to high potential for timber production if forest management is good. Most of this map unit is in large tracts owned by private timber companies or by the Federal government.

The soils are covered with snow for brief periods in winter. None of this acreage is well suited to cultivated crops. The nights are cool enough that crops do not generally mature before the end of the growing season.

Deer and grouse are common, but bear and rabbits are few in this map unit. Fishing is good in the streams and rivers of the map unit. The potential for the development of recreational facilities is good.

Much of the moisture that falls in winter is snow, which does not accumulate for any appreciable time. Water supplying capacity of these soils is high.

Suitable rock for road construction is scarce in this map unit. Roads are costly to build on the Kilowan soils. The need for road base stabilization is high on the Blachly soils because they are often subject to slumping.

These soils are used primarily for timber production, water supply, and recreation. The major limitations are the steep slopes, hazard of erosion, and trafficability concerns.

### 14. Bohannon-Astoria

*Moderately deep and deep, well drained gravelly loams and silt loams*

This map unit consists of moderately deep gravelly loams and deep silt loams that formed in material weathered from sedimentary rock. It is on narrow to wide, moderately sloping ridges and very steep dissected side slopes in the Coast Range. Slopes range from 3 to 75 percent. Douglas-fir, hemlock, and western red cedar are the main trees, and these are alders in drainage ways and on lower side slopes. The understory is vine maple, swordfern, salal, trailing blackberry, oxalis, and Oregongrape. The average annual precipitation is 80 to 130 inches, the average annual air temperature is 47 to 55 degrees F, and the frost-free season is 145 to 200 days. Elevation is 800 to 1,200 feet.

This map unit makes up about 8 percent of the county. It is about 60 percent Bohannon soils, 30 percent Astoria soils, and 10 percent Slickrock, Trask, and Blachly soils.

Bohannon soils are moderately deep over sedimentary bedrock and are well drained. The surface layer is very dark grayish brown gravelly loam. The subsoil is dark yellowish brown gravelly clay loam. Weathered bedrock is at a depth below 34 inches.

Astoria soils are deep and well drained. The surface layer is very dark brown silt loam. The subsoil is yellowish brown silty clay.

The soils in this map unit have moderate to high potential for timber production if forest management is good. Astoria soils are one of the better timber producing soils of the county. Most of this map unit is in large tracts owned by private timber companies or by the Federal government.

The soils of this map unit are covered with snow for brief periods in winter. None of this acreage is well suited to cultivated crops. The nights are so cool that crops do not generally mature before the end of the growing season.

Deer and grouse are common in this map unit. There are a few bear and rabbits. Fishing is good in the streams and rivers of the unit. This map unit offers good potential for the development of recreational facilities.

Much of the moisture that falls in the winter is snow, which does not accumulate for any appreciable time. Water-supplying capacity of these soils is high.

Suitable rock for road construction is scarce in this map unit. Roads are costly to build on the steep Bohannon soils. The need for road base stabilization is high on Astoria soils because they are often subject to slumping.

These soils are used mainly for timber production, water supply, and recreation. The major limitations are the steep slopes and trafficability.

### 15. Kiichis-Klickitat

*Shallow and deep, well drained stony loams and gravelly clay loams*

This map unit consists of shallow stony loams and deep gravelly clay loams that formed in material derived from mixed igneous rock. The moderately sloping soils are on broad to narrow ridges, and the steep soils are on dissected side slopes and canyon walls that extend abruptly to stream bottoms. Slopes range from 3 to 90 percent. None of these soils are cultivated. Douglas-fir, western hemlock, and bigleaf maple are the main trees, and there are alders in drainageways. The understory consists of salal, vine maple, Oregon-grape, trailing blackberry, and fern. The average annual precipitation is 60 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free season is 145 to 210 days. Elevation is 1,100 to 2,600 feet.

This map unit makes up about 11 percent of the county. It is 50 percent Kilchis soils, 40 percent Klickitat soils, and 10 percent well drained Honeygrove, Hembre, and Peavine soils and Rock outcrop.

Kilchis soils are shallow over basic igneous bedrock and are well drained. The surface layer is dark reddish brown stony loam. The subsoil is dark reddish brown very gravelly loam. Bedrock is at a depth of 15 inches.

Klickitat soils are deep. The surface layer is dark reddish brown gravelly clay loam. The subsoil is reddish brown very gravelly clay loam. Fractured basalt is at a depth of 42 inches.

The soils have low to moderate potential for timber production if forest management is good. Regeneration of Douglas-fir may be difficult on south-facing Kilchis soils. The soils are mainly timbered. They are generally too steep or stony to be cultivated. The nights are generally too cool for a crop to mature before the fall rains.

Deer are common in this map unit, and grouse are plentiful. Fishing is good in the streams and rivers of the map unit. Snowfall occurs throughout the winter but does not accumulate for extensive periods.

The supply of rock for road construction is abundant in this map unit. Steep slopes, depth to bedrock, rock outcrop, and large stones make road construction difficult and costly.

The soils are used mainly for timber production, recreation, and water supply. The main limitations are steep slopes and the hazard of erosion.

### Dominantly moderately deep and shallow, well drained, cold soils on mountainous uplands

These soils are at the higher, mountainous elevations on peaks and ridges at the summit of the Coast Range. They are mostly broad, smooth, moderately sloping ridges that have prominent peaks that rise abruptly from the surrounding landscape. They are incised by steep side slopes and canyon walls that have been dissected by streams and rivers. In more than 60 percent of the acreage, slopes are more than 50 percent. The average annual precipitation is 90 to 180 inches. Erosion is a major hazard. This area is covered with snow for long periods in winter.

One map unit is in this group. It is used for timber production. Douglas-fir and hemlock are the main trees. Some noble fir are used for lumber. Because of - high precipitation, the soils are a major source of water supply.

### 16. Valsetz-Luckiamute

*Moderately deep and shallow, well drained stony loams and very shaly loams*

This map unit consists of stony loams and very shaly loams that formed in residuum and colluvium weathered from coarse grained igneous rock and siltstone. It consists mainly of broad ridges and steep dissected side slopes and canyon walls that occur at higher elevations in the Coast Range. Slopes range from 3 to 90 percent. The major trees are Douglas-fir, hemlock, and noble fir. The understory consists of salal, rhododendron, blue huckleberry, beargrass, and fern. The average annual precipitation is 90 to 180 inches, the average annual air temperature is 41 to 45 degrees F, and the frost-free season is 80 to 110 days. Elevation is 1,900 to 3,700 feet.

This map unit makes up about 12 percent of the county. It is about 60 percent Valsetz soils, 20 percent Luckiamute soils, and 20 percent Lurnick, Cruiser, and Yellowstone soils and Rock outcrop.

Valsetz soils are moderately deep over fractured, coarse grained igneous rock. The surface layer is dark reddish brown stony loam. The subsoil is reddish brown and strong brown very gravelly loam. Fractured bedrock is at a depth below 24 inches.

Luckiamute soils are shallow over fractured shale. The surface layer is brown very shaly loam. The subsoil is brown very shaly clay loam. Fractured shale is at a depth of 16 inches, and consolidated bedrock is at a depth of about 35 inches.

These soils have moderate potential for timber production if forest management is good. All of this map unit is in large tracts owned by timber companies or the Federal government.

These soils are covered with snow a major part of the winter. None of this acreage is cultivated. The soils are too stony and steep and the frost-free season is too short for cultivated crops.

Deer, bear, grouse, and other wildlife are common in this map unit. Heavy snowfall in winter months forces deer into lower elevations. Most of this map unit is accessible in spring and summer. The streams provide fair fishing in spring and early in summer.

The supply of rock for road construction is abundant. The steep slopes and depth to bedrock make road construction difficult and costly.

These soils are used mainly for timber production, recreation, and water supply. The principal limitations are the steep slopes and hazard of erosion.

### Broad land-use considerations

The map units vary widely because of the diversity of climate, vegetation, topography, and geological parent material in Polk County. The variations result in many different soil characteristics that create many different management needs and limitations and determine the suitability of soils for specific uses.

Four major land resource areas are in the county: the alluvial flood plains, valley terraces, foothills, and the mountainous Coast Range. Within each, the soils are widely contrasting in their properties and suitability for specific uses. A knowledge of these properties is essential to determine how soils can best be managed and used.

The potential of the soils of Polk County for increased crop production is great. Crops could be increased by using the present-day production technology under favorable economic conditions for the farmers.

The productive capacity could be increased on about 20,000 acres of hilly land that is presently in stands of Oregon white oak and unimproved pasture. Fertilizing and seeding these

areas to improved varieties of grasses and legumes and cropping the gently sloping to moderately sloping areas to annual crops would increase financial return and production. About 25,000 acres of poorly drained soils could be more intensely cropped if drainage were improved. The acreage in the county that has been returned to annual crops has increased in the past few years because the prices for grain crops are more favorable.

It is estimated that about 500 acres a year are now being converted to built-up areas and urban use. The use of this soil survey can assist in making sound, long-range land-use decisions and applying the latest technology.

Flooding and the resulting erosion from floodwaters are the greatest hazards for the soils on the alluvial bottoms along rivers and streams. These are the most intensively farmed soils in the county. They are used for irrigated specialty crops, such as beans and corn for canning, vegetable seed, berries, and orchards. Chehalis, Newberg, Cloquato, McBee, and the poorly drained Wapato soils are in this area. Abiqua, McAlpin, Waldo, Cove, and Bashaw soils in the tributary valleys are subject to overflow for only brief periods and the erosion is only slight during these floods. Winter cover crops are effective in controlling erosion on these soils.

Some of the soils on broad valley terraces are Willamette, Woodburn, Malabon, and Coburg soils which are presently used for cereal grain, orchards, hay, and pasture. Willamette and Woodburn soils that have slopes of more than 3 percent are subject to moderate erosion unless cross-slope tillage, crop rotation, and winter cover crops are used. Amity, Holcomb, Concord, and Dayton soils are nearly level. Runoff is slow, and the hazard of erosion is slight. These soils require drainage for optimum production, however, and in many cases suitable drainage outlets are not available. They are presently used mainly for small grain, grass seed, and pasture.

The short and irregular slopes and ownership boundaries in the foothills make contour farming very difficult, in most cases, on Bellpine, Willakenzie, Steiwer, Hazelair, Helmick, Suver, Nekia, and Jory soils. These soils range from gently sloping to steep. Winter cover crops, crop residues, crop rotation of grasses and legumes, and grassed waterways improve infiltration rates and reduce the hazard of erosion. These soils are used mainly for cereal grain, grass seed, orchards, hay, and pasture.

Drainage is a major management need on about 25 percent of the soils used for crops. Some hilly soils that are somewhat poorly drained are Hazelair, Helmick, and Suver soils. Unless artificially drained, the somewhat poorly drained to poorly drained soils are limited to a narrow range of crops.

The timbered soils in the very steep hilly and mountainous areas are not cultivated, but are used for timber production. Many of these soils are steep, shallow, or stony, and cool nights delay the maturing of cultivated crops. Soils typical to these areas are Klickitat, Hembre, Blachly, Honeygrove, Peavine, Astoria, Bohannon, and Valsetz soils. Non-vegetated logging roads and skid trails and slips and slides on road cuts and fills in the forested areas cause runoff to carry a large load of sediment into rivers and streams. Forested areas are now being intensively managed for optimum yield of timber. Restocking of cutover areas, pre-commercial and commercial thinning, control of competing vegetation, and the use of higher quality tree stock are some practices that insure higher yields of Douglas-fir.

Recreation facilities are available on most soils of the county, Some areas are private, but many areas are open to the public. Facilities include camp areas, picnic grounds, parks, golf courses, paths and trails, and hunting areas.

Many new urban developments are being built, mostly adjacent to communities that have access to sewer, water, and other community services. Some home sites are being developed on small acreage in the rural areas. Soil limitations for home sites and septic tank absorption fields, as well as zoning problems, limit the development of these small tracts.

The potential for wildlife is good in Polk County. The principal species in the county are ring-necked pheasant, quail, dove, duck, geese, and black-tailed deer. Small animals and songbirds are abundant.

The population of many species of wildlife is related to use of the soil, which is influenced by topography and the kinds of plants. Wildlife is generally more abundant and larger and their rate of production is higher on fertile soils than on poor soils.

## Soil maps for detailed planning

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

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

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

This survey was mapped at two levels of detail. At the most detailed level, map units are narrowly defined. This means that soil boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Soil boundaries were plotted and verified at wider intervals. The broadly defined units are indicated by an asterisk in the soil map legend. The detail of mapping was selected to meet the anticipated long-term use of the survey, and the map units were designed to meet the needs for that use.

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

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Woodburn silt loam, 0 to 3 percent slopes, is one of several phases within the Woodburn series.

Some map units are made up of two or more dominant kinds of soil. One such unit is called a soil complex.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Chehulpum-Steiwer complex, 12 to 40 percent slopes, is an example.

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

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas;* they are delineated on the soil map and given descriptive names. Rock outcrop is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map (26).

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

## Soil descriptions

**1A-Abiqua silty clay loam, 0 to 3 percent slopes.** This well drained soil is on broad, alluvial stream terraces along tributary streams of the Willamette River. It formed in silty and clayey mixed alluvium. Slopes average about 2 percent. Elevation is 275 to 400 feet. The average annual precipitation is 40 to 60 inches, the average air temperature is 50 to 54 degrees F, and the frost free period is about 165 to 190 days.

In a representative profile, the surface layer is very dark brown silty clay loam about 15 inches thick. The upper 10 inches of the subsoil is very dark brown silty clay loam, and the lower 35 inches is brown silty clay.

Included with this soil in mapping are areas of McAlpin and Briedwell soils, which make up about 5 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for cereal grain, grass seed, hay, pasture, and orchards. Properly managing crop residues and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to maintain favorable fertility and workability of the soil.

Small grain and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

Water can be applied by means of furrow, border, or sprinkler irrigation, but sprinkler irrigation is most commonly used. Water from streams is generally available for irrigation.

Very few commercial stands of timber are on this soil. The soil is well suited to Christmas tree production.

The wide variety of grains, grasses, legumes, and orchards on this soil furnishes good cover and food for ring-necked pheasant, California quail, bobwhite quail, and mourning doves. If the cover is sufficient on this soil, black-tailed deer are permanent residents. Ducks and geese also feed in areas that are close to water. Grouse, band-tailed pigeons, and mountain quail are not common. Roadway planting, grassed waterways, and preservation of fence rows, woodlots, and brushy areas improve the cover and food for wildlife.

This soil has some limitations for home sites and commercial buildings because of low strength and shrink-swell potential. It has some limitations for septic tank absorption fields because of the moderately slow permeability. The major limitation for

local roads and streets is low strength. Some areas of this soil are connected to community water and sewage systems.

This soil is in capability class I.

**1B-Abiqua silty clay loam, 3 to 5 percent slopes.** This well drained soil is on stream terraces and fans above the flood plain. It formed in silty and clayey mixed alluvium. Slopes average about 4 percent. Elevation is 275 to 400 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 190 days.

In a representative profile, the surface layer is very dark brown silty clay loam about 15 inches thick. The upper 10 inches of the subsoil is very dark brown silty clay loam, and the lower 35 inches is brown silty clay.

Included with this soil in mapping are areas of McAlpin and Briedwell soils, which make up about 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

This soil is used mainly for grass seed, cereal grain, orchards, and forage crops. Properly managing crop residues and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to maintain soil fertility and workability.

Small grain and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

The soil is irrigated by sprinklers. Irrigation increases the hazard of erosion, and water should be applied care fully at rates low enough to control runoff and erosion. Water for irrigation is available from dams and streams in some places.

Very few commercial stands of timber are on this soil. The soil is moderately well suited to Christmas tree production.

The wide variety of grains, grasses, legumes, orchards, shrubs, and trees on this soil furnish good feed and cover for ring-necked pheasant, valley quail, bobwhite quail, and mourning doves. If the cover is sufficient on this soil, black-tailed deer are permanent residents. Ducks and geese also feed in areas that are close to water. Grouse, band-tailed pigeons, and the mountain quail are not common.

Roadway planting, grassed waterways, and preservation of fence rows, wood lots, and brushy areas improve cover and food for wildlife. This soil has numerous drainage ways that are often suitable for small ponds, many of which can be managed for game fish. Water from streams is available most of the year, but most small ditches and streams are dry late in summer. Burning fields and fence rows destroys both cover and food for wildlife.

Increased population growth in the county has resulted in increased construction of home sites on this soil. The primary limitations for community development are shrink-swell potential and the limited ability to support a load. Dwelling and road construction can be designed to offset the latter limitation. Slope and moderately slow permeability restrict the use of septic tank absorption fields in some areas. Some areas are connected to community water and sewage systems.

This soil is in capability subclass IIe.

**2-Abiqua silty clay loam, occasionally flooded, 0 to 3 percent slopes.** This well drained soil is on broad bottom lands. It formed in silty and clayey mixed alluvium. Slopes average 2 percent. Elevation is 275 to 400 feet. This soil is subject to overflow once every 50 years. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 190 days.

In a representative profile, the surface layer is very dark brown silty clay loam about 15 inches thick. The upper 10 inches of the subsoil is dark brown silty clay loam, and the lower 35 inches is brown silty clay.

Included with this soil in mapping are areas of McAlpin, Chehalis, and Briedwell soils, which make up as much as 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight except during flooding.

This soil is used mainly for cereal grain, grass seed, hay, pasture, vegetable, and specialty crops. Properly managing crop residue and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to maintain favorable fertility and workability. The hazard of erosion from floodwater can be reduced by planting winter cover crops.

Small grain and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

Water can be applied by means of furrow, border, or sprinkler irrigation, but sprinkler irrigation is most commonly used. Water from streams generally is available for irrigation.

No commercial stands of timber are on this soil. The soil is not well suited to Christmas tree production because of the hazard of flooding.

The wide variety of grains, legumes, and orchards on this soil furnish good cover and food for ring-necked pheasant, valley quail, bobwhite quail, and mourning doves. If cover is sufficient on this soil, black-tailed deer are permanent residents. Ducks and geese also feed in areas that are close to water. Grouse,

band-tailed pigeons, and mountain quail are not common. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along roadways, using grassed waterways, and preserving fence row, wood lots, and brushy areas improve the cover and food for wildlife.

This soil is limited for use as home sites and commercial buildings because of low strength and shrink-swell potential. It is limited for septic tank absorption fields because of the moderately slow permeability. Local roads and streets are limited by low strength. Some areas of this soil are connected to community water and sewage systems. The hazard of flooding is a major limitation.

This soil is in capability subclass llw.

**3-Amity silt loam.** This somewhat poorly drained soil is on terraces of the Willamette River and its major tributaries. It formed in mixed silty alluvium. Slopes are 0 to 3 percent and average about 2 percent. Elevation is 170 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam about 16 inches thick. The subsurface layer is dark grayish brown, mottled heavy silt loam about 9 inches thick. The subsoil is brown and dark grayish brown, mottled silty clay loam about 23 inches thick. The substratum is olive brown, mottled silty clay loam that extends to a depth of 63 inches or more.

Included with this soil in mapping are areas of Woodburn, Holcomb, Concord, and Dayton soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 9 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 6 to 18 inches in winter and spring.

This soil is used for small grain, hay, pasture, and grass seed. Drained areas are suited to a wider range of crops. Irrigated areas are used for pole beans, corn; and other row crops. Returning all crop residues to the soil and using a cropping system in which grasses, legumes, or grass and legume mixtures are grown at least 25 percent of the time help to maintain fertility and tilth. Small grain and grasses respond to nitrogen; row crops commonly respond to nitrogen; and phosphorus and legumes respond to phosphorus, sulfur, and lime.

The soil is irrigated by sprinkler, furrow, or border irrigation, and sprinklers mainly are used. Irrigation water needs to be applied carefully at rates low enough to prevent runoff. Adequate water for irrigation can generally be obtained from wells.

Drainage is the major concern, but if outlets are available the soil responds readily to open or closed drainage systems. The soil generally requires improved outlets to increase the subsurface drainage and lower the seasonal high water table. For maximum use and production, the soil needs a drainage pattern.

This soil is poorly suited to commercial timber production.

The natural vegetation is grass, shrubs, and scattered Oregon white oak. A seasonal high water table limits the use of this soil to ducks and geese late in fall, in winter, and early in spring. Seeds and tubers from water plants and crop residues are food for waterfowl. The rest of the year, ring-necked pheasant, valley quail, bobwhite quail, mourning doves, and black-tailed deer move into this area for food and cover. This soil is used by some fur-bearing animals.

This soil has some limitations for roads and streets and major limitations for home sites, commercial buildings, and other community uses because of the seasonal high water table.

This soil is in capability subclass llw.

**4D-Apt silty clay loam, 3 to 25 percent slopes.** This well drained soil is on mountainous, lower side slopes of the Coast Range. It formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 15 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 120 inches, the average annual air temperature is 48 to 52 degrees F, and the frost-free period is 160 to 190 days.

In a representative profile, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is dark yellowish brown silty clay about 58 inches thick. Fractured siltstone is at a depth of 66 inches.

Included with this soil in mapping are areas of Honeygrove, Peavine, Cumley, and Astoria soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 7.5 to 10 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for timber production. Other uses are water supply and wildlife habitat. The soil is well suited to the production of Douglas-fir. Red alder is common. The site index for Douglas-fir on this soil ranges from 155 to 180, and the average site index is about 165. Based on the average site index, this soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic; this limits trafficability. It is severely compacted by equipment. Cable logging is desirable because tractor logging causes excessive disturbance. Roads and landings may need to be protected from erosion by water bars

and seeded road cuts and fills. Roads require a maximum of base rock for all-season use.

Plant competition is severe. Grass, brush, and fern competition is especially difficult to control in non-stocked cutover areas. The danger of seedling mortality is low. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. The hazard of windthrow is minimal.

Douglas-fir, hazel, bigleaf maple, red alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use areas of the soil for food and cover. Numerous draws and drainage ways are available for small ponds. Except for a few major creeks and springs, the drainage ways are dry late in summer.

The slope is the major limitation to home sites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**4E-Apt silty clay loam, 25 to 50 percent slopes.** This well drained soil is on mountainous lower side slopes of the Coast Range. It formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 35 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 80 inches, the average annual air temperature is 48 to 52 degrees F, and the frost-free period is 160 to 190 days.

In a representative profile, the surface layer is dark brown silty clay loam about 8 inches thick. The subsoil is dark yellowish brown silty clay, about 58 inches thick. Siltstone is at a depth of 66 inches.

Included with this soil in mapping are areas of Honeygrove, Peavine, Cumley, and Astoria soils, which make up about 15 percent of the map unit.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 7.5 to 10 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production. Other uses are water supply and wildlife habitat. The soil is well suited to the production of Douglas-fir. Red alder is common. The site index ranges from about 155 to 180, and the average is about 165. Based on the average site index, the soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic; this limits trafficability. It is severely compacted by equipment. In some areas, cable logging is desirable because tractor logging causes excessive disturbance. Roads and landings may need water bars and grass seeding to prevent erosion. Roads require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and the hazard of slides.

Plant competition is severe. Grass, brush, and fern competition is especially difficult to control in non-stocked, cutover areas. There is some danger of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. The hazard of windthrow is minimal.

Douglas-fir, hazel, bigleaf maple, red alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use this area for food and cover. Numerous draws and drainage ways are available for small ponds. Except for a few major creeks and springs, the drainage ways are dry late in summer.

The slope is the major limitation to home sites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**5D-Astoria silt loam, 5 to 30 percent slopes.** This well drained soil is on mountainous, lower side slopes of the Coast Range. It formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 15 percent. Elevation is 800 to 1,800 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 48 to 49 degrees F, and the frost-free period is 145 to 190 days.

In a representative profile, the surface layer is very dark brown silt loam about 10 inches thick. The subsoil is dark yellowish brown and yellowish brown heavy silty clay loam and silty clay about 51 inches thick.

Included with this soil in mapping are areas of Bohannon, Slickrock, and Blachly soils, which make up about 15 percent of the map unit.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 11 to 15 inches, and the water-supplying capacity is 22 to 25 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. Other uses are water supply and wildlife habitat. The soil is very well suited to the production of Douglas-fir. Bigleaf maple and red alder are common. The site index for Douglas-fir ranges from about 155 to 175, and the average is about 165. Based on the average site index, this soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year old trees.

Limitations to the use of equipment are slight. Roads and skid trails are unstable when wet. Trafficability is restricted when the soil is wet. Cable logging is desirable because

tractor logging causes excessive disturbance. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight, but the limitation can become major at the lower elevations and in moist areas. In moist areas, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The water-supplying capability is good and the climatic zone is favorable. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainage ways where small ponds could be built.

Slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**5E-Astoria silt loam, 30 to 60 percent slopes.** This well drained soil is on mountainous lower side slopes of the Coast Range. It formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 35 percent. Elevation is 800 to 1,800 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 48 to 49 degrees F, and the frost-free period is 145 to 190 days.

In a representative profile, the surface layer is very dark brown silt loam about 10 inches thick. The subsoil is dark yellowish brown and yellowish brown heavy silty clay loam and silty clay about 51 inches thick.

Included with this soil in mapping are areas of Bohannon, Slickrock, and Blachly soils, which make up about 15 percent of the map unit.

Permeability is moderate. Effective rooting depth is 60 inches or more. The available water capacity is 11 to 15 inches, and the water-supplying capacity is 22 to 25 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. Other uses are water supply and wildlife habitat. The soil is very well suited to the production of Douglas-fir. Bigleaf maple and red alder are common. The site index for Douglas-fir on this soil ranges from about 155 to 175, and the average is about 165. Based on the average site index, this soil is capable of producing about 13, 300 cubic feet, or 74,200 board feet (International rule, one-fourth kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Roads and skid trails are unstable when wet. Trafficability is restricted when the soil is wet. Cable logging is desirable because tractor logging causes excessive soil disturbance (fig. 6). Construction and maintenance of roads is difficult because of the slope and hazard of slides. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight, but the limitation can become major at the lower elevations and in moist areas. In moist areas, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The water-supplying capacity is good, and the climatic zone is favorable. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainage ways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainage - ways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**6A-Bashaw silty clay loam, 0 to 3 percent slopes.** This poorly drained and very poorly drained soil is mainly in flat or depressional areas on alluvial bottoms, terraces, and fans. It formed in clayey alluvium. Some areas of this soil adjacent to streams are subject to frequent overflow. Slopes average about 1 percent. Elevation is 100 to 300 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is black silty clay loam about 11 inches thick. The next layer is black and very dark gray clay about 40 inches thick. The underlying material is very dark gray, mottled silty clay to a depth of 60 inches or more.

Included with this soil in mapping are areas of Cove and Wapato soils, which make up about 10 percent of the map unit.

Permeability is very slow. Effective rooting depth is about 40 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is very slow

or the soil is ponded, and the hazard of erosion is slight. A seasonal high water table is at a depth of less than 6 inches in winter and spring.

This soil is used for spring grain, pasture, and grass seed. Fall-seeded grain and deep-rooted crops are not suited because of the high water table. Cultivation is somewhat difficult because of the silty clay loam surface layer. Productivity is low for most crops, although the soil may be used for moderate production of bentgrass and ryegrass seed. The response to fertilizers and amendments is good. Management of residue and crop rotation help to maintain productivity and increase workability. A good crop rotation system includes grasses and legumes or grass and legume mixtures at least 25 percent of the time.

This soil is subject to cracking when dry and takes in water readily. As the soil is saturated and swells, cracks close. Irrigation is difficult and intake rates vary widely with different moisture content. When the soil is wet, little water enters until the soil dries and cracks again. A favorable moisture and air relationship is difficult to maintain.

This soil needs drainage, but drainage is mainly confined to surface removal of excess water because the lower layers of the soil are clay and silty clay. Tile and surface drainage is effective where suitable outlets can be provided.

This soil is poorly suited to commercial timber production. Native areas contain ash, willow, sedges, grass, and shrubs. The seasonal high water table, ponding, and overflow limit the use of this soil to ducks and geese late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues. The rest of the year, ring-necked pheasant, valley quail, bobwhite quail, mourning doves, and black-tailed deer use areas of the soils for food and cover. Some fur-bearing animals are present.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community development because of the high shrink-swell potential and the high seasonal water table.

This soil is in capability subclass IVw.

**6C-Bashaw silty clay, 3 to 12 percent slopes.** This poorly drained and very poorly drained soil is on foot slopes and fans. It formed in clayey alluvium. Slopes average about 6 percent. Elevation is 100 to 300 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days. The average slope is about 6 percent.

In a representative profile, the surface layer is very dark gray and black clay about 11 inches thick. The next layer is black clay about 33 inches thick. The underlying material is very dark grayish brown clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Cove and Waldo soils, which make up about 10 percent of this map unit.

Permeability is very slow. Effective rooting depth is about 40 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of less than 6 inches in winter and spring.

This soil is used for spring and fall grain, hay, pasture, and grass seed. Deep-rooted crops are not suited because of the seasonal high water table in winter and spring. Cultivation is difficult because of the clayey texture and the critical moisture content at which the soil can be cultivated and worked for an adequate seedbed. Productivity for most crops is low, but bentgrass and ryegrass seed are moderately productive. The response to fertilizers and amendments is good. Management of crop residues and rotation of crops help to maintain productivity and increase workability. A good crop rotation system includes grasses and legumes or grass and legume mixtures at least 25 percent of the time.

This soil is subject to cracking when dry and takes in water readily. As the soil is saturated, it swells and cracks close. Irrigation is difficult and intake rates vary widely with different moisture content. When the soil is wet, little water enters until the soil dries and cracks again. A favorable moisture and air relationship is difficult to maintain.

The soil needs drainage, but because of the clayey texture and weak structure, drainage is largely confined to surface removal of excess water. Tile drainage is effective if suitable outlets can be provided.

This soil is poorly suited to commercial timber production.

Native areas contain ash, willow, sedges, grass, and shrubs. High water tables, ponding, and overflow limit the use of this soil to ducks and geese late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues. The rest of the year, ring-necked pheasant, California quail, bobwhite quail, mourning doves, and black-tailed deer move into this area for food and cover. Some fur-bearing animals are present.

This soil has major limitations for home sites, commercial buildings, and other community development because of the high shrink-swell potential and the high seasonal water table.

This soil is in capability subclass IVw.

**7-Bashaw clay, 0 to 3 percent slopes.** This poorly drained and very poorly drained soil is mainly in flat or depressional areas on alluvial bottoms, terraces, and fans. It formed in clayey alluvium. Some areas adjacent to streams are subject to frequent overflow. Slopes are 0 to 3 percent but average about 1 percent. Elevation is 100 to 300 feet. The average annual precipitation is 40 to 60 inches, the average annual air

temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is black clay about 4 inches thick. The underlying material is black and very dark gray, mottled clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Cove and Waldo soils, which make up about 10 percent of this map unit.

Permeability is very slow. Effective rooting depth is about 40 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is very slow or the soil is ponded, and the hazard of erosion is slight. A seasonal high water table is at a depth of less than 6 inches in winter and spring.

This soil is used for spring grain, hay, pasture and grass seed. Fall-seeded grain and deep-rooted crops are not suited because of the seasonal high water table in winter and spring. Cultivation is difficult because of the clay texture and the critical moisture content at which the soil can be cultivated and worked for an adequate seedbed. Productivity is low for most crops, although the soil may be used for moderate production of bentgrass and ryegrass seed. Response to fertilizers and amendments is good. Management of residue and crop rotation help to maintain productivity and increase workability of the soil. A good rotation system includes grasses and legumes or grass and legume mixtures at least 25 percent of the time.

This soil is subject to cracking when dry and takes in water readily. As the soil is saturated, it swells and cracks close. Irrigation is difficult and intake rates vary widely with different moisture content. When the soil is wet, little water enters until the soil dries and cracks again. A favorable moisture and air relationship is difficult to maintain.

The soil needs drainage, but because of the clay texture and weak structure, drainage is largely confined to surface removal of excess water. Surface and tile drainage is effective if suitable outlets can be provided.

This soil is poorly suited to commercial timber production.

Native areas contain ash, willow, sedges, grasses, and shrubs. This soil is used by ducks and geese late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues. The rest of the year, ring-necked pheasant, valley quail, bobwhite quail, mourning doves, and black-tailed deer move into this area for food and cover. Some fur-bearing animals are present.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community development because of the high shrink-swell potential and the high seasonal water table.

This soil is in capability subclass IVw.

**8C-Bellpine silty clay loam, 3 to 12 percent slopes.** This well drained soil is on low foothills and higher rolling uplands. It formed in colluvium weathered from sedimentary rock. It is underlain by siltstone at a depth of 20 to 40 inches. Slopes average about 7 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown and yellowish red silty clay and clay about 23 inches thick. Partially weathered siltstone is at a depth of 32 inches.

Included with this soil in mapping are areas of Jory and Rickreall soils, which make up about 10 percent of this map unit, and Dupee and Suver soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 6 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are cultivated. Cereal grain, orchards, forage, and grass seed are the main crops. The soil is moderately productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom lands. The soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields. Management of residue and crop rotation help to reduce runoff and erosion. Crop residues also help to maintain and increase productivity and workability. A good crop rotation system includes grasses and legumes or a grass-legume mixture.

This soil generally is not irrigated, and irrigation water generally must be stored in reservoirs. Suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir trees. The soil is well suited to the production of Christmas trees. Mixed stands of Oregon white oak and Douglas-fir and grand fir are in areas of the soil. The site index for Douglas-fir on this soil ranges from 150 to 166. Based on the average site index of 158, this soil is capable of producing about 12,650 cubic feet, or 68,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year old trees.

This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need water bars and grass seeding to prevent erosion.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and

shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The main limitation for homesites is the slow permeability, which affects septic tank filter fields. Most areas of this soil are not on community sewage systems.

This soil is in capability subclass IIe.

**8D-Bellpine silty clay loam, 12 to 20 percent slopes.** This well drained soil is on low foothills and higher, rolling uplands. The soil formed in colluvium weathered from sedimentary rock. It is underlain at a depth of 20 to 40 inches by siltstone. Slope averages about 16 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 23 inches thick. Partly weathered siltstone is at a depth of 32 inches.

Included with this soil in mapping are areas of Jory and Rickreall soils, which make up about 10 percent of the map unit, and Dupee and Suver soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 6 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is medium to slow, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. Some small areas are in oakgrass vegetation and Douglas-fir. Cereal grain, forage, and grass seed are the main crops, and the soil is moderately productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom land. The soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields. Management of crop residue and crop rotation help to reduce runoff and erosion. Crop residues also help to maintain and increase productivity and workability. A good crop rotation system includes grasses and legumes or a grass-legume mixture.

This soil generally is not irrigated, and irrigation water generally must be stored in reservoirs. Suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir trees. Stands of Oregon white oak mixed with Douglas-fir and grand fir are in some areas. The site index for Douglas-fir on this soil ranges from 146 to 171. Based on the average site index of 158, this soil is capable of producing about 12,650 cubic feet, or 68,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need water bars and grass seeding to prevent erosion.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. Ruffed grouse, mountain quail and bandtailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction. The main limitations for homesites and septic tank filter fields are the slow permeability and the slope. Most areas of this soil are not on community sewage systems.

This soil is in capability subclass IIIe.

**8E-Bellpine silty clay loam, 20 to 30 percent slopes.** This well drained soil is on low foothills and higher, rolling uplands. It formed in colluvium weathered from sedimentary rock. It is underlain by siltstone at a depth of 20 to 40 inches. Slopes average about 25 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches' thick. The subsoil is dark reddish brown silty clay and clay about 23 inches thick. Partly weathered siltstone is at a depth of 32 inches.

Included with this soil in mapping are areas 'of Jory and Rickreall soils, which make up about 10 percent of this map unit, and Dupee and Suver soils make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 6 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for forage crops and forestry. A few small areas are used for cereal grain. The slope makes this soil poorly suited to cultivation. To control erosion in cultivated areas, the soil needs such intensive practices as contour cropping, returning crop residue to the soil, rough tillage, winter cover crop, and grassed waterways. In many areas, the length and shape of slopes is not suited to contour farming. Management of crop residue and crop rotation help to reduce runoff and erosion and to maintain the productivity and workability of the soils. A good crop rotation system includes grasses and legumes or grass-legume mixtures.

This soil is well suited to the production of Douglas-fir. It is not well suited to Christmas tree production because the slope causes difficulty in management and harvesting. Mixed stands of Douglas-fir, Oregon white oak, and grand fir are on the soil. The older, even-aged stands are dominantly Douglas-fir. The site index for Douglas-fir on this soil is about 148. Based on this average site index, the soil is capable of producing about 11,700 cubic feet, or 59,700 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Roads and landings need water bars and grass seeding to prevent erosion. Roads need a maximum of base rock for all-season use.

The crops produced on this soil help to provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. Ruffed grouse, mountain quail and bandtailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas of the soil. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction. The main limitations to homesites and septic tank filter fields are the slow permeability and slope. Most areas of this soil are not on community sewage systems.

This soil is in capability subclass IVe.

**8F-Bellpine silty clay loam, 30 to 50 percent slopes.** This well drained soil is on low foothills and higher, rolling uplands. The soil formed in colluvium weathered from sedimentary rock. It is underlain by siltstone at a depth of 20 to 40 inches. Slopes average about 40 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty' clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 23 inches thick. Partly weathered siltstone is at a depth of 32 inches.

Included with this soil in mapping are areas of Jory and Rickreall soils, which make up about 10 percent of this map unit, and Dupee and Suver soils which make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 6 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production and pasture. Oregon white oak and grass are in some areas. The slope makes this soil unsuitable for cultivation. The soil is suited to limited tillage for pasture management. It is well suited to the production of Douglas-fir. The soil is not well suited to Christmas tree production, because the slope causes difficulty in management and harvesting. Mixed stands of Douglas-fir, Oregon white oak, and grand fir are on this soil. The older, even-aged stands are dominantly Douglas-fir. The average site index for Douglas-fir on this soil is about 148. Based on this average site index, the soil is capable of producing about 11,700 cubic feet, or 59,700 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Roads and landings need water bars and grass seeding to prevent erosion. Roads need a maximum of base rock for all-season use.

Areas of soil that are adjacent to cultivated soils provide habitat for ring-necked pheasant, California quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Blacktailed deer are common in both cultivated and uncultivated areas of the soil. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction. This soil has major limitations for dwellings and roads because of the slope. Most areas are not on community sewage systems.

This soil is in capability subclass Vle.

**8G-Bellpine silty clay loam, 50 to 75 percent slopes.** This well drained soil is on low foothills and higher, rolling uplands. This soil formed in colluvium weathered from sedimentary rock. It is underlain by siltstone at a depth of 20 to 40 inches. Slopes average about 60 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 23 inches thick. Partly weathered siltstone is at a depth of 32 inches.

Included with this soil in mapping are areas of Jory and Rickreall soils, which make up about 10 percent of the map unit, and Dupee and Suver soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 6 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production and pasture. Oregon white oak and grass are in a few small areas. The slope makes this soil unsuitable for cultivation. The soil is well suited to the production of Douglas-fir. Mixed stands of Douglas-fir, Oregon white oak, and grand fir are on the soil. The older, even-aged stands are dominantly Douglas-fir. The average site index for Douglas-fir on this soil is about 148. Based on this average site index, the soil is capable of producing about 11,700 cubic feet, or 59,700 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

The very steep slopes limit most operations to cable logging, and aerial seeding and weeding. The slope creates difficulties in road construction and maintenance. Roads and landings need water bars and grass seeding to prevent erosion. Roads on this soil need a maximum of base rock for all-season use.

Ring-necked pheasant, California quail, and bobwhite quail are in areas where the soil is intermingled with cultivated soils. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Blacktailed deer are common. Numerous drainageways are suitable for small ponds.

Increased population growth in the county has resulted in increased home construction in areas adjacent to this soil. The main limitation to homesites, septic tank filter fields, dwellings, and roads is the slope. Most areas of this soil are not on community sewage systems.

This soil is in capability subclass VIIe.

**9D-Blachly silty clay loam, 3 to 30 percent slopes.** This well drained soil is on mountainous uplands of the Coast Range. The soil formed in residuum and colluvium weathered from basic igneous and sedimentary rock. Slopes average about 18 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free period is 160 to 180 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 15 inches thick. The subsoil is reddish brown and yellowish red silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Hembre and Klickitat soils, which make up about 10 percent of this map unit, and Kilowan and Marty soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 9 to 11 inches or more, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. It is well suited to Douglas-fir. Bigleaf maple and alder are common in stands of fir. The average site index for Douglas-fir on this soil ranges from about 160 to 175. Based on an average site index of 167, the soil is capable of producing about 13,450 cubic feet, or 75,900 board feet (International rule, one-fourth kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

When wet, this soil is sticky and plastic; this restricts trafficability. It is severely compacted (fig. 7). Cable logging is desirable because tractor logging causes excessive disturbance. Roads on this soil require a maximum of base rock for all-season use. Roads and landings may need water bars and grass seeding to prevent erosion.

Brush and fern competition is especially difficult to control in nonstocked, cutover areas. The water-supplying capacity is good, and the climatic zone is favorable. Natural regeneration is good, but supplementary site preparation, seeding, and planting may be needed. Weeding and thinning are needed for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of the low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass VIe.

**9E-Blachly silty clay loam, 30 to 50 percent slopes.** This well drained soil is on mountainous uplands of the Coast Range. It formed in residuum and colluvium weathered from basic igneous and sedimentary rock. Slopes average about 40 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free period is 160 to 180 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 10 inches thick. The subsoil is reddish brown and yellowish red silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Hembre and Klickitat soils, which make up about 10 percent of this map unit, and Kilowan and Marty soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. It is well suited to the production of Douglas-fir. Bigleaf maple and alder are common

in stands of fir. The site index for Douglas-fir on this soil ranges from about 160 to 175, and the average is about 165. Based on an average site index of 167, this soil is capable of producing about 13,450 cubic feet, or 75,900 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

When wet, this soil is sticky and plastic; this restricts trafficability. It is severely compacted. Cable logging is desirable because tractor logging causes excessive disturbance. Construction and maintenance of roads is difficult because of the slope and the hazard of slides. Roads require a maximum of base rock for all-season use. Roads and landings may need water bars and grass seeding to prevent erosion.

Brush and fern competition is especially difficult to control in nonstocked, cutover areas. The water-supplying capacity is good and the climatic zone is favorable. Natural regeneration is good but supplementary site preparation, seeding, and planting may be needed. Weeding and thinning are needed for good stand development.

Blue grouse, ruffed grouse, and the black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass VIe.

**10D-Bohannon gravelly loam, 3 to 25 percent slopes.** This well drained soil is in mountainous areas of the Coast Range. It formed in gravelly residuum and colluvium weathered from sedimentary rock. It is underlain by partly weathered sandstone at a depth of 20 to 40 inches. Slopes average about 15 percent. Elevation is 1,100 to 1,600 feet. The average annual precipitation is 80 to 130 inches, the average annual air temperature is about 50 to 53 degrees F, and the frost-free period is about 160 to 190 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown gravelly loam about 16 inches thick. The subsoil is dark brown and dark yellowish brown gravelly clay loam about 18 inches thick. Partly weathered sandstone is at a depth of 34 inches.

Included with this soil in mapping are areas of Astoria, Slickrock, Trask, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 6 inches, and the water-supplying capacity is 16 to 24 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. It is well suited to the production of Douglas-fir. Hemlock is mixed with Douglas-fir at higher elevations. Bigleaf maple is common, and red alder is on lower slopes and drainageways. The site index for Douglas-fir on this soil is about 150. Based on this site index, the soil is capable of producing about 11,900 cubic feet, or 61,600 board feet (International rule, one-fourth kerf), of merchantable timber from a fully stocked, even-aged stand of 80-yearold trees.

Trafficability is good except during very wet periods. There are few limitations to the use of equipment, but cable logging is desirable for minimum disturbance. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight, but this limitation can become major on the lower slopes and on moist sites. In moist areas, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifer seedlings. There is little danger of seedling mortality. Natural regeneration is generally good, but supplementary site preparation, seeding, and planting may be needed. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this dry period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass VIe.

**10E-Bohannon gravelly loam, 25 to 50 percent slopes.** This well drained soil is in mountainous areas in the Coast Range. The soil formed in gravelly residuum and colluvium weathered from sedimentary rock. It is underlain by partly weathered sandstone at a depth of 20 to 40 inches. Slopes average about 35 percent. Elevation is 1,100 to 1,600 feet. The average annual precipitation is 80 to 130 inches, the average annual air temperature is about 50 to 53 degrees F, and the frost-free period is about 160 to 190 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown gravelly loam about 16 inches thick. The subsoil is dark brown and dark yellowish brown gravelly clay loam about 18 inches thick. Partly weathered sandstone is at a depth of 34 inches.

Included with this soil in mapping are areas of Astoria, Slickrock, Trask, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 6 inches, and the water-supplying capacity is 16 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. It is well suited to the production of Douglas-fir. Hemlock is mixed with Douglas-fir at higher elevations. Bigleaf maple is common, and red alder is on lower slopes and drainageways. The site index for Douglas-fir on this soil is about 150. Based on this site index, the soil is capable of producing about 11,900 cubic feet, or 61,600 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

Trafficability is good on this soil except during very wet periods. There are some limitations to equipment use; therefore, cable logging is desirable for minimum disturbance. Slides are a hazard on this soil where water accumulates in yarded areas or as a result of road construction. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight, but this limitation can become major on the lower slopes and on moist areas. In moist areas, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifer seedlings. There is little danger of seedling mortality. Natural regeneration is generally good, but supplementary site preparation, seeding, and planting may be needed. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**10F-Bohannon gravelly loam, 50 to 75 percent slopes.** This well drained soil is in mountainous areas in the Coast Range. The soil formed in gravelly residuum and colluvium weathered from sedimentary rock. It is underlain by partly weathered sandstone at a depth of 20 to 40 inches. Slopes average about 65 percent. Elevation is 1,100 to 1,600 feet. The average annual precipitation is 80 to 130 inches, the average annual air temperature is about 50 to 53 degrees F, and the frost- free period is about 160 to 190 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown gravelly loam about 16 inches thick. The subsoil is dark brown and dark yellowish brown gravelly clay loam about 18 inches thick. Partly weathered sandstone is at a depth of 34 inches.

Included with this soil in mapping are areas of Astoria, Slickrock, Trask, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 6 inches, and the water-supplying capacity is 16 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. It is well suited to the production of Douglas-fir. Hemlock is mixed with Douglas-fir at higher elevations. Bigleaf maple is common, and red alder is on lower slopes and in drainageways. The site index for Douglas-fir on this soil is about 150. Based on this site index, the soil is capable of producing about 11,900 cubic feet, or 61,600 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

Limitations to the use of equipment are major, because the slope limits most operations to cable logging and aerial seeding and weeding. There is a major slide hazard on this soil, because slides can be caused by the accumulation of water resulting from yarding and road construction.

Plant competition is slight, but this limitation can become major on the lower slopes and in moist areas. In moist areas, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifer seedlings. There is little danger of seedling mortality. Natural regeneration is generally good, but supplementary site preparation, seeding, and planting may be needed. Weeding and thinning are needed for good stand development. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vlle.

**11-Brenner silt loam.** This poorly drained soil is on the lowest part of the flood plain or in swales adjacent to terraces or uplands. It formed in clayey alluvium from mixed sources.

Slopes are 0 to 3 percent but average about 1 percent. Elevation is 1,000 to 1,200 feet. The average annual precipitation is 80 to 130 inches, the average annual air temperature is 48 to 53 degrees F, and the frost-free period is about 165 to 200 days.

In a representative profile, the surface layer is very dark brown silt loam about 11 inches thick. The subsoil is grayish brown and light gray silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Knappa soils and Xerofluvents, loamy, which make up about 10 percent of this map unit.

Permeability is slow. Effective rooting depth is 30 to 50 inches. Available water capacity is 8.5 to 9.5 inches, and the water-supplying capacity is 22 to 24 inches. Runoff is slow to very slow or the soil is ponded, and the hazard of erosion is slight. The soil is subject to frequent flooding, and a seasonal high water table is at a depth of less than 12 inches early in spring.

This soil is used for pasture, forage crops, and hay. It is not suited to deep-rooted, perennial crops because adequate drainage outlets generally cannot be maintained in most areas in winter and spring. However, if adequate drainage can be maintained and drainage can be improved, climatically adapted water-tolerant crops that need only a shallow rooting zone do well. Water-tolerant grasses and legumes are fairly productive without drainage. Drainage also permits the use of higher producing grasses and legumes and allows earlier and later growth.

Irrigation is necessary for maximum production of all crops. It should be applied so that the soil is not over-irrigated, causing a higher water table. Water is sometimes available from streams and ponds.

This soil is poorly suited to commercial timber production. A high water table, flooding, and ponding limit the use of this soil to ducks late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residue in areas of well drained soils adjacent to this soil. California quail, bobwhite quail, mourning doves, and black-tailed deer use this area for food and cover the rest of the year. This soil is also used by fur-bearing animals. Grouse and band-tailed pigeons are not common.

Such water-control structures as dikes, small dams, and drain ditches improve the habitat for ducks in winter and for other game species the rest of the year. Cover and food supplies are also improved by planting along streambanks, ditch, banks, and roadways; by grassing waterways; and by maintaining fence rows, wood lots, and brushy areas. Protecting fields and fence rows from burning enhances food supplies and cover for wildlife.

This soil has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of flooding and a seasonal high water table. There are also major hazards for dwellings with or without basements, small commercial buildings, and local roads and streets because of flooding and the seasonal high water table. Dwellings can be designed to offset the seasonally high water table. There are slight hazards for embankments, dikes, and levees as well as for pond reservoir areas.

This soil is in capability subclass IIIw.

**12A-Briedwell silt loam, 0 to 3 percent slopes.**

This well drained soil is on gravelly terraces. It formed in old alluvium that overlies an irregular substratum of siltstone. The soil is underlain by a gravelly substratum at a depth of 40 to 50 inches. Slopes average about 2 percent. Elevation is 350 to 650 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown and brown gravelly clay loam and very gravelly clay loam about 35 inches thick. The substratum is very gravelly loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Abiqua and McAlpin soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is about 30 to 40 inches. Available water capacity is 4 to 6 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for hay, pasture, cereal grain, and Christmas trees. Orchards and deep-rooted crops are not commonly grown on this soil because of the limited depth to gravel and the tendency toward droughtiness. Management of residue and crop rotation help to reduce runoff and erosion and to maintain productivity and workability. A good crop rotation system includes grasses and legumes or a grass and legume mixture at least 25 percent of the time. Grain and grass crops respond to nitrogen. Legumes need phosphorus, sulfur, boron, and lime in places. If stubble mulching or crop residues are used, additional nitrogen is needed to prevent decreased yields. In years without rain late in spring, the soil is quite droughty.

Erosion can be controlled by residue management, rough tillage, winter cover, or stubble mulching. Cover crops planted early in fall help to ensure adequate growth.

This soil is not generally irrigated. Irrigation water must be stored in reservoirs, but suitable sites are not generally available. Runoff and seepage can be controlled best by sprinkler irrigation.

Commercial stands of timber are not on this soil. The soil is well suited to Christmas trees.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak,

Douglas-fir, poison-oak, snowberry, wild rose, and grass, ruffed grouse, mountain quail, and band-tailed pigeons are common. These birds feed on the fruit and seeds of trees and shrubs. .Black-tailed deer are common in both cultivated and uncultivated areas of the soil. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintenance of fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has few limitations for homesites, commercial buildings, roads and streets, and other community uses.

This soil is in capability subclass IIs.

**12C-Briedwell silt loam, 3 to 12 percent slopes.**

This well drained soil is on gravelly terraces. The soil formed in old alluvium that overlies an irregular substratum of siltstone. It is underlain by gravelly substratum at a depth of 40 to 50 inches. Slopes average about 7 percent. Elevation is 350 to 650 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown and brown gravelly clay loam and very gravelly clay loam about 35 inches thick. The substratum is very gravelly loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Abiqua and McAlpin soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is about 30 to 40 inches. Available water capacity is 4 to 6 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for hay, pasture, cereal grain, and Christmas trees. Orchards and deep-rooted crops are not commonly grown on this soil because of the limited depth to gravel and the tendency toward droughtiness. Management of residue and crop rotation help to reduce runoff and erosion and to maintain productivity and workability. A good crop rotation system includes grasses and legumes or a grass and legume mixture at least 25 percent of the time. Grain and grass crops respond to nitrogen. Legumes need phosphorus, sulfur, boron, and lime in places. If stubble mulching or crop residues are used, additional nitrogen is needed to prevent a decrease in yields. In years without rain late in spring, the soil is quite droughty.

Erosion can be controlled by crop residue management, rough tillage, winter cover, or stubble mulching. Cover crops planted in fall help to insure adequate growth.

This soil is not generally irrigated. Irrigation water must be stored in reservoirs, but suitable sites are not generally available. Runoff and seepage can be controlled best by sprinkler irrigation.

Commercial stands of timber are not on this soil. The soil is fairly well suited to Christmas trees.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, poison-oak, snowberry, wild rose, and grass, ruffed grouse, mountain quail, and band-tailed pigeons are common. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has some limitations for homesites, septic tank absorption fields, and local roads and streets because of the slope.

This soil is in capability subclass IIIe.

**12D-Briedwell slit loam, 12 to 20 percent slopes.**

This well drained soil is on gravelly terraces. It formed in old alluvium that overlies an irregular substratum of siltstone. The soil is underlain by gravelly substratum at a depth of 40 to 50 inches. Slopes average about 16 percent. Elevation is 350 to 650 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown and brown gravelly clay loam and very gravelly clay loam about 35 inches thick. The substratum is very gravelly loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Abiqua and McAlpin soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is 30 to 40 inches. Available water capacity is 4 to 6 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for natural and improved pasture. Orchards and deep-rooted crops are not suited because of limited depth to a gravelly substratum and tendency toward droughtiness. Management of crop residue and crop rotation help to reduce runoff and erosion and to maintain productivity and workability. A good crop rotation system includes grasses and legumes or a grass-legume mixture at least 50 percent of the time. Grass crops respond to nitrogen, and legumes respond to phosphorus, sulfur, boron, and lime in some places. In years without rain late in spring, this soil is quite droughty.

Erosion can be controlled by grassed waterways, cross-slope farming, residue management, and winter cover crops. Cover crops planted early in fall help to

insure adequate growth. The soil is not generally irrigated because of the excessive slope.

Commercial stands of timber are not on this soil. It is limited for Christmas trees because of the slope that restricts management and harvest.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, poison-oak, snowberry, wild rose, and grass, ruffed grouse, mountain quail, and band-tailed pigeons are common. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has major limitation for all types of community uses because of the slope.

This soil is in capability subclass IVe.

**13-Camas gravelly sandy loam.** This excessively drained soil is on undulating alluvial bottoms. The soil formed in very gravelly alluvium. It is subject to overflow several times per year, and it is flooded about once every 3 or 4 years. The soil is traversed by overflow channels. It is underlain by gravel and sand at a depth of 12 to 20 inches. Slopes average about 2 percent. Elevation is 125 to 250 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown gravelly sandy loam about 12 inches thick. The substratum is variegated dark yellowish brown very gravelly coarse sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Pilchuck, Newberg, and Cloquato soils, which make up about 10 percent of this map unit.

Permeability is very rapid. Effective rooting depth is 12 to 20 inches. Available water capacity is 1.5 to 3.5 inches, and the water-supplying capacity is 10 to 15 inches. Runoff is slow, and the hazard of erosion is slight. The soil is subject to frequent flooding in fall, winter, and spring.

Most of the acreage of this soil is cultivated. The soil is used mainly for small grain and forage crops. If irrigated, it is used for vegetable, seed, and specialty crops. The soil is poorly suited to many of the crops grown, but it is used for crops because it often occurs as small areas within other soils.

Erosion can be controlled by winter cover crops. Cover crops planted early in fall allow adequate rooting and top growth before periods of overflow. Stubble and other plant growth left on the soil in winter before being incorporated into the soil help to control erosion from floodwaters. Fertilization and irrigation may be necessary in many years for early establishment of a cover crop.

Management of crop residue and crop rotation help to maintain productivity and filth and to control erosion. A crop rotation system that includes grasses and legumes at least 25 percent of the time helps to maintain fertility.

Because of the low available water capacity of this soil, frequent applications of irrigation water are necessary to prevent crops from wilting. Because the soil is commonly managed below the wilting point, the crops are stunted and yields low. The gravelly surface layer makes tillage and seedbed preparation difficult. Such crops as berries or hops which require installation of poles, increase the hazard of debris accumulation and in many cases cause severe gullying during floods.

No commercial stands of timber are grown on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops; the fence rows; and wooded tracts of ash, cottonwood, Douglas-fir, and shrubs furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning doves. Black-tailed deer are permanent residents. Ducks and geese also feed on this soil. Streambank and roadway planting, grassed waterways, and fence rows and brushy areas improve cover and food for wildlife. Water is available from streams most of the year. Burning field and fence rows and clearing wooded and brushy areas destroy both cover and food for wildlife.

This soil has major limitations for homesites, commercial buildings, or other community uses because it is subject to occasional flooding.

This soil is in capability subclass IVw.

**14-Chehalis silty clay loam, occasionally flooded.** This well drained soil is on gently undulating alluvial bottoms. The soil formed in mixed recent alluvium. It is subject to overflow several times in some years and is flooded about once every 3 to 4 years. The soil is traversed by overflow channels and sloughs. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days:

In a representative profile, the surface layer is very dark grayish brown silty clay loam about 12 inches thick. The subsoil is dark brown silty clay loam about 35 inches thick. The substratum is dark yellowish brown silty clay loam that extends to a depth of 64 inches or more.

Included with this soil in mapping are areas of Cloquato, Newberg, McBee, and Camas soils, which make up about 10 percent of this map unit. Also included are a few areas of soils in which the upper 10 inches is fine sandy loam or loam, the result of recent deposition by flood waters.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 25

to 28 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is common in winter and spring.

Most areas of this soil are cultivated. The soil is used for row crops, forage crops, small grain, seed crops, and orchards. It is irrigated for vegetables and many specialty crops (fig. 8). The soil is well suited to most crops grown in the area. The hazard of erosion from flood waters can be reduced by planting winter cover crops and installing dikes. Properly managing crop residue and using a cropping system in which grasses and legumes or green manure crops are grown at least 25 percent of the time help to maintain favorable fertility and workability. The crops grown on the soil respond well to fertilizers and amendments.

The use of this soil for orchards or such crops as berries and hops, which require installation of poles, increases the hazard of debris accumulation and may cause severe gullying during periods of flooding. This soil is irrigated from shallow wells, streams, rivers, and sloughs.

No commercial timber is produced on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops; the fence rows; and wooded tracts of ash, cottonwood, Douglas-fir, and shrubs furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents. Ducks and geese also feed on this soil. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Streambank and roadway planting, grassed waterways, and fence rows and brushy areas improve cover and food for wildlife. Water from streams is available most of the year. Burning fields and fence rows and clearing wooded and brushy areas destroy both cover and food for wildlife.

This soil has major limitations for homesites, commercial buildings, or other community uses because it is subject to common flooding.

This soil is in capability subclass IIw.

**15C-Chehulpum silt loam, 3 to 12 percent slopes.** This well drained soil is on low foothills. The soil formed in material weathered from sedimentary rock. It is underlain by siltstone at a depth of 12 to 20 inches. Slopes average about 6 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam and silty clay loam 10 inches thick. The subsoil is dark brown silty clay loam about 6 inches thick. Partly weathered sedimentary bedrock is at a depth of 16 inches.

Included with this soil in mapping are areas of Steiwer, Hazelair, and Dupee soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is 10 to 20 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 6 to 13 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for hay and pasture, but it is mainly in natural stands of grass and Oregon white oak. The soil is too shallow for cultivated crops. Improved varieties of grass are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures better cover than if these grasses are planted later. This cover helps to protect the soil from erosion the following winter. The soil is droughty. It generally is not fertilized extensively, but small amounts of fertilizer are applied early in spring or in fall.

No commercial stands of timber are grown on this soil. The soil is poorly suited to growing Christmas trees because of droughtiness.

In areas where this soil is intermingled with cultivated soils, ring-necked pheasant, California quail, and bobwhite quail may be present. Oregon white oak, grass, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of shallow depth to bedrock.

This soil is in capability subclass VIs.

**15E-Chehulpum slit loam, 12 to 40 percent slopes.** This well drained soil is on low foothills. It formed in material weathered from sedimentary rock. The soil is over siltstone at a depth of 12 to 20 inches. Slopes average about 25 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown silty clay loam about 6 inches thick. Partly weathered sedimentary bedrock is at a depth of 16 inches.

Included with this soil in mapping are areas of Steiwer, Hazelair, and Dupee soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is 10 to 20 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 6 to 13 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for pasture. The vegetation is Oregon white oak and grasses. Erosion can be controlled by maintaining a ground cover of natural vegetation.

No commercial stands of timber are grown on this soil. The soil is poorly suited to growing Christmas trees because of droughtiness and the slope.

In areas where this soil is intermingled with cultivated soils, ring-necked pheasant, California quail, and bobwhite quail may be present. Oregon white oak, grasses, poison-oak, and wild

rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, and roads and streets, and other community uses because of the shallow depth to rock and the slope.

This soil is in capability subclass Vlls.

**16E-Chehulpum-Stelwer complex, 12 to 40 percent slopes.** This complex consists of shallow and moderately deep, well drained soils. These soils formed in alluvium and colluvium weathered from sedimentary bedrock. Slopes average about 25 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

The Chehulpum soil is on the steeper side slopes and ridges. It makes up about 50 percent of the complex. The Steiwer soil is on the less steep side slopes and broader ridges and in depressional drainageways. It makes up about 35 percent of the complex.

In a representative profile of the Chehulpum soil, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown silty clay loam about 6 inches thick. Partly weathered sedimentary bedrock is at a depth of 16 inches.

Permeability is moderate in the Chehulpum soil. Effective rooting depth is 10 to 20 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 6 to 13 inches. Runoff is rapid, and the hazard of erosion is high.

In a representative profile of the Steiwer soil, the surface layer is very dark grayish brown silt loam about 15 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 11 inches thick. Partly weathered siltstone is at a depth of 26 inches.

Permeability is moderately slow in the Steiwer soil. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 4 to 8 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is high.

Included with this complex in mapping are areas of Hazelair, Dupee, and Santiam soils, which make up about 15 percent of the unit.

These soils are used mainly for pasture. The vegetation is Oregon white oak and grasses. These soils are not suitable for cultivated crops because of the excessive slopes. Erosion can be controlled by maintaining a permanent ground cover of perennial grasses and legumes.

No commercial stands of timber are grown on these soils. The soils are poorly suited to growing Christmas trees because of the droughtiness and the steep slopes.

In areas of this complex that are intermingled with cultivated soils, ring-necked pheasant, California quail, and bobwhite quail mar be present. Native grass, Oregon white oak, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

The soils in this complex have major limitations for homesites, commercial buildings, roads and streets, and other community uses because of the slope.

This complex is in capability subclass Vlls.

**17-Cloquato silt loam.** This well drained gently undulating soil is on alluvial bottoms. The soil formed in mixed recent alluvium. It is subject to overflow several times in some years, and it is flooded about once every 3 or 4 years. The soil is traversed by overflow channels and sloughs. It is more than 60 inches deep. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam about 34 inches thick. The upper 11 inches of the substratum is brown fine sandy loam, and the lower part is dark yellowish brown fine sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Newberg and Camas soils, which make up about 5 percent of this map unit, and McBee and Chehalis soils, which make up about 5 percent.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 9 to 15 inches, and the water-supplying capacity is 23 to 25 inches. Runoff is slow, and the hazard of erosion is moderate. Flooding is common in winter and spring.

Most areas of this soil are cultivated. The soil is used for row crops, forage crops, small grain, seed crops, and orchards. It is irrigated for vegetables and many specialty crops. The soil is well suited to most crops grown in the county. The erosion hazard from flood waters can be reduced by planting winter cover crops and installing dikes. Properly managing crop residue and using a cropping system in which grasses and legumes or green manure crops are grown at least 25 percent of the time help to maintain favorable fertility and workability and to reduce runoff and erosion. Crops grown on this soil respond well to fertilizers and amendments.

The use of this soil for orchards or such crops as berries and hops which require installation of poles, increases the hazard of debris accumulation during periods of flooding and may cause severe gullying by flood waters. The soil is irrigated from shallow wells, streams, rivers, and sloughs.

No commercial timber is grown on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops; the fence rows; and the wooded tracts of ash, cottonwood, Douglas-fir, and shrubs furnish good food and cover for ring-necked pheasants, California quail, bobwhite quail, and mourning dove.

Black-tailed deer are permanent residents. Ducks and geese also feed on the soil. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Streambank and roadway plantings, grassed waterways, and fence rows and brushy areas improve cover and food for wildlife. Water from streams is available most of the year. Burning fields, burning fence rows, and clearing wooded and brushy areas destroy cover and food for wildlife.

This soil has major limitations for homesites, commercial buildings, or other community uses because it is subject to occasional flooding.

This soil is in capability subclass llw.

**18-Coburg silty clay loam.** This moderately well drained soil is on terraces above the flood plain in the Willamette Valley. It formed in silty alluvial deposit. Slopes average about 2 percent. Elevation is 180 to 200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silty clay loam about 15 inches thick. The subsoil is very dark grayish brown, dark brown, and dark yellowish brown silty clay that extends to a depth of 60 inches or more. Mottles are common in the subsoil and substratum.

Included with this soil in mapping are areas of Malabon soils, which make up about 10 percent of this map unit, and Chehalis soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 18 to 30 inches in winter and spring.

This soil is well suited to pasture, hay, small grain, grass seed, and vegetable crops. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by a seasonal high water table, unless the soil is drained. Properly managing crop residues and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to reduce runoff and erosion and to maintain productivity and workability. Small grains and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

The soil may be irrigated by sprinkler, furrow, or border irrigation. Sprinkler irrigation is the most common method and is very satisfactory. Irrigation water should be applied carefully at rates low enough to prevent runoff. Irrigation water is available from reservoirs or streams.

The soil has moderate drainage concerns that respond to a subsurface type of drainage. Drainage is needed for maximum use and production. Seepage from soils in higher areas can be controlled by interception and random drains. Runoff is controlled by grassed waterways and vegetative cover in some places.

No commercial stands of timber are grown on this soil. The soil is well suited to Christmas tree production.

The native vegetation of grass, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning doves. Black-tailed deer are permanent residents. Ducks and geese also feed in areas near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

This soil has some limitations for homesites, commercial buildings, and local roads and streets because of low strength. The major limitations for septic tank absorption fields are the moderately slow permeability and the seasonal high water table.

This soil is in capability subclass llw.

**19-Coburg silty clay loam, occasionally flooded.** This moderately well drained soil is on broad low stream terraces above the active flood plain in the Willamette Valley. It formed in silty alluvial deposits. Slopes average about 2 percent. Elevation is 170 to 300 feet. This soil is subject to overflow in some years. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silty clay loam about 15 inches thick. The subsoil is very dark grayish brown, dark brown, and dark yellowish brown silty clay that, extends to a depth of 60 inches or more. Mottles are common in the subsoil and substratum.

Included with this soil are areas of Malabon soils, which make up about 10 percent of this map unit, and Chehalis soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight except during flooding. The soil is occasionally flooded late in winter and early in spring. A seasonal high water table is at a depth of 18 to 30 inches in winter and spring.

This soil is well suited to pasture, hay, small grain, grass seed, and vegetable crops. Long-lived, deeprooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table, unless the soil is drained. Properly managing crop residue and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to reduce runoff and erosion and to maintain productivity and workability.

The hazard of erosion from flood waters can be reduced by seeding winter cover crops. Small grain and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

The soil is irrigated by sprinkler, furrow, or border irrigation. Sprinkler irrigation is the most common method and is very satisfactory. Irrigation water should be applied carefully at rates low enough to prevent runoff. Irrigation water is available from reservoirs or streams.

The soil has moderate drainage concerns that respond to a subsurface type of drainage. Drainage is needed for maximum use and production. Seepage from soils in higher areas can be controlled by interception and random drains. Runoff can be controlled by grassed waterways and vegetative cover in some places.

No commercial stands of timber are grown on this soil. The soil is poorly suited to Christmas tree production because of the flood hazard.

The native vegetation of grass, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents. Ducks and geese also feed in areas that are near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

This soil has some limitations for homesites, commercial buildings, and local roads and streets because of low strength and flooding. The major limitations for septic tank absorption fields are the moderately slow permeability and the seasonal high water table.

This soil is in capability subclass IIw.

**20-Concord silt loam.** This poorly drained soil is on terraces of the Willamette River and its tributaries. It formed in silty and clayey alluvium of mixed mineralogy. Slopes average about 1 percent. Elevation is 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown mottled silty clay loam about 6 inches thick. The subsoil is dark grayish brown mottled silty clay about 17 inches thick. The substratum is dark brown mottled silty clay loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Dayton and Amity soils, which make up as much as 10 percent of this map unit.

Permeability is slow. Effective rooting depth is greater than 60 inches. Available water capacity is 9 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow to very slow or the soil is ponded, and the hazard of erosion is slight. A seasonal high water table is at a depth of less than 6 inches in winter and spring.

This soil is used for grass seed, cereal grain, hay, and pasture. Proper management of crop residues and a cropping system in which grasses or legumes or grass and legume mixtures are grown at least 25 percent of the time help to maintain fertility and tilth.

Small grains and grasses grown on this soil respond to nitrogen, and legumes respond to phosphorus and sulfur. Moderate to high applications of lime are needed to correct acidity.

Irrigation is needed for maximum production of all crops. Water should be applied carefully so that the soil is not overirrigated. Overirrigation causes a high water table. Water is available, at times, from streams and ponds.

This soil needs drainage for maximum production and use. Drainage is generally hard to establish because of poor outlets, seasonal overflow, and inundation from higher areas. The soil responds well to drainage if adequate outlets are provided.

This soil is poorly suited to commercial timber production.

Native areas contain grass, shrubs, and scattered Oregon white oak. A high water table limits the use of this soil to ducks and geese late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues. The rest of the year, ring-necked pheasants, California quail, bobwhite quail, mourning doves, and black-tailed deer move into this area for food and cover. The soil is used mainly by some fur-bearing animals.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of shrink-swell potential and the seasonal high water table.

This soil is in capability subclass IIIw.

**21-Cove silty clay loam.** This poorly drained soil is on alluvial bottoms along tributary streams. It formed in mixed clayey alluvium. Slopes are 0 to 2 percent but average about 1 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark brown silty clay loam about 8 inches thick. The subsoil is black and dark gray clay about 29 inches thick. The substratum is dark gray mottled clay that extends to a depth of 60 inches or more. Mottles are common in the subsoil and substratum.

Included with this soil in mapping are areas of Bashaw and Waldo soils, which make up about 10 percent of this map unit.

Permeability is very slow. Effective rooting depth is less than 40 inches because of a seasonal high water table. Available water capacity is 4 to 6 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is very slow or the soil is ponded, and the hazard of erosion is slight. Flooding is common. A seasonal high water table is at a depth of less than 12 inches in winter.

This soil is used mainly for grass seed, hay, and pasture, and some areas are used for spring grain. Management of crop residue and crop rotation are needed to maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 25 percent of the time improves tilth and yield. Grain and grass crops respond to nitrogen. Legumes need phosphorus, sulfur, boron, potassium, and lime.

The soil is subject to cracking when dry; it takes in water readily until it is saturated and then swells and closes the cracks. Irrigation is difficult, and intake rates vary with moisture content from rapid to very slow. Once the soil is wet, little water enters until it dries and cracks again. A favorable moisture and air relationship is difficult to maintain.

The soil needs drainage, but, as a result of the heavy texture, drainage is confined largely to surface removal of excess water. Tile drainage can be installed, and it is effective if suitable outlets can be provided.

This soil is poorly suited to commercial timber production.

Native areas of this soil contain ash, oak, wild rose, poison-oak, sedges, and grass. The high water table, ponding, and overflow limit the use of this soil to ducks and geese late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residue. The rest of the year, ring-necked pheasants, California quail, bobwhite quail, mourning dove, and black-tailed deer move into this area for food and cover. This soil is used by some fur-bearing animals.

This soil has major limitations for homesites, commercial buildings, roads, and streets, and other community uses because of a high shrink-swell potential, flooding, and the seasonal high water table.

This soil is in capability subclass IVw.

**22-Cove silty clay loam, thick surface.** This poorly drained soil is on alluvial bottoms along tributary streams. It formed in mixed clayey alluvium. The soil is more than 60 inches deep. Slopes average about 1 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark gray silty clay loam about 19 inches thick. The subsoil is very dark gray clay about 24 inches thick. The substratum is gray clay that extends to a depth of 60 inches or more. Mottles are common in the subsoil and substratum.

Included with this soil in mapping are areas of Bashaw and Waldo soils, which make up as much as 10 percent of this map unit.

Permeability is very slow. Effective rooting depth is less than 40 inches because of a seasonal high water table. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is very slow or the soil is ponded, and the hazard of erosion is slight. Flooding is common. A water table is at a depth of less than 12 inches in winter.

This soil is used for small grain, pasture, and hay. Small drained and irrigated acreages are used for vegetables and specialty crops. Deep-rooted perennial crops are not suited to most areas of the soil because adequate drainage generally cannot be maintained in winter and spring. Management of crop residue and crop rotations are needed to maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 25 percent of the time improves tilth and yield. Grain and grass crops respond to nitrogen. Legumes respond to phosphorus, sulfur, boron, and lime. Vegetables and berries respond to nitrogen, phosphorus, potassium, and sulfur.

Sprinkler irrigation is used for vegetable crops, hay, and pasture. Application rates should be low enough to prevent a high water table. Water is available from streams and ponds.

This soil has a high water table late in winter. Some ponding occurs during and after overflow. Drainage can be improved by surface smoothing and open ditches. If adequate outlets are available, deep tile systems are used for drainage. Trenches should be filled with permeable material.

This soil is poorly suited to commercial timber production.

Native areas contain ash, oak, wild rose, poison-oak, sedges, and grass. The high water table, ponding, and overflow limit the use of this soil to ducks and geese from late in fall to early in spring. Waterfowl feed on seeds and tubers from water plants and crop residue. The rest of the year, ring-necked pheasants, California quail, bobwhite quail, mourning dove, and black-tailed deer move into this area for food and cover. This soil is used by some fur-bearing animals.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of the high shrink-swell potential, flooding, and seasonal high water table.

This soil is in capability subclass IIIw.

**23D-Cruiser gravelly loam, bedrock substratum, 3 to 25 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium

weathered from coarse grained igneous rock. Bedrock is at a depth of 40 to 60 inches. Slopes average about 14 percent. Elevation is 2,200 to 3,200 feet. The average annual precipitation is 90 to 100 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is dark reddish brown gravelly loam and loam about 12 inches thick. The subsoil is reddish brown and yellowish red loam about 30 inches thick. Strongly weathered igneous rock is at a depth of 42 inches.

Included with this soil in mapping are areas of Valsetz, Yellowstone, and Luckiamute soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 25 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production (fig. 9), and it is well suited to the production of conifers. The site index for Douglas-fir on this soil is about 135, for western hemlock about 132, and for noble fir about 134. Based on the site index for Douglas-fir, this soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (International rule one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-yearold trees.

Limitations to the use of equipment are slight. The soil is stable and trafficability is good, except during very wet periods. It generally is covered with snow in winter. Roads, skid trails, and landings should be protected by water bars and seeded to grass to control erosion.

The danger of seedling mortality or plant competition is slight. Plant competition is especially difficult to control in poorly stocked areas. Natural regeneration is fair, and some supplementary site preparation and planting is needed. Weeding and thinning may be required for good development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vle.

**23E-Cruiser gravelly loam, bedrock substratum, 25 to 50 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from coarse grained igneous rock. It is underlain by bedrock at a depth of 40 to 60 inches. Slopes average about 35 percent. Elevation is 2,200 to 3,200 feet. The average annual precipitation is 90 to 100 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is dark reddish brown gravelly loam and loam about 12 inches thick. The subsoil is reddish brown and yellowish red loam about 30 inches thick. Strongly weathered igneous rock is at a depth of 42 inches.

Included with this soil in mapping are areas of Valsetz, Yellowstone, and Luckiamute soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 25 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is well suited to the production of conifers. The site index for Douglas-fir on this soil is about 135, for western hemlock about 132, and for noble fir about 134. Based on the site index for Douglas-fir, this soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (International rule, one fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. The soil is stable and trafficability is good except in very wet periods. It generally is covered with snow in winter. Roads, skid trails, and landings'should be protected by water bars and seeded to grass to control erosion.

The hazard of seedling mortality or plant competition is slight. Plant competition is especially difficult to control in poorly stocked areas. Natural regeneration is fair, and some supplementary site preparation and planting is needed. Weeding and thinning may be required for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vle.

**23F-Cruiser gravelly loam, bedrock substratum, 50 to 70 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from coarse grained igneous rock. It is underlain by bedrock at a depth of 40 to 60 inches. Slopes average about 60 percent.

Elevation is 2,200 to 3,200 feet. The average annual precipitation is 90 to 100 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is dark reddish brown gravelly loam and loam about 12 inches thick. The subsoil is reddish brown and yellowish red loam about 30 inches thick. Strongly weathered igneous rock is at a depth of 42 inches.

Included with this soil in mapping are areas of Valsetz, Yellowstone, and Luckiamute soils, and Rock outcrop which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 25 inches. Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is well suited to the production of conifers. The site index for Douglas-fir on this soil is about 135, for western hemlock about 132, and for noble fir about 134. Based on the site index for Douglas-fir, this soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (International rule, one fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major on this soil. The slope limits most operations to cable logging, aerial seeding, and weeding. The slope and areas of rock outcrop interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of the slope. This soil is generally covered with snow in winter. Roads, skid trails, and landings should be protected by water bars and seeded to grass to control erosion.

Danger of seedling mortality or plant competition is slight. Natural regeneration is fair, and some supplementary site preparation and planting is needed. Weeding and thinning may be required for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIIe.

**24D-Cumley silty clay loam, 2 to 20 percent slopes.** This moderately well drained soil is in the mountains of the Coast Range. It formed in residuum and colluvium weathered from basic igneous and sedimentary rock. Slopes average about 12 percent. Elevation is 800 to 1,400 feet. The average annual precipitation is 55 to 75 inches, the average annual air temperature is about 46 to 51 degrees F, and the frost-free period is 165 to 190 days.

In a representative profile, the surface layer is very dark brown and very dark grayish brown silty clay loam about 7 inches thick. The subsoil is brown mottled silty clay and clay 38 inches thick. The substratum is mottled grayish brown clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Apt and Honeygrove soils, which make up about 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 9 to 12 inches, and the water-supplying capacity is 22 to 26 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is used for timber production, and it is well suited for the production of Douglas-fir. Bigleaf maple and alder are in stands of fir. The site index for Douglas-fir on this soil ranges from about 150 to 170, and the average site index is about 155. Based on the average site index, this soil is capable of producing about 12,400 cubic feet, or 65,800 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic, limiting trafficability, and it is severely compacted. Cable logging is desirable because tractor logging causes excessive disturbance. Roads require a maximum of base rock for all-season use. Roads and landings may need water bars and grass seeding to prevent erosion.

Plant competition is a major limitation. Brush and fern competition is especially difficult to control in non-stocked, cutover areas. There is little danger of seedling mortality. The water-supplying capacity is good, and the climatic zone is favorable. Natural regeneration is good but may need to be supplemented with site preparation seeding and planting. Weeding and thinning are needed for good stand development. There is some hazard of windthrow.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the. Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use this area for food and cover. Numerous draws and drainageways are available for small ponds on this soil. Except for a few major creeks and springs, the drainageways are dry late in summer.

The moderately slow permeability, the high shrink-swell potential, and the seasonal high water table are the major limitations to homesites. This soil is in capability subclass Vle.

**25-Dayton silt loam.** This poorly drained soil is on terraces of the Willamette River and its tributaries. It formed in silty and clayey alluvium or lacustrine sediment. Slopes average about 1 percent. Elevation is 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is grayish brown silty clay loam about 7 inches thick. The subsoil is gray and grayish brown clay about 30 inches thick. The substratum is grayish brown silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Amity and Concord soils, which make up about 5 percent of this map unit.

Permeability is very slow. Effective rooting depth is 30 to 40 inches. Available water capacity is 2 to 5 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow to very slow or the soil is ponded, and the hazard of erosion is slight. A seasonal high water table is at a depth of less than 24 inches in winter and spring.

The soil is used for grass seed, hay, pasture, and some spring grain. Properly managing crop residue and using a cropping system that includes grasses and legumes or grass and legume mixtures at least 25 percent of the time help to maintain and increase productivity and workability and, in some areas, to prevent erosion. Moderate to high applications of lime are needed to correct acidity.

If the soil is irrigated, care must be taken to prevent overirrigation and drowning of crops. The soil needs drainage for maximum production and use. Drainage is difficult to establish because outlets are inadequate and the slowly permeable clay subsoil is at a shallow depth. Because of the shallow depth to clay, tiles need to be placed below the clay subsoil and at close intervals. Subsurface drainage is difficult to establish in areas where a thick clayey substratum underlies the clay subsoil. Unless adequate outlets can be provided, tile drainage in these areas is not very effective. Even with drainage, the control of the water table is difficult. If suitable outlets for tile cannot be established, drainage is confined to surface removal of excess water.

This soil is poorly suited for commercial timber production.

Native areas contain ash, willow, sedges, and grass and shrubs. The high water table and ponding limit the use of this soil to ducks and geese from late in fall to early in spring. Waterfowl feed on seeds and tubers from water plants and crop residue. The rest of the year, ring-necked pheasants, California quail, bobwhite quail, mourning dove, and black-tailed deer move into this area for food and cover. This soil is used by some fur-bearing animals.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of the high shrink-swell potential and the seasonal high water table.

This soil is in capability subclass IVw.

**26C-Dixonville silty clay loam, 3 to 12 percent slopes.** This well drained soil is on low foothills and the higher rolling uplands. It formed in colluvium weathered from basic igneous rock. Bedrock is at a depth of 20 to 40 inches. Slopes average about 8 percent. Elevation is 250 to 750 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam and silty clay about 16 inches thick. The subsoil is dark reddish brown clay about 23 inches thick. Partly weathered basalt is at a depth of 39 inches.

Included with this soil in mapping are areas of Philomath soils, which make up about 10 percent of this map unit, and Nekia and Ritner soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 17 to 23 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for forage crops and forest products. A small acreage is used for cereal grain, pasture, and grass seed. The soil is moderately productive for these crops. It is not so productive or so easily tilled as some soils on terraces or bottom lands.

This soil responds well to fertilizer and amendments. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields. Management of crop residue and crop rotation are needed to maintain productivity and workability and to reduce runoff and erosion. A crop rotation system that includes grasses and legumes or a grass and legume mixture improves tilth and yields.

This soil produces fair stands of Douglas-fir trees. It is well suited to Christmas trees. Stands of Oregon white oak are mixed with Douglas-fir and grand fir on this soil. The site index for Douglas-fir on this soil ranges from 110 to 120. Based on the average site index of 115, this soil is capable of producing about 7,900 cubic feet, or 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber for a fully stocked, even-aged stand of 80-year-old trees.

This soil is plastic and sticky when wet, restricting trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills.

The crops grown on this soil provide food and cover for ring-necked pheasant, valley quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons are common in areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The main limitation of this soil for homesites is the slow permeability for septic tank filter fields. Most areas of this soil are not on community sewage systems.

This soil is in capability subclass IIIe.

**26D-Dixonville silty clay loam, 12 to 20 percent slopes.** This well drained soil is on low foothills and the higher rolling uplands. It formed in colluvium weathered from basic igneous rock. Bedrock is at a depth of 20 to 40 inches. Slopes average about 15 percent. Elevation is 30 to 750 feet. The average annual precipitation is 40 to 60 inches, average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam and silty clay about 16 inches thick. The subsoil is dark reddish brown clay about 23 inches thick. Partly weathered basalt is at a depth of 39 inches.

Included with this soil in mapping are areas of Philomath soils, which make up about 10 percent of this map unit, and Nekia and Ritner soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 17 to 23 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for forage crops and forest products. A small acreage is used for cereal grain, pasture, and grass seed. The soil is moderately productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizer and amendments. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields. Management of crop residue and crop rotation are needed to maintain productivity and workability and to reduce runoff and erosion. A crop rotation system that includes grasses and legumes or a grass and legume mixture improves tilth and yields.

These soils generally are not irrigated. Irrigation water generally must be stored in reservoirs, and suitable reservoir sites are limited.

This soil produces fair stands of Douglas-fir trees. Stands of Oregon white oak are mixed with Douglas-fir and grand fir on the soil. The site index for Douglas-fir on this soil ranges from 110 to 120. Based on an average site index of 115, this soil is capable of producing about 7,900 cubic feet, or 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber for a fully stocked, even-aged stand of 80-year-old trees.

This soil is plastic and sticky when wet, restricting trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills.

The crops grown on this soil provide food and cover for ring-necked pheasant, valley quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, western hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The main limitations for homesites and septic tank filter fields are the slow permeability and the slope. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIIe.

**27C-Dupee slit loam, 3 to 12 percent slopes.** This somewhat poorly drained soil is in swales and depressions and on foothills. It formed in colluvium overlying weathered sedimentary bedrock. Slopes average about 7 percent. Elevation is 250 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam about 9 inches thick. The subsurface layer is dark yellowish brown silty clay loam about 8 inches thick. The upper 7 inches of the subsoil is mottled, dark yelowish brown silty clay loam, and the lower 27 inches is mottled, dark yellowish brown and brown silty clay. The substratum is mottled, grayish brown, gray, and yellowish brown clay that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Chehulpum, Steiwer, and Willakenzie soils, which make up about 5 percent of this map unit, and Bellpine and Jory soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 12 to 14 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow and the hazard of erosion is slight. A seasonal high water table is at a depth of 24 to 36 inches in winter.

This soil is used for cereal grain, pasture, hay, and woodland. Erosion can be controlled by cross-slope farming and winter cover crops or by interception ditches and rough tillage. Planting grasses in drainageways helps to prevent gullying. Management of crop residue and crop rotation are needed to reduce runoff and erosion and to maintain productivity and workability. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 50 percent of the time help control erosion, increase fertility, and improve tilth.

Grains and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

This soil generally is not irrigated. Water for irrigation needs to be stored in reservoirs if adequate sites are available. The soil needs drainage for maximum production and use. Open drainage ditches are subject to erosion unless they are properly laid out. Drainage can generally be accomplished by using interceptor drains and by using a random ditch system to drain wet spots in depressions. Runoff from higher soils can be intercepted by open ditches or grassed waterways.

No commercial stands of timber are on this soil. The soil is poorly suited to Christmas tree production.

The crops on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting suited trees, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife. Gophers, squirrels, and other burrowing animals are common pests.

This soil has some limitations for homesites, commercial buildings, and local roads and streets because of wetness, the moderate shrink-swell potential, and low strength. It has major limitations for septic tank absorption fields because of the moderately slow permeability and wetness. The soil has major limitations for sewage lagoons and sanitary landfills because of wetness.

This soil is in capability subclass IIIe.

**27D-Dupee silt loam, 12 to 20 percent slopes.** This somewhat poorly drained soil is in swales and depressions and on foothills. It formed in colluvium overlying weathered sedimentary bedrock. Slopes average about 16 percent. Elevation is 250 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam about 9 inches thick. The subsurface layer is dark yellowish brown silty clay loam about 8 inches thick. The upper 7 inches of the subsoil is mottled, dark yellowish brown silty clay loam, and the lower 27 inches is mottled, dark yellowish brown and brown silty clay. The substratum is mottled, grayish brown, gray, and yellowish brown clay that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Chehulpum, Steiwer, and Willakenzie soils, which make up about 5 percent of this map unit, and Bellpine and Jory soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 12 to 14 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 24 to 36 inches in winter.

This soil is used for cereal grain, pasture, hay, and woodland. Erosion can be controlled by cross-slope farming and winter cover crops or by interception ditches and rough tillage. Planting grasses in drainageways helps to prevent gullying. Management of crop residue and crop rotation are needed to reduce runoff and erosion and to maintain productivity and workability. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 75 percent of the time help to control erosion, increase fertility, and improve tilth.

Grains and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

This soil generally is not irrigated. If irrigated, sprinkler irrigation is suitable. Water for irrigation needs to be stored in reservoirs if adequate sites are available. The soil needs drainage for maximum production and use. Drainage can be accomplished by using subsurface interceptor drains.

No commercial stands of timber are grown on this soil. The soil is poorly suited to Christmas tree production.

The crops grown on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting suited tree species, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife. Gophers, squirrels, and burrowing animals are common pests.

This soil has major limitations for homesites, commercial buildings, and local roads and streets because of the slope and wetness of the soil. It has major limitations for septic tank absorption fields because of the slope, moderately slow permeability, and wetness. The soil also has major limitations

for sewage lagoons and sanitary landfills because of wetness.

This soil is in capability subclass IVe.

**28-Grande Ronde silty clay loam.** This somewhat poorly drained soil is on terraces and in swales of low hills. It formed in mixed old clayey alluvial deposit. Slopes are 0 to 2 percent but average about 1 percent. Elevation is 275 to 400 feet. The average annual precipitation is about 60 to 80 inches, the average annual air temperature is 49 to 50 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silty clay loam about 7 inches thick. The upper 19 inches of the subsoil is dark brown, mottled silty clay, and the lower 9 inches is grayish brown, mottled clay. The substratum is grayish brown and yellowish brown, mottled clay that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Waldo, Cove, and McAlpin soils, which make up about 15 percent of this map unit.

Permeability is slow. Effective rooting depth is about 35 to 50 inches. Available water capacity is 5 to 7.5 inches, and the water-supplying capacity is 18 to 22 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 18 to 24 inches in winter.

This soil is used for pasture, forage, and small grain. A seasonal high water table limits the use, but the wetness can be reduced by adequate drainage. If the soil is not drained, climatically suited water-tolerant crops grow well if they need only a somewhat restricted root zone. Water-tolerant grasses and legumes are fairly productive without drainage. The soil needs drainage, however, for maximum production and use. Drainage is generally hard to install because of unavailable outlets, seasonal overflow, and inundation from higher soils. This soil responds readily to drainage if adequate outlets are provided. After the soil is adequately drained, all climatically suited crops are likely to grow well. Adequate drainage permits the use of a wider variety of grasses, legumes, and small grains and allows earlier and later growth.

Irrigation is needed for maximum production of all crops. Water should be applied carefully so that the soil is not overirrigated. Overirrigation causes a high water table. Water is sometimes available from streams and ponds.

This soil is poorly suited to commercial timber production.

A seasonal high water table, flooding, and ponding make this soil suitable for ducks late in winter and in spring. Waterfowl feed on seeds and tubers from water plants and crop residue on well drained soils adjacent to this soil. California quail, bobwhite quail, mourning doves, and black-tailed deer use this area for food and cover the rest of the year. The soil is also used by fur-bearing animals. Grouse and band-tailed pigeons are uncommon.

Water-control structures, such as dikes, small dams, and drainage ditches, improve the habitat for ducks in winter and for other game species the rest of the year. Cover and food supplies are also improved by plantings along streambanks, ditch banks, and roadways, and by maintaining fence rows, wood lots, and brushy areas. Protecting field and fence rows from burning enhances food supplies and cover for wildlife.

This soil has major limitations for septic tank absorption fields because of the seasonal high water table and the slow percolation rate. There is some hazard for dwellings without basements, small commercial buildings, and local roads and streets because of the seasonal high water table and the shrink-swell potential. Dwellings can be designed to offset the shrinking and swelling. The soil can be used for roadfill but is limited by the seasonal high water table, shrink-swell potential, and low strength.

This soil is in capability subclass IIIw.

**29C-Hazelair silt loam, 3 to 12 percent slopes.** This moderately well drained to somewhat poorly drained soil is on low, convex foothills. The soil formed in clayey colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 7 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is very dark grayish brown, mottled silty clay loam about 7 inches thick. The substratum is grayish brown and light olive brown, mottled clay about 21 inches thick. Weathered sedimentary bedrock is at a depth of 38 inches.

Included with this soil in mapping are areas of Bellpine, Suver, Chehulpurii, Dupee, Steiwer, and Wiilakenzie soils, which make up about 10 percent of this map unit.

Permeability is slow. Effective rooting depth is 24 to 30 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 12 to 24 inches in winter and spring.

This soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Organic-matter content can be maintained or improved by returning all crop residue to the soil and using a soil-building cropping system for 50 to 75 percent of the rotation. Sheet and rill erosion can be controlled by cross-slope farming and grassed waterways.

Grain and grass crops respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime generally is required to reduce acidity.

This soil generally is not irrigated. If irrigated, irrigation water needs to be stored in reservoirs. The soil needs drainage for maximum production and use. Open drainage ditches are subject to erosion unless they are carefully laid out. Drainage generally can be accomplished by interceptor drainageways and some random lines to drain wet spots in the lower areas. Deep, underground tile systems intercept and remove excess water caused by the perched water table and seepage in winter and early in spring.

No commercial stands of timber are grown on this soil. This soil is poorly suited to Christmas tree production because of the seasonal high water table and the clayey subsoil.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites and commercial buildings because of the seasonal high water table, the shrink-swell potential in the subsoil, and the limited ability to support a load. Dwellings can be designed to offset the last two limitations. There is some hazard for local roads and streets because of the shrink-swell potential and the seasonal high water table. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, seasonal high water table, and slow permeability.

This soil is in capability subclass IIIe.

**29D-Hazelair silt loam, 12 to 20 percent slopes.** This moderately well drained to somewhat poorly drained soil is on low, convex foothills. The soil formed in clayey colluvium weathered from sedimentary rock. Siltstone bedrock is at a depth of 20 to 40 inches. Slopes average about 16 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam and silty clay loam about 10 inches thick. The subsoil is very dark grayish brown, mottled silty clay loam about 7 inches thick. The substratum is grayish brown and light olive brown, mottled clay about 21 inches thick. Weathered sedimentary bedrock is at a depth of 38 inches.

Included with this soil in mapping are areas of Bellpine, Suver, Chehulpum, Dupee, Steiwer, and Willakenzie soils, which make up about 10 percent of this map unit.

Permeability is slow. Effective rooting depth is 24 to 30 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 12 to 24 inches in winter and spring.

The soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Cross-slope tillage and planting and a winter cover crop help to control erosion. Grassed waterways help to remove excess water. Limiting tillage to seedbed preparation and weed control and leaving the soil cloddy in rainy periods help to protect the soil from erosion. A cropping system that uses soil-building crops for more than 75 percent of the rotation is suitable.

Grain and grasses respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity.

This soil generally is not irrigated. Where irrigation is possible, water needs to be stored in reservoirs. Limited drainage can be accomplished by using interceptor drains and some random lines to drain wet spots in the lower soil areas. Installing deep, underground tile systems across the slopes intercepts and removes excess water caused by a perched water table and seepage in winter and early in spring.

No commercial stands of timber are grown on this soil. It is poorly suited to Christmas tree production because of the seasonally high water table, excessive slope, and clayey subsoil.

Crops grown on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites and commercial buildings because of the seasonal high water table, the shrink-swell potential in the subsoil, and the limited ability of the soil to support a load. Dwellings can be designed to offset these latter limitations. The hazards for local roads and streets are the shrink-swell potential and the seasonal high water table. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, seasonal high water table, and slow permeability.

This soil is in capability subclass IVe.

**29E-Hazelair slit loam, 20 to 30 percent slopes.**
This moderately well drained to somewhat poorly drained soil is on low, convex foothills. The soil formed in clayey colluvium weathered from sedimentary rock. Siltstone bedrock is at a depth of 20 to 40 inches. Slopes average about 25 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam and silty clay loam 10 inches thick. The subsoil is very dark grayish brown, mottled silty clay loam about 7 inches thick. The substratum is grayish brown and light olive brown, mottled clay about 21 inches thick. Weathered sedimentary bedrock is at a depth of 38 inches.

Included with this soil in mapping are areas of Bellpine, Suver, Chehulpum, Dupee, Steiwer, and Willakenzie soils, which make up about 10 percent of this map unit.

Permeability is slow. Effective rooting depth is 24 to 30 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is rapid, and the hazard of erosion is high. A seasonal high water table is at a depth of 12 to 24 inches in winter and spring.

The soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Cross-slope tillage and planting and a winter cover crop help to control erosion. Grassed waterways help to remove excess water. Limiting tillage to seedbed preparation and weed control and leaving the soil cloddy during rainy periods help to protect the soil from erosion. A cropping system that uses soil-building crops for more than 75 percent of the rotation is suitable.

Grain and grass crops respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity.

This soil generally is not irrigated because of the slope and drainage concerns.

No commercial stands of timber are grown on this soil. It is poorly suited to Christmas tree production because of the seasonal high water table, excessive slope, and clayey subsoil.

Crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees and shrubs and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Planting grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites, commercial buildings, and local roads and streets because of the slope, the seasonal high water table, the high shrink-swell potential in the subsoil, and the limited ability of the soil to support a load. Dwellings and road construction can be designed to offset the last three limitations. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, the seasonal high water table, the excessive slope, and the slow permeability. It has some limitations for recreational use because of the slope and seasonal high water table.

This soil is in capability subclass IVe.

**30C-Helmick slit loam, 3 to 12 percent slopes.**
This somewhat poorly drained soil is on slightly convex foot slopes and ridges. It formed in colluvium weathered from sedimentary bedrock. Slopes average about 7 percent. Elevation is 250 to 400 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 49 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown heavy silty clay loam about 6 inches thick. The substratum is grayish brown, gray, light brownish gray, and strong brown clay that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Bellpine, Suver, Steiwer, Dupee, and Willakenzie soils, which make up about 10 percent of this map unit, and Hazelair soils, which make up 5 percent.

Permeability is very slow. Effective rooting depth is 20 to 36 inches. Available water capacity is 5.5 to 7.5 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 12 to 24 inches in winter and early in spring.

This soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Organicmatter content and tilth can be maintained or improved by returning all crop residue to the soil and using a cropping system in which grasses, legumes, or grass and legume mixtures are grown at least 50 to 75 percent of the time. Sheet and rill erosion can be controlled by cross-slope farming and grassed waterways.

Grain and grasses respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity.

This soil generally is not irrigated. In areas where irrigation is possible, water needs to be stored in reservoirs. The soil needs drainage for maximum production and use. Open drainage ditches are subject to erosion unless they are carefully laid out.

Drainage generally can be accomplished by interceptor drainageways and some random lines to drain wet spots in the lower areas. Deep, underground tile systems intercept and remove excess water caused by the perched water table and seepage in winter and early in spring.

No commercial stands of timber grow on this soil. The soil is poorly suited to Christmas tree production because of the seasonal high water table and clayey subsoil.

Crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak and other trees, shrubs, and grasses, ruffed grouse, mountain quail, and band-tailed pigeon are common. These birds feed on the fruit and seeds of trees and shrubs. Blacktailed deer are common in cultivated and uncultivated areas. Using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas provide cover and food for wildlife.

The soil has major limitations for homesites and commercial buildings because of the seasonal high water table, the shrink-swell potential in the subsoil, and the limited ability of the soil to support a load. Dwellings can be designed to offset some of these limitations. There is some hazard for local roads and streets because of the shrink-swell potential and the seasonal high water table. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the slope, the clayey subsoil, the seasonal high water table, and the very slow permeability.

This soil is in capability subclass IIIe.

**30D-Helmick silt loam, 12 to 20 percent slopes.** This somewhat poorly drained soil is on slightly convex foot slopes and ridges. It formed in colluvium weathered from sedimentary bedrock. Slopes average about 16 percent. Elevation is 250 to 400 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 49 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown heavy silty clay loam about 6 inches thick. The substratum is grayish brown, gray, light brownish gray, and strong brown clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Bellpine, Suver, Steiwer, Dupee, and Willakenzie soils, which make up about 10 percent of this map unit, and Hazelair soils, which make up 5 percent.

Permeability is very slow. Effective rooting depth is 20 to 36 inches. Available water capacity is 5.5 to 7.5 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 12 to 24 inches in winter and early in spring.

This soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Cross-slope tillage and planting and a winter cover crop is needed to help control erosion. Grassed waterways help to remove excess water. Limiting tillage to seedbed preparation and weed control and leaving the soil cloddy in rainy periods help to protect the soil from erosion. Organic-matter content and tilth can be maintained or improved by returning all crop residue to the soil and using a cropping system in which grasses, legumes, or grass and legume mixture are grown at least 50 to 75 percent of the time.

Grain and grasses respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity.

This soil generally is not irrigated. In areas where irrigation is possible, water needs to be stored in reservoirs. Limited drainage can be accomplished by interceptor drains and some random lines to drain wet spots in the lower areas. Deep underground tile systems installed across the slopes intercept and remove excess water caused by a perched water table and seepage in winter and early in spring.

No commercial stands of timber grow on this soil. The soil is poorly suited to Christmas tree production because of the seasonal high water table, excessive slope, and clayey subsoil.

Crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak and other trees, shrubs, and grasses, common birds are ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Using grasses waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites and commercial buildings because of the slope, seasonal high water table, shrink-swell potential in the subsoil, and the limited ability of the soil to support a load. Dwellings can be designed to offset these latter limitations. There is some hazard for local roads and streets because of the shrink-swell potential and the seasonal high water table. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the slope, the clayey subsoil, the seasonal high water table, and very slow permeability.

This soil is in capability subclass IVe.

**30E-Helmick silt loam, 20 to 50 percent slopes.** This somewhat poorly drained soil is on slightly convex foot slopes and ridges. It formed in colluvium weathered from sedimentary bedrock. Slopes average about 36 percent. Elevation is 250 to 400 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 49 to 54 degrees F, and

the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is dark brown silt loam and silty clay loam about 10 inches thick. The subsoil is dark brown heavy silty clay loam about 6 inches thick. The substratum is grayish brown, gray, light brownish gray, and strong brown clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Bellpine, Suver, Dupee, and Willakenzie soils, which make up about 10 percent of this map unit, and Hazelair soils, which make up 5 percent.

Permeability is very slow. Effective rooting depth is 20 to 36 inches. Available water capacity is 5.5 to 7.5 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is rapid, and the hazard of erosion is high. A seasonal high water table is at a depth of 12 to 24 inches in winter and early in spring.

This soil is used predominantly for hay and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Management of orchards and other cultivated crops is difficult because of the slope. Cross-slope tillage and planting and a winter cover crop are needed to help control erosion. Grassed waterways help remove excess water. Limiting tillage to seedbed preparation and weed control and leaving the soil cloddy in rainy periods help to protect the soil from erosion. In cultivated areas, organic-matter content and tilth can be maintained or improved by returning all crop residues to the soil and using a cropping system in which grasses, legumes, or grass and legume mixtures are grown at least 50 to 75 percent of the time.

Grain and grass crops respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity.

This soil generally is not irrigated because of the excessive slope and inherent drainage concerns.

No commercial stands of timber grow on this soil. This soil is poorly suited to Christmas tree production because of the seasonal high water table, the excessive slope, and the clayey subsoil.

Crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak and other trees, shrubs, and grasses, common birds are ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in cultivated and uncultivated areas. Using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites, commercial buildings, and local roads and streets because of the excessive slope, the seasonal high water table, the shrink-swell potential in the subsoil, and the limited ability to support a load. Dwelling and road construction can be designed to offset the last three limitations. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, the seasonal high water table, the excessive slope, and the very slow permeability. This soil also has some limitations for recreation because of the slope and seasonal high water table.

This soil is in capability subclass VIe.

**31C-Helvetia silt loam, 0 to 12 percent slopes.**

This moderately well drained soil is on broad terraces above the flood plain in the Willamette Valley. It formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 8 percent. Elevation is 240 to 400 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 15 inches thick. The subsoil is dark yellowish brown, brown, and dark brown silty clay loam that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Steiwer, Chehulpum, Hazelair, Willakenzie, and Woodburn soils, which make up about 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 22 to 26 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 36 to 72 inches in winter and early in spring.

This soil is well suited to small grain, seed crops, vegetables, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table unless the soil is drained. Management of crop residue and crop rotation help to reduce runoff and erosion and to maintain productivity and workability. The crop rotation system commonly includes grasses, legumes, or a grass and legume mixture at least 25 to 50 percent of the time. If berries and orchard trees are grown, a well-fertilized cover crop planted in fall protects the soil in winter.

Grain and grasses need nitrogen fertilizer. Legumes respond to phosphorus, boron, and sulfur. Lime is generally required to reduce acidity. Vegetable crops respond to nitrogen, phosphorus, and potassium. Excessive cultivation can cause a tillage pan, which can be broken by subsoiling.

Sprinkler irrigation is used for some crops. Irrigation water should be applied carefully at rates low enough to prevent runoff. Water for irrigation is obtained from ponds or deep wells.

In winter months and early in spring, this soil receives seepage from higher lying soils and a perched water table can form. Deep tile drains can be installed to intercept and remove excess water and lengthen the season of use. Subsoiling

across the tile lines improves the efficiency of the system. Runoff may be controlled by grassed waterways and vegetative cover.

No commercial stands of timber grow on this soil, but the soil is well suited to Christmas tree production.

The native vegetation of grasses, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Blacktailed deer are permanent residents. Ducks and geese also feed in areas near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

The soil has some limitations for homesites, commercial buildings, and local roads and streets because of low stength. It has major limitations for septic tank absorption fields, sanitary landfills, and sewage lagoons because of slow permeability and the seasonal high water table.

This soil is in capability subclass IIIe.

**31D-Helvetia slit loam, 12 to 20 percent slopes.** This moderately well drained soil is on broad terraces above the flood plain in the Willamette Valley. It formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 16 percent. Elevation is 240 to 400 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 15 inches thick. The subsoil is dark yellowish brown, brown, and dark brown silty clay loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Steiwer, Chehulpum, Hazelair, Willakenzie, and Woodburn soils, which make up about 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 22 to 26 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 36 to 72 inches in winter and early in spring.

This soil is well suited to small grain, grass seed, hay, and pasture and, in some places, to orchards. Longlived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by a seasonal high water table unless the soil is drained. Management of crop residue and crop rotation help reduce runoff and erosion and to maintain productivity and workability. The crop rotation system commonly includes grasses, legumes, or a grass and legume mixture at least 75 percent of the time. If berries and orchard trees are grown, a well-fertilized cover crop planted in fall protects the soil in winter. Tilling and planting across the slope help to reduce runoff and erosion.

Grain and grasses respond to nitrogen fertilizer. Legumes respond to phosphorus, sulfur, and boron. Lime is generally required to reduce acidity. Orchard trees respond to nitrogen, potassium, and boron. Excessive cultivation can cause a tillage pan that can be broken by subsoiling.

Irrigation is moderately difficult because of the slope. Sprinkler irrigation is used for some crops. Irrigation water should be applied carefully at rates low enough to prevent excessive runoff. Water for irrigation is obtained from ponds, or deep wells.

In winter and early in spring, this soil receives seepage from higher lying soils, and deep, underground tile systems installed across the slope help to intercept and remove excess water. Runoff may be reduced by grassed waterways and vegetative cover.

No commercial stands of timber grow on this soil. The soil is poorly suited to Christmas tree production because of the slope.

The native vegetation of grasses, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Blacktailed deer are permanent residents. Ducks and geese also feed in areas near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadsides, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

The soil has major limitations for homesites, commercial buildings, and local roads and streets because of the slope and seasonal high water table. It also has major limitations for septic tank absorption fields, sanitary landfills, and sewage lagoons because of the slow permeability, excessive slope, and seasonal high water table.

This soil is in capability subclass IVe.

**32D-Hembre gravelly silt loam, 3 to 25 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from basalt rock. Basalt is at a depth of 40 to 60 inches. Slopes average about 14 percent. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 47 to 50 degrees F, and the frost-free period is about 145 to 180 days.

In a representative profile, the surface layer is dark reddish brown gravelly silt loam about 10 inches thick. The subsoil is dark reddish brown and reddish brown silty clay loam about 44 inches thick. Basalt is at a depth of 54 inches.

Included with this soil in mapping are areas of Marty, Klickitat, and Blachly soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 10 inches, and the water-supplying capacity is 22 to 24 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. It is very well suited to the production of Douglas-fir. Western hemlock is mixed with fir at higher elevations. The site index for Douglas-fir on this soil ranges from about 160 to 180, and the average site index is about 170. Based on this average site index, the soil is capable of producing about 14,500 cubic feet, or 78,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Trafficability is good except during very wet periods. There are some limitations to the use of equipment, and cable logging causes minimum disturbance. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is especially difficult to control and is a major limitation on the lower areas and moist areas. In moist areas, alder, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The water-supplying capacity is good, and the climatic zone is favorable. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**32E-Hembre gravelly silt loam, 25 to 50 percent slopes.** This well drained soil is in the mountains of the Coast Range. This soil formed in residuum and colluvium weathered from basalt rock. Basalt is at a depth of 40 to 60 inches. Slopes average about 35 percent. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 47 to 50 degrees F, and the frost-free period is about 145 to 180 days.

In a representative profile, the surface layer is dark reddish brown gravelly silt loam about 10 inches thick. The subsoil is dark reddish brown and reddish brown silty clay loam about 44 inches thick. Basalt is at a depth of 54 inches.

Included with this soil in mapping are areas of Marty, Klickitat, and Blachly soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 10 inches, and the water-supplying capacity is 22 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. It is very well suited to the production of Douglas-fir. Western hemlock is mixed with fir at higher elevations. The site index for Douglas-fir on this soil ranges from about 160 to 180, and the average index is about 170. Based on this average site index, the soil is capable of producing about 14,500 cubic feet, or 78,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Trafficability is good except during very wet periods. There are some limitations to the use of equipment, and cable logging causes minimum disturbance. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is a slight hazard but it is a major limitation in lower areas and moist areas. In moist areas, alder, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The watersupplying capacity is good, and the climatic zone is favorable. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of the low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**32F-Hembre gravelly silt loam, 50 to 75 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from basalt rock. Basalt is at a depth of 40 to 60 inches. Slopes average about 65 percent. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 47 to 50 degrees F, and the frost-free period is about 145 to 180 days.

In a representative profile, the surface layer is dark reddish brown gravelly silt loam about 10 inches thick. The subsoil is dark reddish brown and reddish brown silty clay loam about 44 inches thick. Basalt is at a depth of 54 inches.

Included with this soil in mapping are areas of Marty, Klickitat, and Blachly soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 10 inches, and the water-supplying capacity is 22 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. It is very well suited to the production of Douglas-fir. The site index for Douglas-fir on this soil ranges from about 160 to 180, and the average index is about 170. Based on this average site index, the soil is capable of producing about 14,500 cubic feet, or 78,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight; however, the slope limits most operations to cable logging and aerial seeding and weeding. Construction and maintenance of roads is difficult because of the slope and hazard of slides. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is a slight hazard, but it is a major limitation on the lower areas and moist areas. In moist areas, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The watersupplying capacity is good, and the climatic zone is favorable. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass VIIe.

**33-Holcomb silt loam.** This somewhat poorly drained soil is on smooth terraces. It formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent but average about 1 percent. Elevation is 220 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown, mottled silt loam about 12 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 6 inches thick. The upper 6 inches of the subsoil is grayish brown, mottled light silty clay loam, and the lower part is dark grayish brown, mottled clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Willamette, Woodburn, Amity, Dayton, and Concord soils, which make up as much as 10 percent of this map unit.

Permeability is very slow. Effective rooting depth ranges from 20 to 30 inches. Available water capacity is 5 to 8 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 12 to 15 inches late in fall, in winter, and early in spring.

Most areas of this soil are cleared and used for grain, seed crops, hay, and pasture. Restricted drainage is a moderately severe limitation to crops. In undrained areas, the seasonal high water table limits the choice of crops. Deep-rooted crops do not grow well, and most crops are adversely affected by the excess moisture. This soil can be used, however, for many row crops; and it can be used for small grain, forage crops, and grass seed.

In dry summer months, irrigation is needed for vegetables. Irrigation water must be applied frequently. Drainage is needed to make these soils better suited to crops, and drainage is difficult because of the very slowly permeable layer in the subsoil and the lack of adequate outlets.

Properly managing crop residue and using a cropping system in which grasses and legumes or grass and legume mixtures are grown at least 25 percent of the time help to maintain fertility and workability.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and lime.

No commercial stands of timber grow on this soil.

Native areas contain ash, willow, sedges, and grasses. The seasonal high water table limits the use of the soil to ducks and geese and late in fall, in winter, and early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues on well drained soils adjacent to this soil. During the rest of the year, ringnecked pheasant, California quail, bobwhite quail, mourning dove, and black-tailed deer move into the area for food and cover. This soil is used by fur-bearing animals.

The Holcomb soil exhibits many major soil limitations restricting its use for commercial and urban development. The main limitations are the high shrink-swell potential in the subsoil, limited ability to support a load, and seasonal high water table. Dwellings and roads need to be designed to offset the limited ability to support a load. Septic tank absorption fields

are unsuited because of the very slow permeability in the subsoil and the seasonal high water table.

This soil is in capability subclass lllw.

**34D-Honeygrove silty clay loam, 3 to 25 percent slopes.** This well drained soil is in the mountains of the Coast Range. It formed in residuum and colluvium weathered from sedimentary and igneous rocks. Slopes average about 15 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is 48 to 53 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 10 inches thick. The upper 15 inches of the subsoil is reddish brown silty clay and clay, and the lower part is yellowish red clay and silty clay that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Apt and Peavine soils, which make up about 5 percent of this map unit, and, in areas where dikes of igneous rocks extrude, Klickitat soils make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 25 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for timber production. The soil is well suited to the production of Douglas-fir. Red alder and bigleaf maple are common. The site index for Douglas-fir on this soil ranges from about 150 to 175, and the average site index is about 160. Based on this average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic; this limits trafficability. It is severely compacted by equipment. In some areas, cable logging may be necessary because tractor logging causes excessive disturbance. Roads and landings may need water bars and grass seeding to prevent erosion. Roads require a maximum of base rock for all-season use (fig. 10). Construction and maintenance of roads is difficult because of the slope and the hazard of slides.

There is some hazard of plant competition. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little danger of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use areas of the soil for food and cover.

Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides because of the clay subsoil and high precipitation.

This soil is in capablity subclass Vle.

**34E-Honeygrove silty clay loam, 25 to 50 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary and igneous rocks. Bedrock is at a depth of more than 60 inches. Slopes average about 35 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is 48 to 53 degrees F, and the frost-free period is 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 10 inches thick. The upper 15 inches of the subsoil is reddish brown silty clay and clay, and the lower part is yellowish red clay and silty clay that extends to a depth of 62 inches or more.

Included with this soil in maping are areas of Apt and Peavine soils, which make up about 10 percent of the map unit and, in areas where dikes of igneous rocks extrude, Klickitat soils make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 25 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production. The soil is well suited to the production of Douglas-fir. Red alder and bigleaf maple are common. The site index on this soil ranges from about 150 to 175, and the average site index is about 160. Based on this average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, onefourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic, limiting trafficability. It is severely compacted by equipment. In some areas, cable logging may be necessary because tractor logging causes excessive disturbance. Roads and landings may need water bars and grass seeding to prevent erosion. Roads require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and the hazard of slides.

Plant competition is a slight hazard. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little danger of seedling mortality. Natural regeneration generally is adequate, but supplemental site preparation and seeding or planting may be needed.

Douglas-fit, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse,

mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use areas for food and cover. Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides because of the clay subsoil, high precipitation, and slope.

This soil is in capability subclass VIe.

**34F-Honeygrove silty clay loam, 50 to 75 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary and igneous rocks. Bedrock is at a depth of more than 60 inches. Slopes average about 65 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is 48 to 53 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 10 inches thick. The upper 15 inches of the subsoil is reddish brown silty clay and clay, and the lower part is yellowish red clay and silty clay that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Apt and Peavine soils, which make up about 10 percent of this map unit, and, in areas where dikes of igneous rocks extrude, Klickitat soils make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 25 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production. The soil is well suited to the production of Douglas-fir. Red alder and bigleaf maple are common. The site index on the soil ranges from about 150 to 175, and the average site index is about 160. Based on this average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment. The very steep slopes limit most operations to cable logging and aerial seeding. Tractor logging causes excessive disturbance. Roads and landings may need water bars and grass seeding to prevent erosion. Roads require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and hazard of slides.

There is some hazard of plant competition. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little danger of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use areas of the soil for food and cover. Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides because of the clay subsoil, high precipitation, and slope.

This soil is in capability subclass VIIe.

**35C-Jory silt loam, 2 to 12 percent slopes.** This well drained soil is in the lower foothills and on higher, rolling uplands. It formed in colluvium weathered from sedimentary and basic rocks. Slopes average about 8 percent. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silt loam and light silty clay loam about 20 inches thick. The subsoil is reddish brown and dark reddish brown silty clay loam and silty clay that extends to a depth of 70 inches or more.

Included with the soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is medium, and the hazard of erosion is slight.

Most areas of this soil are cultivated. Cereal grain, orchards, forage, and grass seed are the major crops. The soil is highly productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residue is used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to reduce runoff and erosion and maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir. It is well suited to Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on this soil. The site index for Douglas-fir on this soil ranges from 146 to 167, and the average site index is 160. Based on the average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. The soil is sticky and plastic when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent vegetative cover.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas of the soil. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The principal limitation to homesites is the soil's moderately slow permeability, which is the major limitation for septic tank filter fields. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIe.

**35D-Jory silt loam, 12 to 20 percent slopes.** This well drained soil is on the lower foothills and on higher, rolling uplands. It formed in colluvium weathered from sedimentary and basic rocks. Slopes average about 18 percent. Elevation is 350 to 1,200 feet. The average annual precipitation is 50 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silt loam and light silty clay loam about 20 inches thick. The subsoil is reddish brown and dark reddish brown silty clay loam and silty clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils, which make up about 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. Cereal grain, orchards, forage, and grass seed are the major crops. The soil is highly productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 50 percent of the time help to reduce runoff and erosion and maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir trees. It is moderately well suited to. Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The site index on the soil ranges from 146 to 167, and the average site index is 160. Based on the average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is sticky and plastic when wet; this restricts trafficablility. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent vegetative cover. The slope may interfere with management and harvesting.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The principal limitation to homesites is the slope. Road cuts and fills on the soil often create unstable conditions, and the soil is subject to slips and slides. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIIe.

**35E-Jory silt loam, 20 to 30 percent slopes.** This well drained soil in on the lower foothills and on higher, rolling uplands. It formed in colluvium weathered from sedimentary and basic rocks. Slopes average about 25 percent. Elevation is 250 to 1,200 feet, the average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54

degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silt loam and light silty clay loam about 20 inches thick. The subsoil is reddish brown and dark reddish brown silty clay loam and silty clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is rapid, and hazard of erosion is high.

This soil is used mainly for forage crops and woods. Cereal grain, orchards, and grass seed are the main crops. The slope makes the soil poorly suited to cultivation. To control erosion in cultivated areas, intensive practices, such as contour cropping, returning crop residue to the soil, rough tillage, and winter cover crops are needed.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 75 percent of the time help to reduce runoff and erosion and maintain fertility and workability.

This soil produces good stands of Douglas-fir. It is poorly suited to Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The site index for Douglas-fir on this soil ranges from 150 to 160, and the average site index is 155. Based on the average site index, this soil is capable of producing about 12,400 cubic feet, or 65,800 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocky, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is sticky and plastic when wet; this restricts trafficability. Roads and landings need water bars and grass seeding cuts and fills to prevent erosion. The slope causes difficulty in management and harvesting.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction in areas adjacent to this soil. The slope is the major limitation to homesites and roads. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IVe.

**36C-Jory silty clay loam, 2 to 12 percent slopes.** This well drained soil is on the lower foothills and on higher, rolling uplands that border mountainous areas. It formed in colluvium weathered from sedimentary and basic rock. Slopes average about 8 percent. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 11 inches thick. The subsoil is reddish brown and dark reddish brown clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is medium, and the hazard of erosion is slight.

Most of this soil is cultivated. Cereal grain, orchards, forage, and grass seed are the major crops, and the soil is highly productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to reduce runoff and erosion and maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir. It is well suited to Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on this soil. The site index for Douglas-fir on this soil ranges from 146 to 167, and the average site index is 160. Based on the average site index, this soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is sticky and plastic when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent vegetative cover.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed .on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The principal limitation to homesites is for septic tank filter fields which are limited by the soil's moderately slow permeability. Most areas of this soil are not on community sewage systems.

This soil is in capability subclass IIe.

**36D-Jory silty clay loam, 12 to 20 percent slopes.**

This well drained soil is on the lower foothills and on higher, rolling uplands that border the mountainous areas. It formed in colluvium weathered from sedimentary and basic rock. Slopes average about 18 percent. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 11 inches thick. The subsoil is reddish brown and dark reddish brown clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage of this soil is cultivated. Cereal grain, orchards, forage, and grass seed are the major crops, and the soil is highly productive for these crops. It is not so productive or so easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 50 percent of the time reduces runoff and erosion and helps to maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil-produces good stands of Douglas-fir trees. It is moderately well suited to Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The site index for Douglas-fir on this soil ranges from 146 to 167, and the average site index is 160. Based on the average site index, this soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

This soil is sticky and plastic when wet; this restricts trafficability. There are some limitations to the use of equipment. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent vegetative cover. The slope may interfere with management and harvesting.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasants, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. Slope is the major limitation for homesites. Road cuts and fills often create unstable conditions because these areas are subject to slips and slides. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIIe.

**36E-Jory silty clay loam, 20 to 30 percent slopes.**

This well drained soil is on the lower foothills and on higher, rolling uplands that border the mountainous areas. It formed in colluvium weathered from sedimentary and basic rock. Slopes average about 25 percent. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 11 inches thick. The subsoil is reddish brown and dark reddish brown clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is

rapid, and the hazard of erosion is high.

This soil is used principally for forage crops and forestry, and cereal grain, orchards, and grass seed are also grown. The slope makes the soil poorly suited to cultivation. To control erosion in cultivated areas, farmers need such intensive practices as contour cropping, use of crop residue, rough tillage, and winter cover crops.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 75 percent of the time help to reduce runoff and erosion and maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir. It is poorly suited to Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The site index for Douglas-fir on this soil ranges from 150 to 160, and the average site index is 155. Based on the average site index, the soil is capable of producing about 12,400 cubic feet, or 65,800 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is sticky and plastic when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent vegetative cover. The slope causes difficulty in management and harvesting.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction in areas adjacent to this soil. The slope is a limitation to roads and homesites. Building roads on the soil often causes instability and susceptibility to slippage. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IVe.

**37D -Jory silty clay loam, 2 to 30 percent slopes.**

This well drained soil is on the lower foothills and on higher, rolling uplands that border the mountainous area. It formed in colluvium weathered from sedimentary and basic rock. Slopes average about 15 percent. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 11 inches thick. The subsoil is reddish brown and dark reddish brown clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is medium, and the hazard of erosion is slight.

This soil is used principally for timber production. Christmas tree production is well suited to the less sloping areas. Some areas of the soil are in stands of Oregon white oak and grass. The less sloping areas also are suited to cultivation. The soil is well suited to the commercial production of Douglas-fir. Mixed stands of Douglas-fir, Oregon white oak, and grand fir are on this soil. The average site index for Douglas-fir is about 160. Based on the average site index, this soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Roads and landings need erosion protection by constructing water bars and seeding cuts and fills and skid roads to a permanent vegetative cover. Roads on this soil need a maximum of base rock for all-season use.

The crops and natural vegetation on this soil and adjacent, cultivated soils provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction in areas adjacent to this soil. Some of the more gently sloping areas of the soil are suited to home construction, but septic tank filter fields have a major limitation because of the moderately slow permeability. The steeper areas of this soil have major limitations for dwellings and roads. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass VIe.

**37E-Jory silty clay loam, 30 to 50 percent slopes.** This well drained soil is on the lower foothills and higher rolling uplands that border the mountainous area. The soil formed in colluvium weathered from sedimentary and basic rock. Slopes average about 40 percent. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 11 inches thick. The subsoil is reddish brown and dark reddish brown clay that extends to a depth of 70 inches or more.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up about 5 to 10 percent of this map unit, and Bellpine soils, which make up about 5 percent.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 25 to 28 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used principally for timber production. Some areas are in natural stands of Oregon white oak and grass. The slope makes this soil unsuited to cultivation. Pasture management includes limited tilling.

This soil is well suited to the production of commercial stands of Douglas-fir. It is not well suited to Christmas tree production. Mixed stands of Douglas-fir, Oregon white oak, and grand fir are on the soil. The site index for Douglas-fir on this soil ranges from 142 to 161, and the average site index is 153. Based on the average site index, the soil is capable of producing about 12,200 cubic feet, or 64,100 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Roads and landings need water bars and grass seeding to prevent erosion. Roads need a maximum of base rock for all-season use. The slope causes difficulty in management and harvesting.

The crops and natural vegetation on this soil and surrounding cultivated areas provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction in areas adjacent to this soil. This soil has major limitations for dwellings and roads because of the slope. Building roads on the soil often causes instability and susceptibility to slippage. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass VIe.

**38E-Kilchis stony loam, 3 to 30 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. It formed in gravelly residuum and colluvium weathered from igneous rock. Bedrock is at a depth of 12 to 20 inches. Slopes average about 20 percent. Elevation is 1,100 to 2,600 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 45 to 53 degrees F, and the frost-free period is about 145 to 180 days.

In a representative profile the surface layer is dark reddish brown stony and very gravelly loam about 8 inches thick. The subsoil is dark reddish brown very gravelly loam about 7 inches thick. Fractured diorite is at a depth of 15 inches.

Included with this soil in mapping are areas of Klickitat soils, which make up about 10 percent of this map unit, and Hembre and Blachly soils, which make up 5 percent. Some areas of Rock outcrop are included.

Permeability is moderately rapid. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 inch to 2 inches. Water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is high.

This soil is used for timber production. It has fair suitability for the production of Douglas-fir. Bigleaf maple is common, and red alder is on lower slopes and in drainageways. The site index for Douglas fir on this soil is about 118. Based on this site index, this soil is capable of producing about 8,300 cubic feet, or 21,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

Limitations to the use of equipment are few. This soil is stable, and trafficability is good. The soil forms a good road base, and road cuts are quite stable. Stones and rocks, however, interfere with harvesting, site preparation, planting, and roadbuilding.

Plant competition is a slight hazard, and stands of Douglas-fir may develop slowly after harvesting. Plant competition is especially difficult to control in old, poorly stocked, cutover areas. There is some danger of seedling mortality. Some loss of trees can be expected as a result of drought in summer and of shrub and grass competition, particularly on south-facing slopes where natural regeneration is often spotty. Site preparation, seeding, and planting are needed. Weeding and thinning may be needed for good stand development. There is some hazard of windthrow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous. Small herds of Roosevelt elk are in the extreme

western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope and shallowness of the soil are the major limitations to homesites.

This soil is in capability subclass Vls.

**38F-Kilchis stony loam, 60 to 90 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. It formed in gravelly residuum and colluvium weathered from igneous rock. It is underlain by bedrock at a depth of 12 to 20 inches. Slopes average about 65 percent. Elevation is 1,100 to 2,600 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 45 to 53 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown stony and very gravelly loam about 8 inches thick. The subsoil is dark reddish brown very gravelly loam about 7 inches thick. Fractured diorite is at a depth of 15 inches.

Included with this soil in mapping are areas of Klickitat soils, which make up about 10 percent of this map unit, and Hembre and Blachly soils, which make up 5 percent. Some areas of Rock outcrop are included.

Permeability is moderately rapid. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 inch to 2 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production. It has fair suitability for the production of Douglas-fir. Bigleaf maple is common, and red alder is on lower slopes and in drainageways. The site index for Douglas-fir on this soil is about 118. Based on this site index, this soil is capable of producing about 8,300 cubic feet, or 21,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

Limitations to the use of equipment are major. The very steep slopes limit most operations to cable logging, aerial seeding, and weeding. Very steep slopes, stones, and rocks interfere with site preparation, planting, road-building, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of very steep slopes and depth to rock.

Plant competition is a slight hazard, and stands of Douglas-fir develop slowly in some areas after harvesting. Plant competition is especially difficult to control in old, poorly stocked cutover areas. There is some danger of seedling mortality. Some loss of trees can be expected as a result of drought in summer and of shrub and grass competition, particularly on south-facing slopes where natural regeneration is often spotty. Site preparation, seeding, and planting are needed. Weeding and thinning may be needed for good stand development. There is some hazard of windthrow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope and shallowness of the soil are major limitations to homesites.

This soil is in capability subclass Vlls.

**39F-Kilchis-Klickitat complex, 60 to 90 percent slopes.** This complex consists of well drained soils in mountainous topography in the Coast Range. These soils formed in residuum and colluvium weathered from igneous rock. They are shallow to deep over bedrock. Slopes average about 70 percent. Elevation is 1,100 to 2,600 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free period is 160 to 200 days.

The Kilchis soil is on the steeper side slopes and in convex areas. It makes up about 50 percent of the complex. The Klickitat soil is on the less steep side slopes and broader ridges and in depressional drainageways. It makes up abut 35 percent of the complex.

In a representative profile of the Kilchis soil, the surface layer is dark reddish brown gravelly and very gravelly loam about 8 inches thick. The subsoil is dark reddish brown very gravelly loam about 7 inches thick. Fractured diorite is at a depth of 15 inches.

Permeability is moderately rapid in the Kilchis soil. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 inch to 2 inches, and the watersupplying capacity is 16 to 20 inches. Runoff is very rapid, and the hazard of erosion is high.

In a representative profile of the Klickitat soil, the surface layer is dark reddish brown gravelly clay loam about 7 inches thick. The upper 8 inches of the subsoil is dark reddish brown gravelly clay loam, and the lower 27 inches is reddish brown very gravelly clay loam. Fractured basalt is at a depth of 42 inches.

Permeability is moderate in the Klickitat soil. Effective rooting depth is 36 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is very rapid, and the hazard of erosion is high.

Included with this complex in mapping are areas of Blachly soils that make up about 15 percent of the unit. Some areas of Rock outcrop are also included.

These soils are used for timber production. The site index for Douglas-fir is about 118 on the Kilchis soil and about 145 on the Klickitat soil. Based on these site indices, this unit is capable of producing about 8,300 to 11,300 cubic feet, or 31,200 to 56,900 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. The very steep slopes limit most operations to cable logging (fig. 11), aerial seeding, and weeding. Very steep slopes, stones, and rocks interfere with site preparation, planting, roadbuilding, and intermediate harvest cutting by tractor logging. Construction and maintenance of roads is difficult because of the very steep slopes and depth to bedrock.

Plant competition is a slight hazard, and stands of Douglas-fir develop slowly in some areas after harvesting. Plant competition is especially difficult to control in old, poorly stocked, cutover areas. There is some danger of seedling mortality. Some loss can be expected from drought in summer and from shrub and grass competition, particularly on south-facing slopes where natural regeneration is often spotty. Site preparation, seeding, and planting are needed. Weeding and thinning are needed in some areas for good stand development. The windthrow hazard is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous in areas of this complex. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this complex are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope and the shallowness of the soils in this complex are the major limitations to homesites.

This complex is in capability subclass VIIs.

**40D-Kilowan gravelly silty clay loam, 3 to 25 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in residuum and colluvium weathered from mixed rock. Sedimentary bedrock is at a depth of 20 to 40 inches. Slopes average about 20 percent. Elevation is 250 to 1,800 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free period is about 145 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly silty clay loam and silty clay loam about 13 inches thick. The subsoil is yellowish red silty clay about 11 inches thick. Partly weathered fractured siltstone is at a depth of 24 inches.

Included with this soil in mapping are areas of Blachly, Hembre, and Klickitat soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production, and it is very well suited to the production of Douglas-fir. The site index for Douglas-fir on this soil ranges from 131 to 160, and the average site index is about 145. Based on the average site index, this soil is capable of producing about 11,300 cubic feet, or 56,900 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When this soil is wet, it is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment. Cable logging is desirable because tractor logging causes excessive disturbance. Roads and landings may need water bars and grass seeding to prevent erosion. Roads require a maximum of base rock for all-season use.

Plant competition is a slight hazard. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little danger of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. The hazard of windthrow is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIe.

**40E-Kilowan gravelly silty clay loam, 25 to 50 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in residuum and colluvium weathered from mixed rock. Sedimentary bedrock is at a depth of 20 to 40 inches. Slopes average about 40 percent. Elevation is 250 to 1,800 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly silty clay loam and silty clay loam about 13 inches thick. The subsoil is yellowish red silty clay about 11

inches thick. Partly weathered fractured siltstone is at a depth of 24 inches.

Included with this soil in mapping are areas of Blachly, Hembre, and Klickitat soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is very well suited to the production of Douglas-fir. The site index for Douglas-fir on this soil ranges from 131 to 160, and the average site index is about 145. Based on the average site index, this soil is capable of producing about 11,300 cubic feet, or 56,900 board feet (International rule, one-fourth inch kerf), of merchantable timber for a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When this soil is wet, it is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment. Cable logging is desirable because tractor logging causes excessive disturbance. Roads and landings may need water bars and grass seeding to control erosion. Roads require a maximum base rock for all-season use.

Plant competition is a slight hazard. Grass, brush, and fern competition may be especially difficult to control in nonstocked, cutover areas. There is little danger of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. The hazard of windthrow is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vie.

**40F-Kilowan gravelly silty clay loam, 50 to 75 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in residuum and colluvium Weathered from mixed rock. Sedimentary bedrock is at a depth of 20 to 40 inches. Slopes average about 60 percent. Elevation is 250 to 1,800 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 45 to 53 degrees F, and the frost-free period is about 145 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly silty clay loam and silty clay loam about 13 inches thick. The subsoil is yellowish red silty clay about 11 inches thick. Partly weathered fractured siltstone is at a depth of 24 inches.

Included with this soil in mapping are areas of Blachly, Hembre, and Klickitat soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is very well suited to the production of Douglas-fir. The site index for Douglas-fir on this soil ranges from 131 to 160, and the average site index is about 145. Based on the average site index, this soil is capable of producing about 11,300 cubic feet, or 56,900 board feet (international rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. When this soil is wet, it is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment. The slope limits most operations to cable logging, aerial seeding, and weed control. Tractor logging causes severe disturbance in very steep areas. Roads and landings may need water bars and grass seeding to control erosion. Roads require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and hazard of slides.

Plant competition is a slight hazard. Grass, brush, and fern competition may be especially difficult to control in nonstocked, cutover areas. There is little danger of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. The hazard of windthrow is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIIe.

**41D-Klickitat gravelly clay loam, 3 to 30 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly and cobbly residuum and colluvium weathered from basic igneous rock. Basalt is at a depth of 40 to 50 inches. Slopes average about 20 percent. Elevation is 1,100 to 2,600 feet. The average annual precipitation is 60 to 120 inches, the average annual air temperature is about 45 to 53 degrees F, and frost-free period

is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly clay loam about 7 inches thick. The upper 8 inches of the subsoil is dark reddish brown gravelly clay loam, and the lower 27 inches is reddish brown very gravelly clay loam. Fractured basalt is at a depth of 42 inches.

Included with this soil in mapping are areas of Kilchis, Blachly, Honeygrove, and Marty soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 36 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production, and it is well suited to the production of Douglas-fir. Bigleaf maple is common, and red alder is on lower slopes. The site index for Douglas-fir on this soil ranges from 135 to 160, and the average site index is about 145. Based on the average site index, this soil is capable of producing about 11,300 cubic feet, or 56,900 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stock, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is stable and trafficability is good. The soil forms a good road base, and road cuts are quite stable. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight, so stands of Douglas-fir may develop slowly after harvesting. Plant competition is especially difficult to control in old, poorly stocked, cutover areas. There is some danger of seedling mortality. Some loss of trees can be expected as a result of drought and shrub and grass competition, particularly on south-facing slopes where natural regeneration is often spotty. Site preparation, seeding, and planting are needed. Weeding and thinning may be needed for good stand development. The hazard of windthrow is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of the low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vls.

**41E-Klickitat gravelly clay loam, 30 to 50 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly and cobbly residuum and colluvium weathered from basic igneous rock. Basalt is at a depth of 40 to 50 inches. Slopes average about 40 percent. Elevation is 1,100 to 2,700 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 45 to 53 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly clay loam about 7 inches thick. The upper 8 inches of the subsoil is dark reddish brown gravelly clay loam, and the lower 27 inches is reddish brown very gravelly clay loam. Fractured basalt is at a depth of 42 inches.

Included with this soil in mapping are areas of Kilchis, Blachly, Honeygrove, and Marty soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 36 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is well suited to Douglas-fir. Bigleaf maple is common, and red alder is on lower slopes. The site index for Douglas-fir on this soil ranges from 135 to 160, and the average site index is about 145. Based on' the average site index, this soil is capable of producing about 11,300 cubic feet, or 56,900 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to use of equipment are slight. The slope limits some operations to cable logging, aerial seeding, and weeding. The slope, stones, and rocks interfere with site preparation, planting, road building, and intermediate harvesting by tractor logging. This soil forms a good road base and road cuts are quite stable. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is a slight hazard, so stands of Douglas-fir may develop slowly after harvesting. Plant competition is especially difficult to control in old, poorly stocked, cutover areas. There is some danger of seedling mortality. Some loss of trees can be expected as a result of drought and shrub and grass competition, particularly on south-facing slopes where natural regeneration is often spotty. Site preparation and seeding and planting are needed. Weeding and thinning may be needed for good stand development. The hazard of windthrow is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this dry period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIs.

**41F-Klickitat gravelly clay loam, 50 to 75 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly and cobbly residuum and colluvium weathered from basic igneous rock. Basalt is at a depth of 40 to 50 inches. Slopes average about 65 percent. Elevation is 1,100 to 2,600 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 45 to 53 degree F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly clay loam about 7 inches thick. The upper 8 inches of the subsoil is dark reddish brown gravelly clay loam, and the lower 27 inches is reddish brown very gravelly clay loam. Fractured basalt is at a depth of 42 inches.

Included with this soil in mapping are areas of Kilchis, Blachly, Honeygrove, and Marty soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 36 to 50 inches. Available water capacity is 2 to 4 inches, and the water-supplying capacity is 17 to 19 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is well suited to Douglas-fir. Bigleaf maple is common, and red alder is on lower slopes. The site index for Douglas-fir on this soil ranges from 135 to 160, and the average site index is about 145. Based on the average site index, this soil is capable of producing about 11,300 cubic feet, or 56,900 board feet (International rule, one - fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. The slope limits most operations to cable logging, aerial seeding, and weeding. Very steep slopes, stones, and rock outcrops interfere with site preparation, planting, road building, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of very steep slopes (fig. 12). Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is a slight hazard, so stands of Douglas-fir may develop slowly after harvesting. Plant competition is especially difficult to control in old, poorly stocked, cutover areas. There is some danger of seedling mortality. Some loss of trees can be expected as a result of drought and of shrub and grass competition, particularly on south-facing slopes where natural regeneration is often spotty. Site preparation, seeding, and planting are needed. Weeding and thinning may be needed for good stand development. The hazard of windthrow is minimal.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIIs.

**42B-Knappa silt loam, 0 to 7 percent slopes.** This well drained soil is on terraces above the flood plain. It formed in silty alluvium. Slopes average about 4 percent. Elevation is 350 to 1,200 feet. The average annual precipitation is 70 to 130 inches, the average annual air temperature is 48 to 52 degrees F, and the frost-free period is 145 to 180 days.

In a representative profile, the surface layer is very dark grayish brown silt loam about 12 inches thick. The subsoil is dark brown and yellowish brown silty clay loam about 30 inches thick. The substratum is variegated, light brownish gray, yellowish brown, and pale brown silty clay loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Brenner and a loamy alluvial soil, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for timber production. Smaller acreage is used for hay and pasture. The soil is well suited to the production of Douglas-fir. Bigleaf maple and red alder are also common. The site index for Douglas-fir on this soil ranges from 160 to 180, and the average site index is about 170. Based on this average site index, this soil is capable of producing about 14,500 cubic feet, or 78,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Roads and skid trails are unusable and trafficability is restricted when this soil is wet. Compaction can become a major concern if the soil is used when wet.

Plant competition is a major hazard. Salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. There is little hazard of windthrow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and

September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

Hazards for septic tank absorption fields, dwellings, and commercial buildings are slight. There is some hazard for local roads and streets because of the low strength of the soil.

This soil is in capability subclass IIe.

**43D-Luckiamute very shaly loam, 3 to 30 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in shaly residuum and colluvium weathered from sedimentary rock. Shale is at a depth of 12 to 20 inches. Slopes average about 20 percent. Elevation is 1,900 to 3,000 feet. The average annual precipitation is 90 to 150 inches, the average annual air temperature is 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is brown very shaly loam about 3 inches thick. The subsoil is brown very shaly clay loam about 13 inches thick. Fractured shale is at a depth of 16 inches.

Included with this soil in mapping are areas of Lurnick, Valsetz, and Yellowstone soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 14 to 20 inches. Available water capacity is 1.0 inch to 2.5 inches, and the water-supplying capacity is 12 to 14 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. The soil has fair suitability for Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on this soil ranges from 90 to 111, and the average site index is about 100. Based on the average site index, this soil is capable of producing about 6,200 cubic feet, or 16,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. The soil is stable and trafficaility is good. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition from salal, brackenfern, and vine maple is a hazard, which often prevents establishment of conifer seedlings. This soil is generally covered with snow for long periods in winter. There is some danger of seedling mortality. Natural regeneration is generally slow and may need to be supplemented with site preparation, seeding, and planting. Seeding and thinning are needed for good stand development. There is some hazard of windthrow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIs.

**43F-Luckiamute very shaly loam, 30 to 75 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in shaly residuum and colluvium weathered from sedimentary rock. Shale bedrock is at a depth of 12 to 20 inches. Slopes average about 60 percent. Elevations range from 1,900 to 3,000 feet. The average annual precipitation is 90 to 150 inches, the average annual air temperature is 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is brown very shaly loam about 3 inches thick. The subsoil is brown very shaly clay loam about 13 inches thick. Fractured shale is at a depth of 16 inches.

Included with this soil in mapping are areas of Lurnick, Valsetz, and Yellowstone soils, which make up about 15 percent of the map unit.

Permeability is moderate. Effective rooting depth is 14 to 20 inches. Available water capacity is 1.0 inch to 2.5 inches, and the water-supplying capacity is 12 to 14 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. The soil has fair suitability for Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on this soil ranges from 90 to 111, and the average site index is about 100. Based on the average site index, this soil is capable of producing about 6,200 cubic feet, or 16,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. The slope limits most operations to cable logging, aerial seeding, and weeding. The slope also interferes with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. Roads and landings should be protected with water bars and seeded to grass to control erosion.

Plant competition from salal, brackenfern, and vine maple is a hazard, which often prevents establishment of conifer seedlings. Plant competition is especially difficult to control in poorly stocked areas. The soil is generally covered with snow for long periods in winter. It is often dry in summer, especially on south-facing slopes. There is some danger of seedling mortality. Natural regeneration is slow, and some supplemental site preparation may be needed. The slope, however, severely limits most management operations.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the

extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIIs.

**44D-Lurnick gravelly loam, 3 to 30 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 20 percent. Elevation is 1,900 to 3,000 feet. The average annual precipitation is 90 to 150 inches, the average annual air temperature is 41 to 45 degrees F, and the frost-free period is about 90 to 100 days.

In a representative profile, the surface layer is very dark grayish brown gravelly loam about 9 inches thick. The upper 6 inches of the subsoil is dark brown gravelly silty clay loam, and the lower 15 inches is dark yellowish brown very gravelly silty clay. Fractured siltstone is at a depth of 30 inches.

Included with this soil in mapping are areas of Luckiamute, Valsetz, and Yellowstone soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 14 to 20 inches. Available water capacity is 1.0 inch to 2.5 inches, and the water-supplying capacity is 12 to 14 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production, and it has fair suitability for Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on the soil ranges from 111 to 119, and the average site index is about 115. Based on the average site index, the soil is capable of producing about 7,900 cubic feet, or 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. When wet, this soil is sticky and plastic. Cable logging avoids the excessive disturbance and compaction caused by tractor logging. This soil is generally covered with snow for long periods in winter. Roads and landings need water bars and grass seeding to prevent erosion.

Some plant competition, mainly from salal, brackenfern, and vine maple, often prevents establishment of conifer seedlings. Because this soil often is dry in summer, seedling mortality is a danger. Natural regeneration is generally slow and may need to be supplemented with site preparation, seeding, and planting. Seeding and thinning are needed for good stand development. There is some hazard of windthrow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall months because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIs.

**44E-Lurnick gravelly loam, 30 to 50 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil developed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 40 percent. Elevation is 1,900 to 3,000 feet. The average annual precipitation is 90 to 180 inches, the average annual air temperature is 41 to 45 degrees F, and the frost-free period is about 90 to 110 days.

In a representative profile, the surface layer is very dark grayish brown gravelly loam about 9 inches thick. The upper 6 inches of the subsoil is dark brown gravelly silty clay loam, and the lower 15 inches is dark yellowish brown very gravelly silty clay. Fractured siltstone is at a depth of 30 inches.

Included with this soil in mapping are areas of Valsetz and Yellowstone soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 14 to 20 inches. Available water capacity is 1.0 inch to 2.5 inches, and the water-supplying capacity is 12 to 14 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it has fair suitability for Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on this soil ranges from 111 to 119, and the average site index is about 115. Based on the average site index, this soil is capable of producing about 7,900 cubic feet, or 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. When wet, this soil is sticky and plastic and compacts easily. Cable logging avoids the excessive disturbance and compaction caused by tractor logging. The slope and rock outcrops interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. This soil is generally covered with snow for long periods in winter. Roads and landings should be protected by water bars and seeded to grass to prevent erosion.

Plant competition is slight. It is especially difficult to control in nonstocked areas. There is some danger of seedling mortality.

seedling mortality. This soil often is dry in summer months, especially on south-facing slopes. Since natural regeneration is slow, some supplemental site preparation and planting is needed. Weeding and thinning may be required for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIIs.

**44F-Lurnick gravelly loam, 50 to 75 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 60 percent. Elevation is 1,900 to 3,000 feet. The average annual precipitation is 90 to 180 inches, the average annual air temperature is 41 to 45 degrees F, and the frost-free period is about 90 to 110 days.

In a representative profile, the surface layer is very dark grayish brown gravelly loam about 9 inches thick. The upper 6 inches of the subsoil is dark brown gravelly silty clay loam, and the lower 15 inches is dark yellowish brown very gravelly silty clay. Fractured siltstone is at a depth of 30 inches.

Included with this soil in mapping are areas of Valsetz and Yellowstone soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 14 to 20 inches. Available water capacity is 1.0 inch to 2.5 inches, and the water-supplying capacity is 12 to 14 inches. Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production, and it has fair suitability for Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on this soil -ranges from 111 to 119, and the average site index is about 115. Based on the average site index, this soil is capable of producing about 7,900 cubic feet, or 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. This soil is plastic and sticky when wet and compacts easily. The very steep slopes limit most operations to cable logging, aerial seeding, and weeding. Very steep slopes and rock outcrops interfere with site preparation, planting, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of very steep slopes. This soil is generally covered with snow in winter. Roads and landings should be protected by water bars and grass to control erosion.

Plant competition is a slight hazard. It is especially difficult to control in nonstocked areas. This soil often is dry in summer, especially on south-facing slopes. There is some danger of seedling mortality. Because natural regeneration is slow, the soil may need some supplemental site preparation. Weeding and thinning may be required for good stand development. There is some hazard of windthrow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass VIIs.

**45-Malabon silty clay loam.** This well drained soil is on broad terraces along rivers and major streams. It formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 200 to 300 feet. The soil is subject to overflow about once in 50 years. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silty clay loam about 15 inches thick. The upper 10 inches of the subsoil is dark brown light silty clay, and the lower part is dark yellowish brown silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Coburg and Willamette soils, which make up about 5 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is more than 40 inches. Available water capacity is 9 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for cereal grain, grass seed, hay, pasture, vegetable, and specialty crops. Properly managing crop residue and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to maintain favorable fertility and workability.

Small grain and grass respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and, in many places, lime. If crop residues

are used, additional nitrogen is needed to prevent decreased yields.

Water can be applied by means of furrow, border, or sprinkler irrigation, but sprinkler irrigation is most commonly used. Smoothing this soil for irrigation or for surface drainage is easier than on other soils, and it does no permanent damage. Streams are generally available for irrigation.

No commercial stands of timber are on this soil. The soil is well suited to Christmas tree production.

This soil supports a wide variety of grain, grasses, legumes, orchards, and vegetable crops which furnish good cover and food for ring-necked pheasant, valley quail, bobwhite quail, and mourning dove. If cover is sufficient, black-tailed deer are permanent residents. Ducks and geese also feed in areas close to water. Grouse, band-tailed pigeons, and mountain quail are not common. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along roadways, using grassed waterways, and preserving fence rows, woodlots and brushy areas improve the cover for wildlife

Low strength and moderate shrink-swell potential are limitations for homesites and commercial buildings. The moderately slow permeability of the soil is a limitation for septic tank absorption fields. The low strength is a major limitation for local roads and streets.

This soil is in capability subclass IIs.

**46-Malabon silty clay loam, occasionally flooded.**

This well drained soil is on broad, low terraces along streams. It formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 200 to 300 feet. This soil is flooded by overflow several times during the year about once every 10 years. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silty clay loam about 15 inches thick. The upper 10 inches of the subsoil is dark brown light silty clay, and the lower part is dark yellowish brown silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Coburg and Willamette soils, which make up about 5 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is more than 40 inches. Available water capacity is 9 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight, except during flooding. The soil is subject to occasional flooding in winter and early in spring.

This soil is used mainly for cereal grain, grass seed, hay, pasture, vegetable, and specialty crops. Properly managing crop residue and using a cropping system in which grasses and legumes are grown at least 25 percent of the time help to maintain favorable fertility and workability. The hazard of erosion from flood waters can be reduced by planting winter cover crops.

Small grain and grass respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

Water can be applied by means of furrow, border, or sprinkler irrigation, but sprinkler irrigation is most commonly used. Smoothing the soil for irrigation or for surface drainage is easier than on other soils, and it does no permanent damage. Water from streams is generally available for irrigation.

No commercial stands of timber occur on this soil. The soil is not well suited to Christmas tree production because of the hazard of flooding.

This soil supports a wide variety of grains, legumes, orchards, and vegetable crops, which furnish good cover and food for ring-necked pheasant, valley quail, bobwhite quail, and mouring dove. If cover is sufficient, black-tailed deer are permanent residents. Ducks and geese also feed in areas of this soil close to water. Grouse, band-tailed pigeons, and mountain quail are not common. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve the cover and food for wildlife.

This soil has major limitations for all community development uses, because it is subject to occasional overflow.

This soil is in capability subclass IIw.

**47D-Marty gravelly loam, 3 to 25 percent slopes.**

This well drained soil is in the mountains of the Coast Range. It formed in residuum and colluvium weathered from igneous rock. Slopes average about 15 percent. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 45 to 50 degrees F, and the frost-free period is about 150 to 160 days.

In a representative profile, the surface layer is dark reddish brown gravelly loam about 13 inches thick. The upper 21 inches of the subsoil is reddish brown gravelly loam, and the lower 12 inches is reddish brown gravelly clay loam. The substratum is strong brown clay loam that extends. to a depth of 60 inches or more.

Included with this soil in mapping are areas of Hembre, Klickitat, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is greater than 60 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium. and the hazard of erosion is moderate.

This soil is used for timber production, and it is very well suited to the production of Douglas-fir. Western hemlock is

mixed with fir at higher elevations. The site index for Douglas-fir on this soil ranges from about 145 to 165, and the average site index is about 155. Based on this site index, the soil is capable of producing about 12,400 cubic feet, or 65,800 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Trafficability is good except during very wet periods. Limitations to the use of equipment are slight, but cable logging causes less disturbance than tractor logging. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is not generally a major concern. It may be severe, however, on the lower slopes and on moist sites, where red alder, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little seedling mortality. This soil has a good water-supplying capacity and it is in a favorable climatic zone. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. There is little hazard of windthrow. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**47E-Marty gravelly loam, 25 to 60 percent slopes.** This well drained soil is in the mountains of the Coast Range. It formed in residuum and colluvium weathered from igneous rock. Slopes average about 40 percent. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 45 to 53 degrees F, and the frostfree period is about 150 to 200 days.

In a representative profile, the surface layer is dark reddish brown gravelly loam about 13 inches thick. The upper 21 inches of the subsoil is reddish brown gravelly loam, and the lower 12 inches is reddish brown gravelly clay loam. The substratum is strong brown clay loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Hembre, Klickitat, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is more than 60 inches. The available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is very well suited for the production of Douglas-fir. Western hemlock is mixed with fir at higher elevations. The site index for Douglas-fir on this soil ranges from about 145 to 165, and the average site index is about 155. Based on this site index, this soil is capable of producing about 12,400 cubic feet, or 65,800 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Trafficability is good, except during very wet periods. There are some limitations to the use of equipment. Cable logging causes less disturbance than tractor logging. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is not generally a major concern. It may be severe, however, on the lower slopes and on moist sites, where red alder, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little seedling mortality. This soil has a good water-supplying capacity and it is in a favorable climatic zone. Natural regeneration is generally good but may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. There is little hazard of windthrow. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**48A-McAlpin silty clay loam, 0 to 3 percent slopes.** This moderately well drained to somewhat poorly drained soil is on broad low fans and the flood plain in tributary valleys. It formed in silty alluvial deposits. Slopes average about 2 percent. Elevation is 300 to 450 feet. This soil is subject to overflow in some years. The average annual preciptiation is 40 to 60 inches, the average annual air temperature is 40 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silty clay loam about 18 inches thick. The upper 18 inches of the subsoil is brown and dark brown, mottled silty clay loam, and the lower part is dark brown, mottled silty clay that extends

to a depth of 62 inches or more.

Included with this soil in mapping are areas of Abiqua and Briedwell soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is limited by a seasonal high water table. Available water capacity is 8 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight, except during flooding. A seasonal high water table is at a depth of 24 to 36 inches in winter and early in spring.

This soil is well suited to pasture, hay, small grain, and grass seed. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by a seasonal high water table unless the soil is drained. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to maintain fertility and workability. The erosion hazard from floodwaters can be reduced by seeding winter cover crops. Small grain and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus and sulfur, and in many places, lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

Sprinkler irrigation is the most common method of irrigation, and it is very satisfactory. Irrigation water should be applied carefully at rates low enough to prevent runoff. Water for irrigation is available from reservoirs or streams.

The soil has a moderate drainage problem, but it responds to pattern drainage. Drainage is needed for maximum use and production. Seepage from soils at a higher elevation can be controlled by interception and random drains. Runoff may be controlled by grassed waterways and vegetative cover.

No commercial stands of timber occur on this soil. The soil is not well suited to Christmas tree production

Native vegetation is grasses, hazel, poison oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, valley quail, bobwhite quail, and mourning dove. Blacktailed deer are permanent residents, and ducks feed in areas near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambands and roadways, using grassed waterways, and preseving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

Low strength and rare flooding are limitations to homesites, commercial buildings and local roads and streets. The moderately slow permeability and seasonal high water table are major limitations to septic tank absorption fields.

This soil is in capability subclass llw.

**48B-McAlpin silty clay loam, 3 to 6 percent slopes.** This moderately well drained soil is on alluvial fans that are above the flood plain and along tributaries. It formed in silty alluvial deposit. Slopes average about 5 percent. Elevation is 300 to 450 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silty clay loam about 18 inches thick. The upper 18 inches of the subsoil is brown and dark brown, mottled silty clay loam, and the lower part is dark brown, mottled silty clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Abiqua and Briedwell soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. The effective rooting depth is limited by a seasonal high water table. Available water capacity is 8 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow to medium, and the hazard of erosion is slight. A seasonal high water table is at a depth of 24 to 36 inches in winter and early in spring.

This soil is well suited to pasture, hay, small grain, and grass seed. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by a seasonal high water table unless the soil is drained. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to reduce runoff and erosion and help to maintain fertility and workability. Small grains and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and in may places, lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

A sprinkler system is the most common and most satisfactory method of irrigation. Irrigation water should be applied carefully at rates low enough to prevent runoff. Water for irrigation is available from reservoirs or streams.

The soil has a moderate drainage problem, but it responds to pattern drainage. Drainage is needed for maximum use and production. Seepage from soils at a higher elevation can be controlled by interception and random drains. Runoff may be controlled by grassed waterways and vegetative cover.

No commercial stands of timber grow on this soil. The soil is well suited to Christmas tree production.

Native vegetation is grass, hazel, poison oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, valley quail, bobwhite quail, and mourning dove. Blacktailed deer are permanent residents, and ducks and geese also feed on areas

near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

The low strength is a limitation to homesites, commercial buildings, and local roads and streets. The moderately slow permeability and seasonal high water table are major limitations to septic tank absorption fields.

This soil is in capability subclass lle.

**49-McBee silty clay loam.** This moderately well drained soil is on alluvium bottoms. The soil formed in mixed recent alluvium. It is subject to occasional overflow from channels and sloughs that are in this unit. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silty clay loam about 12 inches thick. The upper 9 inches of the subsoil is dark brown silt loam, and the lower 36 inches is dark brown and brown, distinctly mottled silt loam. The substratum is dark grayish brown, mottled very fine sandy loam that extends to a depth of 64 inches or more.

Included with this soil in mapping are areas of Chehalis, Cloquato, Waldo, and Newberg soils, which make up about 10 percent of this map unit.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 12 inches, and the water supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight. The soil is subject to frequent flooding. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

Most areas of this soil are cultivated. The soil is used for row crops, forage crops, small grains, seed crops, and orchards. Irrigated areas are used for vegetable and many specialty crops. Most crops are well suited to this soil. The hazard of erosion from floodwaters can be reduced by planting winter cover crops and constructing dikes. Properly managing crop residue and using a cropping system in which grasses and legumes or green manure crops are grown at least 25 percent of the time help to reduce erosion from floodwaters and help to maintain soil fertility and workability. The crops on this soil respond well to fertilizers and amendments.

The use of this soil for orchards or crops, such as berries and hops, which require installation of poles, increases the hazard of debris accumulation and may cause severe gullying during flooding. This soil is irrigated from shallow wells, streams, rivers, and sloughs.

No commercial timber is produced on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops; the fence rows; the wooded tracts of ash, cottonwood, Douglas-fir; and the shrubs furnish good food and cover for ring-necked pheasant, valley quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents, and ducks and geese also feed on this soil. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks, and roadways, using grassed waterways, and preserving fence rows and brushy areas improve cover and food for wildlife. Water from streams is available most of the year. Burning fields, fence rows, and clearing wooded and brushy areas will destroy both cover and food for wildlife.

This soil is subject to flooding, which is the major limitation to homesites, commercial buildings, and other community development.

This soil is in capability subclass llw.

**50D-McDuff silty clay loam, 3 to 25 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 15 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is about 48 to 52 degrees F, and the frost-free period is abut 160 to 200 days.

In a representative profile, the surface layer is very dark brown and very dark grayish brown silty clay loam about 11 inches thick. The subsoil is dark brown, dark yellowish brown, strong brown, -and pale brown silty clay about 27 inches thick. Partly weathered siltstone is at a depth of 38 inches.

Included with this soil is mapping are areas of Apt, Honeygrove, and Peavine soils, which make up about 10 percent of this map unit, and Astoria and Cumley soils, which make up about 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of this soil is used for timber production, and the soil is well suited to the production of Douglas-fir. Red alder is common. The site index for Douglas-fir on this soil ranges from about 155 to 180, and the average site index is about 165. Based on this average site index, the soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. When wet, this soil is sticky and plastic; this limits trafficability. It is severely compacted by equipment when wet. Cable logging causes less disturbance than tractor logging. Roads and landings may need erosion protection by constructing water bars and seeding road cuts and fills. Roads require a maximum of base rock for all-season use.

Plant competition is slight. Grass, brush, and fern competition is especially difficult to control in non-stocked, cutover areas. Seedling mortality generally is not a concern. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. There is little hazard of windthrow.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, and fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use this area for food and cover.

Numerous drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**50E-McDuff silty clay loam, 25 to 50 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 35 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is about 48 to 52 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is very dark brown and very dark grayish brown silty clay loam about 11 inches thick. The subsoil is dark brown, dark yellowish brown, strong brown, and pale brown silty clay about 27 inches thick. Partly weathered siltstone is at a depth of 38 inches.

Included with this soil in mapping are areas of Apt, Honeygrove, and Peavine soils, which make up about 10 percent of this map unit, and Astoria and Cumley soils, which make up about 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production, and the soil is well suited to the production of Douglas-fir. Red alder is common. The site index on this soil ranges from about 155 to 180, and the average site index is about 165. Based on this average site index, the soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. When wet, this soil is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment when wet. Caple logging causes less disturbance than tractor logging. Roads and landings may need erosion protection by constructing water bars and seeding road cuts and fills. Roads on this soil require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and the hazard of slides.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use this area for food and cover.

Numerous drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**50F-McDuff silty clay loam, 50 to 75 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 60 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is about 48 to 52 degrees F, and the frost-free period is about 160 to 200 days.

In a representative profile, the surface layer is very dark brown and very dark grayish brown silty clay loam about 11 inches thick. The subsoil is dark brown, dark yellowish brown, strong brown, and pale brown silty clay about 27 inches thick. Partly weathered siltstone is at a depth of 38 inches.

Included with this soil in mapping are areas of Honeygrove and Peavine soils, which make up about 10 percent of this map unit, and Astoria and Cumley soils, which make up about 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production, and the soil is well suited to the production of Douglas-fir. Red alder is common. The site index on this soil ranges from about 155 to 180, and the average site index is about 165. Based on this average site index, the soil is capable of producing about 13,300 cubic feet, or 74,200 board feet, (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. When wet, this soil is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment when wet. Cable logging causes less disturbance than tractor logging. Roads and

landings may need protection from erosion by constructing water bars and seeding road cuts and fills. Roads on this soil require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of steep slopes and the hazard of slides.

Plant competition is slight. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. Seedling mortality generally is not a concern. Natural regeneration generally is adequate, but supplemental site preparation and seeding or planting may be needed. There is little hazard of windthrow.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These game birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants for food. Black-tailed deer use this area for food and cover.

Numerous drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is incapability subclass Vlle.

**51D-Mulkey loam, 5 to 25 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in residuum and colluvium weathered from basic igneous rock. Bedrock is at a depth of 20 to 40 inches. Slopes average about 15 percent. Elevation is 3,000 to 3,400 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is 43 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is very dark brown and very dark grayish brown loam about 23 inches thick. The subsoil is dark brown gravelly loam about 7 inches thick. The upper 5 inches of the substratum is dark yellowish brown very gravelly loam, and the lower part is fractured gabbro.

Included with this soil in mapping are areas of Kilchis soils, which makeup 10 percent of this map unit, and Klickitat soils, which make up about 5 percent.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 6.5 inches, and the water-supplying capacity is 15 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil has only fair suitability for timber production. It is on peaks in open park areas of grass, fern, and intermittent, mixed stands of Douglas-fir, noble fir, and hemlock. The site index for Douglas-fir on this soil is about 90. Based on this site index, the soil is capable of producing about 5,200 cubic feet, or 10,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even–aged stand of 80-yearold trees. The site index for noble fir is about 90.

Limitations to the use of equipment are slight. Trafficability is good, except during very wet periods. Roads, skid trails, and landings need water bars and grass seeding to help control erosion.

Plant competition causes some concerns. Grass and brackenfern are aggressive and often prevent the establishment of conifers. There is some hazard of seedling mortality. This soil generally is covered with snow for long periods in winter. Natural regeneration is slow and site preparation, stocking, and planting are .necessary. There is some hazard of windthrow. High winds are common throughout the year.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall months because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vle.

**52C-Nekia silty clay loam, 2 to 12 percent slopes.** This welt drained soil is in the foothills and on the higher, rolling uplands that border the mountainous area. The soil formed in colluvium and residuum weathered from basic rock. Basalt is at a depth of 20 to 40 inches. Slopes average about 8 percent. Elevation is 300 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 16 inches thick. Partly weathered and fractured basalt is at a depth of 25 inches.

Included with this soil in mapping are areas of Jory and Ritner soils, which make up about 10 percent of this map unit, and Witzel soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is slow, and the hazard of erosion is slight.

Most of this acreage is cultivated. Cereal grain, orchards, forage, and grass seed are the main crops. The soil is moderately productive for these crops. It is not so productive or easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally needed to prevent a decrease in yield. Properly managing crop residue

and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to reduce runoff and erosion and help to maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir trees. It is well suited to the production of Christmas trees. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on this soil. The site index for Douglas-fir on this soil ranges from 141 to 161, and the average site index is 151. Based on the average site index, the soil is capable of producing about 12,200 cubic feet, or 62,500 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitation to the use of equipment are few. This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent grass cover.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common on this unit in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The main limitation to homesites is the moderately slow permeability that restricts septic tank filter fields. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass lle.

**52D-Nekia silty clay loam, 12 to 20 percent slopes.** This well drained soil is in the foothills and on the higher, rolling uplands that border the mountainous area. The soil formed in colluvium and residuum weathered from basic rock. Basalt bedrock is at a depth of 20 to 40 inches. Slopes average about 18 percent. Elevation is 300 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 16 inches thick. Partly weathered and fractured basalt is at a depth of 25 inches.

Included with this soil in mapping are areas of Jory and Ritner soils, which make up 10 percent of this map unit, and Witzel soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage of this soil is cultivated. Cereal grain, orchards, forage, and grass seed are the main crops, and the soil is moderately productive for these crops. The soil is not so productive or easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally needed to prevent a decrease in yield. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 50 percent of the time help to reduce runoff and erosion and help to maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

This soil produces good stands of Douglas-fir. It is moderately suited to Christmas tree production. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The site index for Douglas-fir ranges from 135 to 159, and the average site index is 144. Based on the average site index, this soil is capable of producing about 11,200 cubic feet, or 56,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from 'a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent grass cover. The slope may interfere with management and harvesting.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeon. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The main limitation for homesites is that they cannot be used for septic tank filter fields because of the moderately slow permeability and moderately steep slopes. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIIe.

**52E-Nekia silty clay loam, 20 to 30 percent slopes.** This well drained soil is in the foothills and on the higher, rolling uplands that border the mountainous area. The soil formed in colluvium and residuum weathered from basic rock. Basalt is at a depth of 20 to 40 inches. Slopes average about 25 percent. Elevation is 300 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 16 inches thick. Partly weathered and fractured basalt bedrock is at a depth of 25 inches.

Included with this soil in mapping are areas of Jory and Ritner soils, which make up 10 percent of this map unit, and Witzel soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used principally for forage crops, forestry, cereal grain, orchards, and grass seed. The slope makes this soil poorly suited to cultivation. If cultivated, this soil requires such intensive practices as contour cropping, returning crop residue to the soil, rough tillage, and winter cover crops to control erosion. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 75 percent of the time help to reduce runoff and erosion and help to maintain fertility and workability.

This soil produces good stands of Douglas-fir trees. It is not well suited to Christmas tree production because the slope causes difficulty in management and harvesting. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The average site index for Douglas-fir on this soil is about 144. Based on the average site index, this soil is capable of producing about 11,200 cubic feet, or 56,000 board feet (International rule, one-fourth inch kerf) of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills to permanent grass cover.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeon. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The main limitations for homesites are the major restrictions for septic tank filter fields, dwellings, and roads because of the slope and the moderately slow permeability. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IVe.

**52F-Nekia silty clay loam, 30 to 50 percent slopes.** This well drained soil is in the foothills and on the higher, rolling uplands that border the mountainous area. The soil formed in colluvium and residuum weathered from basic rock. Basalt bedrock is at a depth of 20 to 40 inches. Slopes average about 40 percent. Elevation is 300 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 9 inches thick. The subsoil is dark reddish brown silty clay and clay about 16 inches thick. Partly weathered and fractured basalt bedrock is at a depth of 25 inches.

Included with this soil in mapping are areas of Jory and Ritner soils, which make up about 10 percent of this map unit, and Witzel soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 7 inches, and the water-supplying capacity is 17 to 24 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. Some areas of the soil are in stands of Oregon white oak and grass. Because of slope, cultivation is unsuitable for this soil; however, some limited tilling for pasture is performed.

This soil is well suited to the production of commercial stands of Douglas-fir. It is not well suited to Christmas tree production because the slope causes difficulty in management and harvesting. Mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on the soil. The average site index for Douglas-fir on this soil is about 144. Based on the average site index, this soil is capable of producing about 11,200 cubic feet, or 56,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stock, even-aged stand of 80year-old trees.

Limitations to the use of equipment are slight. Roads and landings need protection from erosion by constructing water bars and seeding cuts and fills and skid roads. Roads on this soil need a maximum of base rock for all-season use.

The crops and natural vegetation on this soil and on adjacent

cultivated areas provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. This soil has major limitations for dwellings, streets, and roads because of the slope. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass Vle.

**53-Newberg fine sandy loam.** This somewhat excessively drained soil is on bottom lands. The soil formed in mixed, recent alluvium. It is flooded by overflow several times a year about once every 3 or 4 years. It is traversed by channels and sloughs that overflow. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown fine sandy loam about 15 inches thick. The next layer is dark yellowish brown fine sandy loam about 11 inches thick. The substratum is dark yellowish brown loamy fine sand and fine sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Pilchuck and Cloquato soils, which make up about 10 percent of this map unit, and McBee and Camas soils, which make up about 5 percent.

Permeability is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is 5 to 8 inches, and the water-supplying capacity is 18 to 24 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is common in winter and early in spring.

This soil is well suited to most crops commonly grown in the county. It is irrigated for vegetable and many specialty crops from shallow wells, streams, rivers, and sloughs. The hazard of erosion by floodwaters can be reduced by planting winter cover crops and constructing dikes. Properly managing crop residue and using a cropping system in which grasses and legumes or green manure crops are grown at least 25 percent of the time to maintain fertility and workability. Crops grown on the soil respond well to fertilizers and amendments.

The use of this soil for orchards or such crops as berries and hops, which require installation of poles, increases the hazard of debris accumulation and may cause severe gullying by floodwaters.

No commercial timber is produced on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops and the fence rows and wooded tracts of ash, cottonwood, Douglas-fir, and shrubs furnish abundant food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents and ducks and geese also feed on the soil. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows and brushy areas improve cover and food for wildlife. Water from streams is available most of the year. Burning fields and fence rows and clearing wooded and brushy areas will destroy both cover and food for wildlife.

This soil has major limitations for homesites, commercial buildings, or other community uses because it is subject to flooding.

This soil is in capability subclass IIw.

**54-Newberg loam.** This somewhat excessively drained soil is on bottom lands. The soil formed in mixed, recent alluvium. It is flooded by overflow several times a year about once every 3 or 4 years. The soil is traversed by channels and sloughs that overflow. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown loam about 20 inches thick. The substratum is dark brown and dark grayish brown fine sandy loam and loamy fine sand that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Chehalis and Cloquato soils, which make up about 10 percent of this map unit, and Camas and McBee soils, which make up 5 percent.

Permeability is moderately rapid. Effective rooting depth is more than 60 inches. Available water capacity is 5 to 8 inches, and the water-supplying capacity is 18 to 24 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is common in winter and early in spring.

Most of the acreage of this soil is cultivated. The soil is used for row crops, forage crops, small grain, seed crops, and orchards. Most crops are well suited to this soil. The soil is irrigated for vegetable and many specialty crops from shallow wells, streams, rivers, and sloughs. The hazard of erosion from floodwaters can be reduced by planting winter cover crops and constructing dikes. Properly managing crop residue and using a cropping system in which grasses and legumes or green manure crops are grown at least 25 percent of the time help to reduce erosion and help to maintain fertility and productivity. The crops on the soils respond well to fertilizers and amendments.

The use of this soil for orchards or such crops as berries and hops, which require installation of poles, increases the hazard of debris accumulation, and may cause severe gullying during flooding.

No commercial timber is produced on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops and the fence rows and wooded tracts of ash, cottonwood, Douglas-fir, and shrubs furnish abundant food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents, and ducks and geese also feed on the soil. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambands and roadways, using grassed waterways, and preserving fence rows and brushy areas improve cover and food for wildlife. Water from streams is available most of the year. Burning fields and fence rows and clearing wooded and brushy areas will destroy both cover and food for wildlife.

This soil has major limitations for homesites, commercial buildings, or other community uses because it is subject to flooding.

This soil is in capability subclass IIw.

**55D-Peavine silty clay loam, 3 to 30 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 20 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 80 inches, the average annual air temperature is about 48 to 53 degrees F, and the frostfree period is about 160 to 210 days.

In a representative profile, the surface layer is dark brown and dark reddish brown silty clay loam about 10 inches thick. The upper 8 inches of the subsoil is reddish brown silty clay loam, and the lower 12 inches is yellowish red clay. Fractured siltstone is at a depth of 30 inches.

Included with this soil in mapping are areas of Honeygrove and McDuff soils, which make up 10 percent of this map unit, and Apt and Klickitat soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is abut 30 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 18 to 22 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for timber production, and the soil is well suited to the production of Douglas-fir. The site index for Douglas-fir on the soil ranges from about 145 to 175, and the average site index is about 160. Based on the average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80 year-old trees.

This soil has major limitations to the use of equipment. When wet, it is sticky and plastic; this limits trafficability. It is severely compacted by equipment. Cable logging causes less disturbance than tractor logging. Roads and landings may need protection from erosion by constructing water bars and seeding road cuts and fills. Roads on this soil require a maximum of base rock for all-season use.

Plant competition is a slight hazard. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. There is little hazard of windthrow.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants for food. Black-tailed deer use this area for food and cover. Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass VIe.

**55E-Peavine silty clay loam, 30 to 60 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. It is underlain by siltstone at a depth of 20 to 40 inches. Slopes average about 45 percent. Elevation is 700 to 1,400 feet. The average annual precipitation is 60 to 80 inches, the average annual air temperature is about 48 to 53 degrees F, and the frost-free period is about 160 to 210 days.

In a representative profile, the surface layer is dark brown and dark reddish brown silty clay loam about 10 inches thick. The upper 8 inches of the subsoil is reddish brown silty clay, and the lower 12 inches is yellowish red clay. Fractured siltstone is at a depth of 30 inches.

Included with this soil in mapping are areas of Honeygrove and McDuff soils, which make up 10 percent of this map unit, and Apt and Klickitat soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is about 30 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 18 to 22 inches. Surface runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production, and the soil is well suited to the production of Douglas-fir. The site index for Douglas-fir on the soil ranges from about 145 to 175, and the average site index is about 160. Based on the average site index, the soil is capable of producing about 12,850 cubic

feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

Limitations to the use of equipment are major. .When wet, this soil is sticky and plastic; this limits trafficability. The soil is severely. compacted by equipment. Cable logging causes less disturbance than tractor logging. Roads and landings may need protection from erosion by constructing water bars and seeding road cuts and fills. Roads on the soil require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and the hazard of slides.

Soil management is affected by plant competition. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. There is little hazard of windthrow.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants. Black-tailed deer use this area for food and cover. Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to severe slips and slides because of the slope.

This soil is in capability subclass Vle.

**55F-Peavine silty clay loam, 60 to 75 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. It is underlain by siltstone at a depth of 20 to 40 inches. Slopes average 65 percent. Elevations range from 700 to 1,400 feet. The average annual precipitation is 60 to 80 inches, the average annual air temperature is about 48 to 53 degrees F, and the frost-free period is about 160 to 210 days.

In a representative profile, the surface layer is dark brown and dark reddish brown silty clay loam about 10 inches thick. The upper 8 inches of the subsoil is reddish brown silty clay, and the lower 12 inches is yellowish red clay. Fractured siltstone is at a depth of 30 inches.

Included with this soil in mapping are areas of Honeygrove and McDuff soils, which make up 10 percent of this map unit, and Apt and Klickitat soils, which make up 5 percent.

Permeability is moderately slow. Effective rooting depth is about 30 inches. Available water capacity is 5 to 7 inches, and the water-supplying capacity is 18 to 22 inches. Surface runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for timber production. The soil is well suited to the production of Douglas-fir. The site index for Douglas-fir on this soil ranges from about 145 to 175, and the average site index is about 160. Based on the average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (international rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

Limitations to the use of equipment are major. When wet, this soil is sticky and plastic; this limits trafficability. The soil is severely compacted by equipment. The slope limits most operations to cable logging, aerial seeding, and weed control. Tractor logging causes excessive disturbance. Roads and landings need protection from erosion by constructing water bars and seeding road cuts and fills. Roads on the soil require a maximum of base rock for all-season use. Construction and maintenance of roads is difficult because of the slope and the hazard of slides.

Soil management is affected by plant competition. Grass, brush, and fern competition is especially difficult to control in nonstocked, cutover areas. There is little hazard of seedling mortality. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting may be needed. There is little hazard of windthrow.

Douglas-fir, hazel, bigleaf maple, alder, and other trees and shrubs are important food and cover plants for ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the leaves, buds, nuts, fruit, and seed from the Pacific dogwood, madrone, elderberry, cascara, and other plants for food. Black-tailed deer use this area for food and cover. Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

The slope is the major limitation to homesites. Roads and streets are subject to severe slips and slides because of the slope.

This soil is in capability subclass Vlle.

**56C-Philomath silty clay, 3 to 12 percent slopes.** This well drained soil is on foot slopes and rolling foothills. The soil formed in materials weathered from basalt rock. Basalt is at a depth of 12 to 20 inches. Slopes average about 7 percent. Elevation is 350 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silty clay and very dark brown clay about 14 inches thick. Partly weathered basalt is at a depth of 14 inches.

Included with this soil in mapping are areas of Dixonville, Ritner, and Witzel soils, which make up about 15 percent of this map unit.

Permeability is slow. Effective rooting depth is restricted by basalt at a depth of about 12 to 20 inches. Available water capacity is 2 or 3 inches, and the water-supplying capacity is 13 to 15 inches. Runoff is slow to medium, and the hazard of erosion is slight.

This soil is used for hay and pasture which is mainly in natural stands of grass and Oregon white oak. Improved varieties of grasses are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures better cover than if planted later, and this cover will help to protect the soil from erosion the following winter. The soil is droughty and generally not fertilized extensively. Small amounts of fertilizer are applied early in spring or in fall.

No commercial stands of timber grow on this soil. The soil is poorly suited to Christmas trees because of droughtiness.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of this soil that are intermingled with cultivated soils. Native grass, Oregon white oak, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and, streets, and other community uses because of the shallow depth to bedrock.

This soil is in capability subclass Vle.

**57E-Philomath silty clay, 12 to 45 percent slopes.** This well drained soil is on foot slopes and low rolling foothills. The soil formed in material weathered from basalt rock. Basalt is at a depth of 12 to 20 inches. Slopes average about 28 percent. Elevation is 350 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silty clay and very dark brown clay about 14 inches thick. Partly weathered basalt is at a depth of 14 inches.

Included with this soil in mapping are areas of Dixonville, Ritner, and Witzel soils, which make up about 15 percent of this map unit.

Permeability is slow. Effective rooting depth is restricted by basalt bedrock at a depth of about 12 to 20 inches. Available water capacity is 2 to 3 inches, and the water-supplying capacity is 13 to 15 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for hay and pasture, which is mainly in natural stands of grass and Oregon white oak. Improved varieties of grasses are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures better cover than if planted later, and this cover helps to protect the soil from erosion the following winter. The soil is droughty and generally not fertilized extensively. Small amounts of fertilizer are applied early in spring or in fall.

No commercial stands of timber grow on this soil. The soil is poorly suited to Christmas trees because of droughtiness.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of this soil that are intermingled with cultivated soils. Native grass, Oregon white oak, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of the shallow depth to bedrock and the slope.

This soil is in capability subclass Vle.

**58-Pilchuck fine sandy loam.** This excessively drained and somewhat excessively drained soil is on gently undulating alluvial bottoms. The soil formed in mixed recent alluvium. It is flooded by overflow several times in a year about once every 3 or 4 years. The soil is traversed by channels and sloughs that overflow. Slopes are 0 to 3 percent but average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown fine sandy loam about 7 inches thick. The substratum is dark brown and very dark grayish brown loamy fine sand and fine sand that extends to a depth of 62 inches or more.

Included with this soil in mapping are areas of Camas and Newberg soils, which make up 10 percent of this map unit, and Chehalis and Cloquato soils, which make up 5 percent.

Permeability is very rapid. Effective rooting depth is more than 60 inches. Available water capacity is 3 to 6 inches, and the water-supplying capacity is 10 to 15 inches. Runoff is slow, and the hazard of erosion is slight. The soil is subject to frequent flooding, and a seasonal high water table is at a depth of 24 to 48 inches in winter and spring.

Most areas of this soil are cultivated. The soil is used for row crops, forage crops, small grain, seed crops, and orchards. Most crops are well suited to the soil. The soil is irrigated for vegetable and many specialty crops from shallow wells, streams, rivers, and sloughs. The hazard of erosion from floodwaters can be reduced by planting winter cover crops and constructing dikes. Properly managing crop residue and using a cropping system in which grasses and legumes or green manure crops are grown at least 25 percent of the time help to maintain fertility and workability. The crops grown on the soil respond well to fertilizers and amendments.

The use of this soil for orchards or such crops as berries and hops, which require installation of poles, increases the hazard of debris accumulation and may cause severe gullying during flooding.

No commercial timber is grown on this soil.

The wide variety of grains, grasses, legumes, orchards, and vegetable crops and the fence rows and wooded tracts of ash, cottonwood, Douglas-fir, and shrubs furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents, and ducks and geese also feed on the soil. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows and brushy areas improve cover and food for wildlife. Water from streams is available most of the year. Burning fields and fence rows and clearing wooded and brushy areas will destroy both cover and food for wildlife.

This soil has major limitations for homesites, commercial buildings, and other community uses because it is subject to frequent flooding.

This soil is in capability subclass IVw.

**59-Pits, quarries.** Sand and gravel deposits are mined along the flood plain of rivers and major streams in the county. These materials are excavated from stream channels, bars, and gravelly alluvial deposit under soils used for farming. These deposits are the major source of mineral aggregate for construction and roads.

Crushed gravel is mined from quarries of igneous rock in uplands. Most quarries are located in remote areas, and they provide an excellent source of rock for logging roads. Formations of igneous rock are extensive in the county, and they yield the best quality of crushed rock. Quarrying cost and transportation, however, limit extensive development.

Pits, quarries, is not assigned to a capability subclass.

**60C-Rickreall silty clay loam, 3 to 12 percent slopes.** This well drained soil is on foot slopes and low, rolling foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 12 to 20 inches. Slopes average about 7 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 5 inches thick. The subsoil is dark reddish brown, reddish brown, and yellowish red silty clay and clay about 12 inches thick. Weathered siltstone is at a depth of 17 inches.

Included with this soil in mapping are areas of Bellpine, Hazelair, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is slow. Effective rooting depth is restricted by sedimentary bedrock at about 12 to 20 inches. Available water capacity is 2 to 3 inches, and the water-supplying capacity is 8 to 14 inches. Runoff is slow to medium, and the hazard of erosion is slight.

This soil is used for hay and pasture, which is mainly in natural stands of grass and Oregon white oak. Improved varieties of grasses are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures better cover than if planted later, and this cover will help to protect the soil from erosion the following winter. This soil is droughty and generally not fertilized extensively. Small amounts of fertilizer are applied early in spring or in fall.

No commercial stands of timber grow on this soil. The soil is poorly suited to growing Christmas trees because of droughtiness.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of the soil that are intermingled with cultivated soils. Native grass, Oregon white oak, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of shallow depth to bedrock.

This soil is in capability subclass Vle.

**60D-Rickreall silty clay loam, 12 to 20 percent slopes.** This well drained soil is on foot slopes and low, rolling foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 12 to 20 inches. Slopes average about 16 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 5 inches thick. The subsoil is dark reddish brown, reddish brown, and yellowish red silty clay and clay about 12 inches thick. Weathered siltstone is at a depth of 17 inches.

Included with this soil in mapping are areas of Bellpine, Hazelair, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of about 12 to 20 inches. Available water capacity is 2 to 3 inches, and the water-supplying capacity is 8 to 14 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for hay and pasture, which is mainly in natural stands of grass and Oregon white oak. Improved varieties of grasses are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures better cover than if planted later, and this cover will help to protect the soil from erosion the following winter. This soil is droughty and generally not fertilized extensively. Small amounts of fertilizer are applied early in spring or in fall.

No commercial stands of timber grow on this soil. The soil is poorly suited to growing Christmas trees because of droughtiness.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of the soil that are intermingled with cultivated soils. Native grass, Oregon white oak, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

The soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of the shallow depth to bedrock.

This soil is in capability subclass Vle.

**60E-Rickreall silty clay loam, 20 to 50 percent slopes.** This well drained soil is on foot slopes and low, rolling foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 12 to 20 inches. Slopes average about 35 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 5 inches thick. The subsoil is dark reddish brown, reddish brown, and yellowish red silty clay and clay about 12 inches thick. Weathered siltstone is at a depth of 17 inches.

Included with this soil in mapping are areas of Bellpine, Hazelair, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of about 12 to 20 inches. Available water capacity is 2 to 3 inches, and the water-supplying capacity is 8 to 14 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for pasture, which is mainly in natural stands of grass and Oregon white oak. Erosion can be controlled by maintaining a ground cover of native vegetation.

No commercial stands of timber grow on this soil. The soil is poorly suited to Christmas trees because of droughtiness and steep slopes.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of the soil that are intermingled with cultivated soils. Oregon white oak, grass, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of shallow depth to rock and the slope.

This soil is in capability subclass VIIe.

**60F-Rickreall silty clay loam, 50 to 75 percent slopes.** This well drained soil is on foot slopes and low, rolling foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 12 to 20 inches. Slopes average about 60 percent. Elevation is 300 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 5 inches thick. The subsoil is dark reddish brown, reddish brown, and yellowish red silty clay and clay about 12 inches thick. Weathered siltstone is at a depth of 17 inches.

Included with this soil in mapping are areas of Bellpine, Hazelair, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of about 12 to 20 inches. Available water capacity is 2 to 3 inches, and the water-supplying capacity is 8 to 14 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for pasture, which is mainly in natural stands of grass and Oregon white oak. Erosion can be controlled by maintaining a ground cover of native vegetation.

No commercial stands of timber grow on this soil. The soil is poorly suited to growing Christmas trees because of droughtiness and the steep slopes.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of this soil that are intermingled with cultivated soils. Oregon white oak, grass, poison-oak, and wild rose provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of shallow depth to rock and the slope.

This soil is in capability subclass VIIe.

**61C-Ritner gravelly silty clay loam, 3 to 12 percent slopes.** This well drained soil is on foothills. The soil formed in cobbly colluvium weathered from basic igneous rock. Basalt is at a depth of 20 to 40 inches. Slopes average about 8 percent. Elevation is 400 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown gravelly silty clay loam about 6 inches thick. The upper 20 inches of the subsoil is dark reddish brown gravelly silty clay loam and silty clay, and the lower 12 inches is dark reddish brown very cobbly silty clay. Fractured basalt is at a depth of 38 inches.

Included-with this soil in mapping are areas of Witzel and Nekia soils, which make up 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by basalt at a depth of 20 to 40 inches. Available water capacity is 3 to 6 inches, and the water-supplying capacity is 16 to 23 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for cereal grain, orchards, pasture, and woodland. It is not so productive or easily tilled as other soils on terraces or bottom lands.

Erosion can be controlled with cross-slope farming, grassed waterways, winter cover crops, and returning crop residue to the soil. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time improve tilth and crop yields.

Grain and grass crops respond to nitrogen, and legumes respond to phosphorus, sulfur, boron, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil generally is not irrigated. Irrigation water generally must be stored in reservoirs, and suitable reservoir sites are limited.

This soil is moderately well suited to Douglas-fir production and is well suited to Christmas tree production. Mixed stands of Oregon white oak, Douglas-fir, and grand fir grow on the soil. The site index for Douglas-fir on the soil ranges from 128 to 142, and the average site index is 135. Based on this site index for Douglas-fir, the soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts and fills.

Seedling mortality and plant competition present some concerns.

The crops grown on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, grand fir, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. There are some limitations for homesites, commercial buildings, and local roads and streets because of depth to rock and low strength. The soil has major limitations for septic tank absorption fields because of the depth to rock and moderately slow permeability.

This soil is in capability subclass IVs.

**61D-Ritner gravelly silty clay loam, 12 to 30 percent slopes.** This well drained soil is on foothills. The soil formed in colluvium weathered from basic igneous rocks. Basalt is at a depth of 20 to 40 inches. Slopes average about 20 percent. Elevation is 400 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown gravelly silty clay loam about 6 inches thick. The upper 20 inches of the subsoil is dark reddish brown gravelly silty clay loam and silty clay, and the lower 12 inches is dark reddish brown very cobbly silty clay. Highly fractured basalt is at a depth of 38 inches.

Included with this soil in mapping are areas of Witzel and Nekia soils, which make up 10 percent of this map unit.

Permeability is moderately , slow. Effective rooting depth is restricted by basalt at a depth of 20 to 40 inches. Available water capacity is 3 to 6 inches, and the water-supplying capacity is 16 to 23 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for pasture and woodland. The slope makes this soil unsuitable for cultivation. Improved varieties of grasses are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures a better cover than if planted later and helps to protect the soil from erosion the following winter.

This soil is moderately well suited to Douglas-fir production. It is not well suited to Christmas tree production because the slope restricts harvesting and management. Mixed stands of Oregon white oak, Douglas-fir and grand fir grow on the soil. The site index for Douglas-fir ranges from 128 to 142, and the average site index is 135. Based on this site index for Douglas-fir, the soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (international rule, one-fourth inch kerf), of merchantable timber from a fully stocked even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts an fills.

Seedling mortality and plant competition present some concerns.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, grand fir, bigleaf maple, and other trees, shrubs and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has major limitations for homesites, commercial buildings, local roads and streets, and septic tank absorption fields because of the slope.

This soil is in capability subclass Vls.

**61E-Ritner gravelly silty clay loam, 30 to 60 percent slopes.** This well drained soil is on foothills. The soil formed in colluvium weathered from basic igneous rock. Basalt is at a depth of 20 to 40 inches. Slopes average about 45 percent. Elevation is 400 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown gravelly silty clay loam about 6 inches thick. The upper 20 inches of the subsoil is dark reddish brown gravelly silty clay loam and silty clay, and the lower 12 inches is dark reddish brown very cobbly silty clay. Highly fractured basalt is at a depth of 38 inches.

Included with this soil in mapping are areas of Witzel and Nekia soils, which make up 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by basalt at a depth of 20 to 40 inches. Available water capacity is 3 to 6 inches, and the water-supplying capacity is 16 to 23 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for pasture and timber production. The slope makes the soil unsuitable for cultivation. Improved varieties of grasses are desirable for cover if they can be established. Planting these grasses early in spring insures a better cover than if, they are planted later and helps to protect the soil from erosion the following winter.

This soil is moderately well suited to Douglas-fir production. It is poorly suited to Christmas tree production because the slope restricts management and harvesting. Mixed stands of Oregon white oak, Douglas-fir, and grand fir grow on the soil. The site index for Douglas-fir on the soil is about 148. Based on this average site index, the soil is capable of producing about 11,700 cubic feet, or 59,700 board feet (International rule, one-fourth inch kerf) of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is plastic and sticky when wet; this restricts trafficability. Roads and landings need protection against erosion by constructing water bars and seeding cuts, fills, and skid roads.

Seedling mortality and plant competition are concerns.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of this soil that are intermingled with cultivated soil. In wooded areas of Oregon white oak, Douglas-fir, grand fir, bigleaf maple, and other trees, shrubs, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has major limitations for all community uses because of the slope.

This soil is in capability subclass VIIs.

**62-Riverwash.** This excessively drained miscellaneous area is in narrow bands along major river and stream channels. This material is too variable to be classified as soil. It is made up of gravel and cobblestones in a sandy matrix. It is recent alluvium. Riverwash is exposed during periods of low water and is subject to shifting during normal high water and at flood stage. It ranges in depth from 40 to more than 60 inches. Slopes are 0 to 5 percent but average about 2 percent. Elevation is 125 to 700 feet. The average annual precipitation is 40 to 80 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 140 to 210 days.

Permeability is rapid to very rapid. Available water capacity and the water-supplying capacity are too variable to rate. Runoff is slow, and the hazard of erosion is high.

None of this miscellaneous area is cultivated or used for timber production. Most is void of vegetation except for occasional bunches of grass and scattered shrubs, which provide very little food and cover for wildlife.

The hazard of frequent flooding from overflow is the major limitation to homesites. Riverwash has some limited recreational use.

Riverwash is in capability subclass VIIIw.

**63-Rock outcrop.** This miscellaneous area is on steep side slopes and escarpments in the mountains of the Coast Range. It is areas of hard igneous rock. Slopes range from 30 to 90 percent. Elevation is 1,100 to 3,500 feet. The average annual precipitation is 60 to 150 inches, the average annual air temperature is 42 to 53 degrees F, and the frost-free period is 90 to 200 days.

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

This miscellaneous area is nearly void of vegetation. It has no commercial stands of timber. Because of the lack of vegetation, this miscellaneous area has little or no value as wildlife habitat.

The slope and outcroppings of rock are the major limitations to community use.

Rock outcrop is in capability subclass VIIIs.

**64B-Salkum silty clay loam, 2 to 6 percent slopes.** This well drained soil is on high, gravelly terraces that have broad, gently sloping tops and steeper side slopes. The soil formed in old, clayey, weathered, gravelly alluvial deposits. Weathered gravel is at a depth of 40 to 60 inches. Slopes average about 4 percent. Elevation is 325 to 375 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish

brown silty clay loam about 12 inches thick. The subsoil is reddish brown and dark reddish brown silty clay and clay about 25 inches thick. The upper part of the substratum is variegated silty clay about 12 inches thick. Weathered basic igneous gravel that can be cut with a knife is at a depth of 49 inches.

Included with this soil in mapping are areas of Briedwell, Dupee, and Bellpine soils, which make up about 5 to 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is about 40 inches. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 18 to 24 inches. Runoff is slow, and the hazard of erosion is slight.

Most of the acreage of this soil is cultivated. Cereal grain, orchards, forage, and grass seed are the major crops, and the soil is highly productive for these crops. It is not so productive or easily tilled as other soils on terraces or bottom lands.

This soil responds well to fertilizers and amendments. If residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to reduce runoff and erosion and help to maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited because of the gravelly substratum.

A few small tracts of mixed stands of Douglas-fir, Oregon white oak, and grand fir grow on this soil. They are not of sufficient acreage for commercial timber production.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The principal limitation to homesites is the major restriction for septic tank filter fields because of moderately slow permeability. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIe.

**64C-Salkum silty clay loam, 6 to 12 percent slopes.** This well drained soil is on high terraces along the foothills. The soil formed in old, weathered, gravelly alluvium. Weathered gravel is at a depth of 40 to 60 inches. Slopes average about 9 percent. Elevation is 350 to 650 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 200 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 12 inches thick. The subsoil is reddish brown and dark reddish brown silty clay and clay about 25 inches thick. The upper part of the substratum is a variegated silty clay about 12 inches thick. Weathered basaltic gravel that can be cut with a knife is at a depth of 49 inches.

Included with this soil in mapping are areas of Bellpine and Briedwell soils, which make up about 10 to 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 40 to 60 inches. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 18 to 24 inches. Runoff is medium, and the hazard of erosion is slight.

Most of the acreage of this soil is cultivated. Cereal grain, orchards, forage, and grass seed are the major crops, and the soil is highly productive for these crops. It is well suited to growing Christmas trees.

This soil responds well to fertilizers and amendments. Where residues are used, additional nitrogen is generally required to prevent a decrease in yields. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to reduce runoff and erosion and help to maintain fertility and workability.

This soil generally is not irrigated. Irrigation water generally must be stored in ponds or reservoirs, and suitable reservoir sites are limited.

The crops and natural vegetation on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

Increased population growth in the county has resulted in increased home construction on this soil. The principal limitation to homesites is the major restriction for septic tank filter fields because of moderately slow permeability. Most areas of the soil are not on community sewage systems.

This soil is in capability subclass IIe.

**65B-Santiam silt loam, 3 to 6 percent slopes.** This moderately well drained soil is on terraces above the main

Willamette Valley floor. The soil formed in silty alluvium over older clayey alluvium. Slopes average about 4 percent. Elevation is 300 to 375 feet. The average annual precipitation is about 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 17 inches thick. The subsoil is dark brown mottled heavy silty clay loam about 17 inches thick. The substratum is grayish brown and dark brown mottled clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Helvetia, Dupee, Steiwer, and Hazelair soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 40 inches or more. Available water capacity is 8 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is better suited to row crops, forage crops, small grain, and grass seed than to other crops. It is well suited to vegetables and to many specialty crops. The choice of crops is somewhat restricted, however, because of the occasional high water table. Long-lived, deep-rooted, deciduous fruit trees, nut trees, strawberries, and alfalfa are all unfavorably affected by wetness caused by the high water table.

Erosion is easily controlled. Returning all crop residue to the soil and using a cropping system in which grasses and legumes or grass and legume mixtures are grown at least 25 percent of the time help to reduce runoff and erosion and to maintain favorable fertility and workability.

Small grains and grasses respond to nitrogen fertilizer; row crops respond to nitrogen and phosphorus fertilizer; and legumes respond to phosphorus fertilizer, and sulfur, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent decreased yields.

Sprinklers and furrows are suitable for irrigation and corrugation methods are well suited to row crops. Water should be carefully applied, and the rate of application should be so low that runoff does not occur. Water for irrigation can be obtained from reservoirs. An adequate supply of water for irrigation is not available from wells.

Wetness is a moderate limitation to the use of this soil for crops. Drainage is needed if the soil is to be used for maximum production. In most places; grid drainage will make the soil more suitable for crops. Seepage from soils in higher areas can be controlled by installing interceptor ditches and random drains.

No commercial stands of timber grow on this soil. The soil is well suited to Christmas tree production.

Native vegetation includes grasses, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents, and ducks and geese also feed in areas near water. Gophers; ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

Increased population growth in the county has resulted in increased homesite construction on this soil. The primary limitations for urban development are high shrink-swell potential of the subsoil, limited ability of the soil to support a load, and a high water table in the rainy season. Dwellings and road construction can be designed to offset the first two limitations. Septic tank absorption fields do not function properly during rainy periods because of the high water table and moderately slow permeability in the subsoil.

This soil is in capability subclass llw.

**65C-Santiam silt loam, 6 to 15 percent slopes.**

This moderately well drained soil is on terraces above the main Willamette Valley floor. The soil formed in silty alluvium over older clayey alluvium. Slopes average about 9 percent. Elevation is 300 to 375 feet. The average annual precipitation is about 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F; and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 17 inches thick. The subsoil is dark brown mottled heavy silty clay loam about 17 inches thick. The substratum is grayish brown and dark brown mottled clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Helvetia, Dupee, Steiwer, and Hazelair soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 40 inches or more. Available water capacity is 8 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is better suited to row crops, forage crops, small grain, and grass seed than to other crops. In some areas, somewhat restricted drainage limits the choice of crops. In places, long-lived, deep-rooted, deciduous fruit trees, nut trees, strawberries, raspberries, and alfalfa do not grow well unless then soil is drained.

Good drainage is needed for maximum use of this soil and for best returns. Seepage from soils in higher areas can be controlled by installing interceptor ditches and random drains. Runoff can be controlled by establishing grassed waterways and by keeping a protective cover of plants on the soil at all times.

Erosion is easily controlled by farming across the slope, establishing grassed waterways, practicing rough tillage, and

protecting the soil with a winter cover crop or stubble mulch. Returning all crop residue to the soil and using a cropping system in which grasses and legumes or mixtures of grasses and legumes are grown at least 50 percent of the time help to reduce runoff and erosion and to maintain favorable soil fertility and workability.

Small grain and grasses respond to nitrogen fertilizer; row crops commonly respond to nitrogen and phosphorus fertilizer; and legumes respond to phosphorus fertilizer, sulfur, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

Water can be applied by means of sprinkler for furrow irrigation or the contour furrow method, but rates should be low enough to prevent erosion. Water for irrigation can be obtained from reservoirs. In most places, adequate water is not available from wells.

No commercial stands of timber grow on this soil. The soil is moderately well suited to Christmas tree production, but is moderately limited by the slope.

Native vegetation includes grasses, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents, and ducks and geese also feed in areas near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Streambank and roadway planting, grassed waterways, and preservation of fence rows, woodlots, and brushy areas improve cover and food for wildlife.

Increased population growth in the county has resulted in increased homesite construction on this soil. The primary limitations for urban development are the high shrink-swell potential in the subsoil, the limited ability of the soil to support a load, high water table in the rainy season, and the moderate slopes. Moderately slow permeability in the subsoil and a seasonal high water table are the major limitations for septic tank absorption fields. Dwelling and road construction can be designed to offset the shrink-swell potential and low strength of the soil.

This soil is in capability subclass IIe.

**65D-Santiam silt loam, 15 to 20 percent slopes.**

This moderately well drained soil is on terraces above the main Willamette Valley floor. The soil formed in silty alluvium over older clayey alluvium. Slopes average about 18 percent. Elevation is 300 to 375 feet. The average annual precipitation is about 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 17 inches thick. The subsoil is dark brown mottled heavy silty clay loam about 17 inches thick. The substratum is grayish brown and dark brown mottled clay that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Helvetia, Dupee, Steiwer, and Hazelair soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is 40 inches or more. Available water capacity is 8 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is well suited to forage crops, small grain, and grass seed. In some areas, somewhat restricted drainage and slope limits the choice of crops. Some long-lived, deep rooted, deciduous fruit trees, nut trees, strawberries, and alfalfa are unfavorably affected by excess moisture unless the soil is drained.

The slope makes this soil unsuitable for grid drainage. In most places, drainage is provided by installing interceptor ditches and random drains.

Erosion can be controlled by tilling across the slope, growing a winter cover crop, and establishing a permanent cover of grass in natural waterways. Properly managing crop residue and using a cropping system in which grasses and legumes or mixtures of grasses and legumes are grown at least 75 percent of the time help to reduce runoff and erosion and to maintain favorable fertility and workability.

Small grain and grasses respond to nitrogen fertilizer and legumes respond to phosphorus fertilizer, sulfur, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

Irrigation is somewhat difficult because of moderately steep slopes. Sprinklers are suitable for applying irrigation water. This water can be obtained from reservoirs. Water should be applied at a rate so low that it will not cause runoff.

No commercial stands of timber grow on this soil. The soil has moderately severe limitations for Christmas tree production because of the slope.

Native vegetation includes grass, hazel, poison-oak, wild blackberry, Douglas-fir, bigleaf maple, and Oregon white oak, which furnish good food and cover for ringnecked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are permanent residents, and ducks and geese also feed on areas near water. Gophers, ground squirrels, moles, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

Increased population growth in the county has resulted in increased homesite construction on this soil. The primary limitations to urban development are the high shrink-swell potential in the subsoil, the limited ability of the soil to support a load, the seasonal high water table in the rainy season, and the

moderately steep slopes. The slope, moderately slow permeability in the subsoil, and seasonal high water table are major limitations for septic tank absorption fields. Dwellings and road construction can be designed to offset the shrink-swell potential and low strength.

This soil is in capability subclass IIIe.

**66D-Slickrock gravelly loam, 3 to 25 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 15 percent. Elevation is 800 to 1,600 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 48 to 52 degrees F, and the frost-free period is about 145 to 180 days.

In a representative profile, the surface layer is very dark grayish brown gravelly loam about 15 inches thick. The subsoil is dark brown and dark yellowish brown gravelly loam and gravelly clay loam that extends to a depth of 65 inches or more.

Included with this soil in mapping are areas of Bohannon, Astoria, Trask, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production, water supply and wildlife habitat. It is very well suited to the production of Douglas-fir. Bigleaf maple and red alder are common. The site index for Douglas-fir ranges from about 155 to 175, and the average site index is about 165. Based on this average site index, the soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-yearold trees.

Limitations to the use of equipment are slight. Roads and skid trails are unstable when wet. Trafficability is restricted when the soil is wet. Cable logging causes less disturbance than tractor logging. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight. Limitations can become major at the lower elevations and on moist sites, where salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The soil has good water-supplying capacity, and it is in a favorable climatic zone. Natural regeneration is generally good but may need to be supplemented by site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass VIe.

**66E-Slickrock gravelly loam, 25 to 50 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in residuum and colluvium weathered from sedimentary rock. Slopes average about 35 percent. Elevation is 800 to 1,600 feet. The average annual precipitation is 80 to 120 inches, the average annual air temperature is about 48 to 52 degrees F, and the frost-free period is about 145 to 180 days.

In a representative profile, the surface layer is very dark grayish brown gravelly loam about 15 inches thick. The subsoil is dark brown and dark yellowish brown gravelly loam and gravelly clay loam that extends to a depth of 65 inches or more.

Included with this soil in mapping are areas of Bohannon, Astoria, Trask, and Blachly soils, which make up about 15 percent of this map unit.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production, water supply, and wildlife habitat. It is very well suited to the production of Douglas-fir. Bigleaf maple and red alder are common. The site index for Douglas-fir on this soil ranges from about 155 to 175, and the average site index is about 165. Based on this average site index, the soil is capable of producing about 13,300 cubic feet, or 74,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Roads and skid trails are unstable when wet. Trafficability is restricted when this soil is wet. Cable logging causes less disturbance than tractor logging. Construction and maintenance of roads is difficult because of steep slope and slide hazards. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is slight. Limitations can become major at the lower elevations and on moist sites, where salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers. There is little danger of seedling mortality. The soil has good water-supplying capacity, and it is in a favorable climatic zone. Natural regeneration is generally good but may need to be supplemented by site

preparation, seeding, and planting. Weeding and thinning are needed for good stand development. The hazard of windthrow is minimal. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Roads and streets are subject to slips and slides.

This soil is in capability subclass Vle.

**67C-Steiwer silt loam, 3 to 12 percent slopes.** This well drained soil is on low foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 8 percent. Elevation is 300 to 500 feet.. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam about 15 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 11 inches thick. Partly weathered sedimentary bedrock is at a depth of 26 inches.

Included with this soil in mapping are areas of Chehulpum and Hazelair soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 3.5 to 8 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for small grain, hay, and pasture. Orchards and deep rooted crops are not generally grown on the soil because of limited depth to bedrock and low available water capacity. Properly managing crop residue and using a cropping system in which grass and legumes or a grass and legume mixture are grown help to reduce runoff and erosion and to maintain fertility and workability. Small grain and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and, in many places, lime. Where stubble mulching is practiced, additional nitrogen is needed.

Erosion is easily controlled by establishing grassed waterways, cross-slope farming, crop residue management, and winter cover crops. Cover crops planted early in fall help to insure adequate growth.

This soil is not generally irrigated. Irrigation water should be applied carefully at rates low enough to prevent runoff. Irrigation water must be stored in reservoirs, but suitable sites generally are not available. In years without rain late in spring, the soil is quite droughty.

No commercial stands of timber grow on this soil. The soil is only moderately suited to growing Christmas trees because of droughtiness.

Ring-necked pheasant, California quail, and bobwhite quail may be present in cultivated areas of this soil. Native grass, Oregon white oak, wild rose, poison oak, and snowberry provide important food and cover for black-tailed deer and other wildlife.

This soil has some limitations for homesites, commercial buildings, roads and streets, and other community uses because of low strength and slope. It has major limitations for septic tank absorption fields because of depth to bedrock and moderately slow permeability.

This soil is in capability subclass IIIe.

**67D-Stelwer silt loam, 12 to 20 percent slopes.** This well drained soil is on low foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 15 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam about 15 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 11 inches thick. Partly weathered sedimentary bedrock is at a depth of 26 inches.

Included with this soil in mapping are areas of Chehulpum and Hazelair soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 3.5 to 8 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is high.

This soil is used mainly for small grain, seeded grass, pasture, and hay. Some areas are in native grass and oak. Orchards and deep-rooted crops are not suited to the soil because of limited depth to bedrock and tendency to be droughty. Properly managing crop residue and using a cropping system in which grass and legumes or a grass and legume mixture are grown help to reduce runoff and erosion and to maintain fertility and workability. Small grains and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and, in many places, lime. If stubble mulching is practiced, additional nitrogen is needed.

Erosion is easily controlled by establishing grassed waterways, cross-slope farming, crop residue management and winter cover crops. Cover crops planted early in fall help to insure adequate growth.

This soil generally is not irrigated because of the slope. In years without rain late in spring, this soil is quite droughty.

No commercial stands of timber grow on this soil. It is poorly suited to growing Christmas trees because of droughtiness, and the slope which restricts management and harvesting.

Ring-necked pheasant, California quail, and bobwhite quail may be present in cultivated areas of this soil. Native grass, Oregon white oak, wild rose, poison-oak, and snowberry provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community use because of the slope.

This soil is in capability subclass IVe.

**67E-Stelwer silt loam, 20 to 50 percent slopes.** This well drained soil is on low foothills. The soil formed in material weathered from sedimentary bedrock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 30 percent. Elevation is 300 to 500 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown silt loam about 15 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 11 inches thick. Partly weathered sedimentary bedrock is at a depth of 26 inches.

Included with this soil in mapping are areas of Chehulpum and Hazelair soils, which make up 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 3.5 to 8 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for oak and grass pasture. The slope makes this soil unsuitable for cultivation. A permanent plant cover should be kept on the soil at all times. Improved varieties of grasses are desirable for cover if they can be established. Planting these grasses early in spring insures a better cover than if they are planted later and helps to protect the soil from erosion. The soil is droughty. Grasses make little or no growth late in summer and in fall. This soil generally is not fertilized extensively because of droughtiness, but small amounts of fertilizer are applied early in spring or in fall.

This soil generally is not irrigated because of the slope.

No commercial stands of timber grow on this soil. It is poorly suited to growing Christmas trees because of droughtiness and the slope which restricts management and harvesting.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of this soil that are near cultivated soils. Native grass, Oregon white oak, wild rose, poison-oak, and snowberry provide important food and cover for black-tailed deer and other wildlife.

This soil has major limitations for homesites, commercial buildings, roads and streets, and other community uses because of the slope.

This soil is in capability subclass Vle.

**68C-Suver silty clay loam, 3 to 12 percent slopes.** This somewhat poorly drained soil is on ridges and smooth, low foothills. The soil formed in fine-textured residuum and colluvium weathered from sedimentary bedrock. Bedrock is at a depth of 40 to 60 inches. Slopes average about 8 percent. Elevation is 275 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is dark brown silty clay loam about 11 inches thick. The subsoil is brown, reddish brown, and grayish brown, mottled silty clay and clay about 17 inches thick. The upper 1,4 inches of the substratum is light olive gray and pale brown clay, and the lower part is sedimentary bedrock.

Included with this soil in mapping are areas of Bellpine and Hazelair soils, which make up 10 percent of this map unit, and Dupee and Willakenzie soils, which make up 5 percent.

Permeability is very slow. Effective rooting depth is 20 to 36 inches. It is limited by a clayey subsoil and a seasonal high water table. Available water capacity is 4 to 7.5 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 12 to 24 inches in winter and spring.

This soil is used for small grain, seeded grass, hay, and pasture. Long-lived, deep-rooted, deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table. Organic-matter content can be maintained or improved by returning crop residue to the soil and a cropping system that includes soil-building crops 50 to 75 percent of the rotation. Sheet and rill erosion can be controlled by cross-slope farming and grassed waterways.

Grain and grass crops respond to nitrogen, and legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil generally is not irrigated. Water for irrigation, where possible, needs to be stored in reservoirs.

The soil needs drainage for maximum production and use. Open drainage ditches are subject to erosion unless care is taken in laying them out. Drainage generally can be accomplished by interceptor drains with some random lines to drain wet spots in the lower areas. Deep, underground tile

systems intercept and remove excess water caused by the perched water table and seepage in winter and early in spring.

No commercial stands of timber grow on this soil. The soil is not well suited to Christmas tree production because of the seasonal high water table and clayey subsoil.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites (fig. 13), commercial buildings, and local roads and streets because of a seasonal high water table, shrink-well potential in the subsoil, and limited ability of the soil to support a load. Dwellings and road construction can be designed to offset the last two limitations. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, seasonal high water table, and very slow permeability.

This soil is in capability subclass IIIe.

**68D-Suver silty clay loam, 12 to 20 percent slopes.** This somewhat poorly drained soil is on ridges and smooth, low foothills. The soil formed in fine-textured residuum and colluvium weathered from sedimentary bedrock. Bedrock is at a depth of 40 to 60 inches. Slopes average about 16 percent. Elevation is 275 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark brown silty clay loam about 11 inches thick. The subsoil is brown, reddish brown, and grayish brown mottled silty clay and clay about 17 inches thick. The substratum, to a depth of 14 inches, is light olive gray and pale brown clay. Sedimentary bedrock is at a depth of 42 inches.

Included with this soil in mapping are areas of Bellpine and Hazelair soils, which make up 10 percent of this map unit, and Dupee and Willakenzie soils, which make up 5 percent.

Permeability is very slow. Effective rooting depth is 20 to 36 inches. It is limited by a clayey subsoil and a seasonal high water table. Available water capacity is 4 to 7.5 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 12 to 24 inches in winter and spring.

This soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted, deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by a seasonal high water table. Tilling and planting across the slope and a winter cover crop help to control erosion. Grassed waterways help to remove excess water. Tillage should be limited to seedbed preparation and weed control. Leaving the soil in a cloddy condition during the rainy period helps to protect against erosion. A suitable cropping system provides soil-building crops for more than 75 percent of the rotation.

Grain and grass crops respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil generally is not irrigated. Water for irrigation, where possible, needs to be stored in reservoirs.

Limited drainage can generally be accomplished by installing interceptor drains and some random lines to drain wet spots in the lower areas. Deep, underground tile systems across the slope intercept and remove excess water from a perched water table and seepage in winter and early in spring.

No commercial stands of timber grow on this soil. The soil is not well suited to Christmas tree production because of the seasonal high water table, slope, and clayey subsoil.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites, commercial buildings, and local roads and streets because of moderate slopes, seasonal high water table, shrink-swell potential in the subsoil, and limited ability of the soil to support a load. Dwellings and road construction can be designed to offset these limitations. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, seasonal high water table, slope, and very slow permeability.

This soil is in capability subclass IVe.

**68E-Suver silty clay loam, 20 to 30 percent slopes.** This somewhat poorly drained soil is on ridges and smooth, low foothills. The soil formed in fine-textured residuum and colluvium weathered from sedimentary bedrock. Bedrock is at a depth of 40 to 60 inches. Slopes average about 25 percent. Elevation is 275 to 800 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52 to 54

degrees F, and the frost-free period is about 165 to 210 days.

In a representative profile, the surface layer is dark brown silty clay loam about 11 inches thick. The subsoil is brown, reddish brown, and grayish brown mottled silty clay and clay about 17 inches thick. The substratum, to a depth of 14 inches, is light olive gray and pale brown clay. Sedimentary bedrock is at a depth of 42 inches.

Included with this soil in mapping are areas of Bellpine and Hazelair soils, which make up 10 percent of this map unit, and Dupee and Willakenzie soils, which make up 5 percent.

Permeability is very slow. Effective rooting depth is 20 to 30 inches. It is limited by a clayey subsoil and a seasonal high water table. Available water capacity is 4 to 7.5 inches, and the water-supplying capacity is 14 to 20 inches. Runoff is rapid, and the hazard of erosion is high. A seasonal high water table is at a depth of 12 to 24 inches in winter and spring.

This soil is used for small grain, grass seed, hay, and pasture. Long-lived, deep-rooted, deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by a seasonal high water table. Tilling and planting across the slope and a winter cover crop help to control erosion. Grassed waterways help to remove excess water. Tillage should be limited to seedbed preparation and weed control. Leaving the soil in a cloddy condition during the rainy period helps to protect it against erosion. A suitable cropping system includes soil-building crops for more than 75 percent of the rotation.

Grain and grass crops respond to nitrogen. Legumes require phosphorus, boron, and sulfur. Lime is generally required to reduce acidity. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil generally is not irrigated because of the slope and inherent drainage concerns.

No commercial stands of timber grow on this soil. The soil is not well suited to Christmas tree production because of the seasonal high water table, slope, and clayey subsoil.

Crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brush areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites, commercial buildings, and local roads and streets because of the seasonal high water table, shrink-swell potential in the subsoil, slope, and the limited ability of the soil to support a load. Dwelling and road construction can be designed to offset the last three limitations. The soil also has major limitations for septic tank absorption fields, sewage lagoons, and sanitary landfills because of the clayey subsoil, high seasonal water table, slope, and very slow permeability. This soil also has some limitations for recreation because of the slope and seasonal high water table.

This soil is in capability subclass IVe.

**69D-Trask shaly loam, 3 to 30 percent slopes.** This well drained soil is in mountainous topography in the Coast Range. The soil formed in shaly residuum and colluvium weathered from sedimentary rock. Partly weathered shale is at a depth of 20 to 40 inches. Slopes average about 20 percent. Elevation is 1,000 to 1,700 feet. The average annual precipitation is 80 to 130 inches, the average air temperature is about 49 to 52 degrees F, and the frost-free period is about 145 to 200 days.

In a representative profile, the surface layer is very dark grayish brown and very dark brown shaly loam and very shaly loam 12 inches thick. The subsoil is dark yellowish brown and yellowish brown very shaly loam about 24 inches thick. Partly weathered shale is at a depth of 36 inches.

Included with this soil in mapping are areas of Astoria, Bohannon, and Slickrock soils, which make up 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 5 inches, and the water-supplying capacity is 15 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. It is well suited to the production of Douglas-fir. Hemlock is mixed with Douglas-fir at higher elevations. Bigleaf maple is common, and red alder is on lower slopes and in drainageways. The site index for Douglas-fir on this soil is about 135. Based on the site index for Douglas-fir, this soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is stable and trafficability is good. Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition is not generally a major concern. It may be on the lower slopes and in moist sites, where salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifer seedlings. This soil is droughty in summer; this causes some seeding mortality. Natural regeneration is generally slow and may need to be supplemented with site preparation, seeding, and planting. Weeding and thinning are needed for good stand development. There is some hazard of windthrow. Swordfern is abundant and is a good source of greenery.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Local roads and streets are subject to slips and slides.

This soil is in capability subclass Vls.

**69F-Trask shaly loam, 30 to 90 percent slopes.**

This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly residuum and colluvium weathered from sedimentary rock. Partly weathered shale is at a depth of 20 to 40 inches. Slopes average about 55 percent. Elevation is 1,000 to 1,700 feet. The average annual precipitation is 80 to 130 inches, the average annual air temperature is about 49 to 52 degrees F, and the frost-free period is about 145 to 200 days.

In a representative profile, the surface layer is very dark grayish brown and very dark brown shaly loam and very shaly loam about 12 inches thick. The subsoil is dark yellowish brown and yellowish brown very shaly loam about 19 inches thick. Partly weathered shale is at a depth of 31 inches.

Included with this soil in mapping are areas of Astoria, Bohannon, and Slickrock soils, which make up 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. Available water capacity is 2.5 to 5 inches, and the water-supplying capacity is 15 to 20 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, and it is well suited to the production of Douglas-fir. Hemlock is mixed with Douglas-fir at higher elevations. Bigleaf maple is common, and red alder is on lower slopes and in drainageways. The site index for Douglas-fir on this soil is about 135. Based on the site index for Douglas-fir, the soil is capable of producing about 10,300 cubic feet, or 47,400 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. The slope limits most operations to cable logging and aerial seeding and weeding. The slope and rock outcrop interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of the slope. Roads and landings should be protected with water bars and seeded to grass to control erosion.

Plant competition may be especially difficult to control in poorly stocked areas. Seedling mortality is a major concern. This soil is droughty in summer, especially on south-facing slopes. Natural regeneration is slow, and some supplemental site preparation may be needed. However, the slope severely limits most management.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites. Local roads and streets are subject to slips and slides.

This soil is in capability subclass Vlls.

**70D-Valsetz stony loam, 3 to 30 percent slopes.**

This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly and cobbly residuum and colluvium weathered from igneous rock. Bedrock is at a depth of 20 to 40 inches. Slopes average about 20 percent. Elevation is 2,000 to 3,500 feet. The average annual precipitation is 90 to 150 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil is reddish brown and strong brown very gravelly loam about 20 inches thick. Fractured gabbro is at a depth of 24 inches.

Included with this soil in mapping are areas of Cruiser, Luckiamute, and Yellowstone soils, which make up 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. The available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 15 to 18 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. It has fair suitability for the production of Douglas-fir. Noble fir and hemlock are mixed with Douglas-fir. The site index for Douglas-fir on this soil ranges from 100 to 135, and the average site index is about 115. Based on the average site index, this soil is capable of producing about 7,900 cubic feet, and 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is stable, and trafficability is good. Stones and cobbles interfere with site preparation, planting, and roadbuilding. The soil generally is covered with snow in winter. Roads and landings should be protected by water bars and seeded to grass to prevent erosion.

Plant competition causes some concerns. Plant competition is especially difficult to control in nonstocked areas. There is some hazard of seedling mortality. This soil is droughty during summer months, especially on south-facing slopes. Natural regeneration is slow, and some supplemental site preparation and planting is needed. Weeding and thinning may be required for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of the soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the diainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainage-ways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vls.

**70E-Valsetz stony loam, 30 to 50 percent slopes.**

This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly, and cobbly residuum and colluvium weathered from igneous rock. Bedrock is at a depth of 20 to 40 inches. Slopes average about 35 percent. Elevation is 2,000 to 3,500 feet. The average annual precipitation is 90 to 150 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil is reddish brown and strong brown very gravelly loam about 20 inches thick. Fractured gabbro is at a depth of 24 inches.

Included with this soil in mapping are areas of Cruiser, Luckiamute, and Yellowstone soils, which make up about 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. The available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 15 to 18 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production. It has fair suitability for the production of Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on this soil ranges from 100 to 135, and the average site index is about 115. Based on the average site index, this soil is capable of producing about 7,900 cubic feet, and 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. Cable logging is desirable for minimum disturbance. Steep slopes, stones, and rocks interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. The soil generally is covered with snow in winter. Roads and landings should be protected with water bars and seeded to grass to prevent erosion.

Plant competition is especially difficult to control in nonstocked areas. This soil is droughty in summer, especially on south-facing slopes. There is some hazard of seedling mortality. Natural regeneration is slow, and the soil may require some supplemental site preparation, particularly on south-facing slopes, where natural regeneration is often spotty. Site preparation, seeding, and planting are needed. Weeding and thinning may be needed for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vlls.

**70F-Valsetz stony loam, 50 to 75 percent slopes.**

This well drained soil is in mountainous topography in the Coast Range. The soil formed in gravelly and cobbly residuum and colluvium weathered from igneous rock. Bedrock is at a depth of 20 to 40 inches. Slopes average about 65 percent. Elevation is 2,000 to 3,500 feet. The average annual precipitation is 90 to 150 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

In a representative profile, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil is reddish brown and strong brown very gravelly loam about 20 inches thick. Fractured gabbro is at a depth of 24 inches.

Included with this soil in mapping are areas of Cruiser, Luckiamute, and Yellowstone soils, which make up about 15 percent of this map unit.

Permeability is moderately rapid. Effective rooting depth is 20 to 40 inches. The available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 15 to 18 inches. Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production. It has fair suitability for the production of Douglas-fir. Noble fir and hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir on this soil ranges from 100 to 135, and the average site index is about 115. Based on the average site index, this soil is capable of producing about 7,900 cubic feet, and 28,300 board feet (International rule, one-fourth inch kerf), of merchantable timber

from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. The slope, stones, and rocks interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. Construction and maintenance of roads isdifficult because of the slope. This soil generally is covered with snow during winter months. Roads and landings should be protected with water bars and seeded to grass to prevent erosion.

Plant competition is especially difficult to control in nonstocked areas. This soil is droughty in summer, especially on south-facing slopes. There is some hazard of seedling mortality. Natural regeneration is slow, and this soil may need some supplemental site preparation.
Seeding, planting, weeding, and thinning are needed for good stand development.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limitation to homesites.

This soil is in capability subclass Vlls.

**71 F-Valsetz-Yellowstone complex, 50 to 90 percent slopes.** This complex is in mountainous topography in the Coast Range. These soils formed in material derived from igneous rock. Slopes average about 70 percent. Elevation is 2,000 to 3,500 feet. The average annual precipitation is 70 to 150 inches, the average annual air temperature is about 41 to 45 degrees F, and the frost-free period is about 80 to 100 days.

The Valsetz soil is on the less steep, lower sideslopes and in concave parts of the landscape. It is a moderately deep, well drained gravelly soil that formed in residuum and colluvium weathered from gabbro and diorite. It makes up about 55 percent of the complex. The Yellowstone soil is on the steeper slopes. It makes up about 35 percent of the complex. It is a shallow, well-drained very gravelly soil that formed in residuum and colluvium weathered from igneous rock.

In a representative profile of the Valsetz soil, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil is reddish brown and strong brown very gravelly loam about 20 inches thick. Fractured gabbro is at a depth of 24 inches.

Permeability is moderately rapid in the Valsetz soil. Effective rooting depth is 20 to 40 inches. Available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 15 to 18 inches. Runoff is very rapid, and the hazard of erosion is high.

In a representative profile of the Yellowstone soil, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil and the upper part of the substratum are dark reddish brown very gravelly loam about 14 inches thick. Fractured gabbro and diorite is at a depth of 18 inches.

Permeability is rapid in the Yellowstone soil. Effective rooting depth is 10 to 20 inches. The available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is very rapid, and the hazard of erosion is high.

Included with this complex in mapping are areas of Luckiamute and Cruiser soils and Rock outcrop.

These soils are used for timber production. The site index for Douglas-fir on the Valsetz soil ranges from 100 to 135, and the average site index is about 115. The site index for the Yellowstone soil is about 80. Based on these average site indices, this map unit is capable of producing about 7,900 and 4,300 cubic feet respectively, or 28,300 and 5,200 board feet (International rule, one-fourth inch kerf) respectively, of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are major. The slope limits most operations to cable logging and aerial seeding and weeding. The slope, stones, and rocks interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of the slope. The map unit generally is covered with snow in winter. Roads and landings should be protected by water bars and seeded to grass to prevent erosion. Slide hazard on these soils may be increased by water accumulation that results from yarding and road construction.

Plant competition is especially difficult to control in poorly stocked areas. There is some hazard of seedling mortality. The soils are droughty in summer, especially on south-facing slopes. Natural regeneration is slow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous in areas of this complex. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this complex are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope is the major limiation to homesites.

This complex is in capability subcalss VIIs.

**72-Waldo silty clay loam.** This poorly drained soil is on flood plains. It formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent but average about 1 percent. Elevation is about 250 to 450 feet. The average annual precipitation is 40 to 60 inches, the average

temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and very dark gray mottled silty clay loam about 13 inches thick. The subsoil is dark gray and dark grayish brown mottled silty clay about 37 inches. The substratum is dark grayish brown mottled silty clay that extends to a depth of 60 inches or more.

Incuded with this soil in mapping are areas of McAlpin soils and Bashaw soils, which make up 10 percent of this map unit.

Permeability is slow. Effective rooting depth is 10 to 20 inches. Available water capacity is 9 to 11 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow to very slow or the soil is ponded, and the hazard of erosion is slight. The soil is subject to occasional flooding in spring. A seasonal high water table is within 6 inches of the surface in winter and spring.

This soil is used for pasture, hay, small grain, and grass seed. It is not well suited to deep-rooted perennial crops because adequate drainage outlets generally cannot be maintained in winter and spring.

Erosion caused by seasonal overflow and runoff from higher areas can be controlled by growing a winter cover crop each year and by properly managing crop residue. Proper crop residue management and rotations will also help maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 25 percent of the time improve tilth and yields.

Small grains and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil may be irrigated, but irrigation water should be applied in small enough amounts that the soil is not overirrigated and a water table does not develop.

Drainage is needed if this soil is to be used to the maximum, but providing drainage is difficult in most areas because outlets are poor and the soil is flooded by seasonal overflow. The soil is also periodically flooded by water that flows from higher areas. Response to drainage is good if adequate outlets are provided.

This soil is poorly suited to commercial timber production and Christmas trees because of the seasonal high water table.

Native areas contain ash, willow, sedges, grass, and shrubs. The seasonal high water table, ponding, and overflow limit the use of this soil to ducks and geese from late in fall to early in spring. Waterfowl feed on seeds and tubers from water plants and crop residues. The rest of the year, ring-necked pheasant, California quail, bobwhite quail, mourning dove, and black-tailed deer move into this area for food and cover. The soil is used by some fur-bearing animals.

This soil has major limitations for homesites, commercial buildings, local roads and streets, septic tanks, and other community uses because of the high shrink-swell potential, seasonal high water table, and occasional flooding.

This soil is in capability subclass IIIw.

**73-Wapato silty clay loam.** This poorly drained soil is in swales and depressions on recent alluvial flood plains. The soil formed in silty mixed alluvium. It is subject to overflow most years. Slopes are 0 to 3 percent and average about 2 percent. Elevation is 125 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown mottled silty clay loam about 15 inches thick. The subsoil is dark grayish brown, dark gray, and gray mottled silty clay loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of McBee, Waldo, and Cove soils.

Permeability is slow. Effective rooting depth is restricted by a seasonal high water table in winter and spring. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow to very slow or the soil is ponded, and the hazard of erosion is slight. The soil is subject to frequent flooding. A seasonal high water table is within 12 inches of the surface in winter and spring.

This soil is used for pasture, hay, small grain, and grass seed. It is not well suited to deep-rooted perennial crops because adequate drainage outlets generally cannot be maintained in winter and spring.

Erosion caused by seasonal overflow can be controlled by growing a winter cover crop each year and by properly managing crop residues. Proper crop residue management and crop rotations also help to maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 25 percent of the time improves tilth and yields.

Small grains and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

Drainage is needed if this soil is to be used to the maximum. Providing drainage is difficult ,in most areas because outlets are poor and seasonal overflow occurs. The soil is also periodically flooded by water that flows from higher areas. Response to drainage is good if adequate outlets are provided.

This soil is poorly suited to commercial timber production and Christmas trees because of the seasonal high water table.

Native areas contain ash, willow, sedges, grass and shrubs. The seasonal high water table, ponding, and overflow limit the use of this soil to ducks and geese from late in fall to early in spring. Waterfowl feed on seeds and tubers from water plants

and crop residues. The rest of the year, ring-necked pheasant, California quail, bobwhite quail, mourning dove, and black-tailed deer move into this area for food and cover. The soil is used by some fur-bearing animals.

This soil has major limitations for homesites, commercial buildings, local roads and streets, septic tanks, and other community uses because of flooding and the seasonal high water table.

This soil is in capability subclass IIIw.

**74C-Willakenzie silty clay loam, 2 to 12 percent slopes.** This well drained soil is on low foothills. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 7 percent. Elevation is about 300 to 800 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 8 inches thick. The subsoil is dark reddish brown silty clay loam about 25 inches thick. Siltstone is at a depth of 33 inches.

Included with this soil in mapping are areas of Jory, Bellpine, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at 20 to 40 inches. Available water capacity is 5 to 7.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for small grain, orchards, hay, and pasture. It is not so productive or easily tilled as other soils on terraces or bottom land.

Erosion can be controlled with cross-slope farming, grassed waterways, winter cover crops, and crop residue management. Residue management and crop rotations also help to maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 25 percent of the time improve tilth and yields.

Grain and grass crops respond to nitrogen, and legumes respond to phosphorus, sulfur, boron, and, in many places, to lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil generally is not irrigated. Irrigation water generally must be stored in reservoirs, and suitable reservoir sites are limited.

This soil is well suited to Douglas-fir and Christmas tree production. Mixed stands of Oregon white oak, Douglas-fir, and bigleaf maple grow on this soil. The site index for Douglas-fir is about 142 to 165, and the average site index is about 160. Based on the average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is not subject to severe compaction during wet-season logging.

Seedling mortality and plant competition present some concerns.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has some limitations for homesites, commercial buildings, and local roads and streets because of low strength. It has major limitations for septic tank absorption fields because of moderately slow permeability and depth to bedrock.

This soil is in capability subclass IIIe.

**74D-Willakenzie silty clay loam, 12 to 20 percent slopes.** This well drained soil is on low foothills. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 16 percent. Elevation is about 300 to 800 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 8 inches thick. The subsoil is dark reddish brown silty clay loam about 25 inches thick. Siltstone is at a depth of 33 inches.

Included with this soil in mapping are areas of Jory, Bellpine, and Steiwer soils, which make up about 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 5 to 7.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for small grain, orchards, hay, and pasture. It is not so productive or easily tilled as other soils on terraces or bottom lands.

Erosion can be controlled by cross-slope farming, grassed waterways, winter cover crops, and crop residue management. Returning crop residue to the soil and crop rotations also help to maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 50 percent of the time improve tilth and yields.

This soil generally is not irrigated. Irrigation water generally must be stored in reservoirs, and suitable reservoir sites are limited.

This soil is well suited to Douglas-fir production. It is not well suited to growing Christmas trees because of the slope which restricts management and harvesting. Mixed stands of Oregon white oak, Douglas-fir, and bigleaf maple grow on the soil. The site index for Douglas-fir is about 142 to 165, and the average site index is about 160. Based on the average site index, the soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stock, even-aged stand of 80-year-old trees.

This soil has some limitations to the use of equipment, but it is not subject to severe compaction during wet season logging.

Seedling mortality and plant competition present some concerns.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has some limitations for homesites, commercial buildings, and local roads and streets because of low strength and the slope. It has major limitations for septic tank absorption fields because of the moderately slow permeability and depth to bedrock.

This soil is in capability subclass IIIe.

**74E-Willakenzie silty clay loam, 20 to 30 percent slopes.** This well drained soil is on low foothills. The soil formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 25 percent. Elevation is about 300 to 800 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 8 inches thick. The subsoil is dark reddish brown silty clay loam about 25 inches thick. Siltstone is at a depth of 33 inches.

Included with this soil in mapping are areas of Jory, Bellpine, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 5 to 7.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for pasture and timber production. A few small areas are used for cereal grain. The slope makes the soil poorly suited to cultivation. To control erosion in cultivated areas, the soil needs such intensive management practices as cross-slope farming, crop residue management, rough tillage, winter cover crops, and grassed waterways.

Properly managing crop residue and crop rotations are needed to reduce runoff and erosion and to maintain productivity and workability. A crop rotation system that includes grasses and legumes or a grass and legume mixture at least 75 percent of the time improves tilth and yields.

Grain and grass crops respond to nitrogen, and legumes respond to phosphorus, sulfur, boron, and, in many places, lime. If crop residues are used, additional nitrogen is needed to prevent a decrease in yields.

This soil is not suited to irrigation because of excessive slopes.

This soil is well suited to Douglas-fir production. It is not well suited to Christmas tree production because the slope restricts management and harvesting. Mixed stands of Oregon white oak, Douglas-fir, and bigleaf maple grow on the soil. The site index for Douglas-fir is about 142 to 165, and the average site index is about 160. Based on the average site index, this soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80year-old trees.

This soil has some limitations to the use of equipment, but it is not subject to severe compaction during wet season logging. Roads and landings need erosion protection by constructing water bars and seeding cuts, fills, and skid trails.

Seedling mortality and plant competition present some concerns.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon. white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common in both cultivated and uncultivated areas. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

The soil has major limitations for homesites, commercial buildings, local roads and streets, septic tank absorption fields, and other community uses because of steep slopes.

This soil is in capability subclass IVe.

**74F-Willakenzie silty clay loam, 30 to 45 percent slopes.** This well drained soil is on low foothills. It formed in residuum and colluvium weathered from sedimentary rock. Siltstone is at a depth of 20 to 40 inches. Slopes average about 40 percent. Elevation is about 300 to 800 feet. The average annual precipitation is 40 to 50 inches, the average annual air

temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown silty clay loam about 8 inches thick. The subsoil is dark reddish brown silty clay loam about 25 inches thick. Siltstone is at a depth of 33 inches.

Included with this soil in mapping are areas of Jory, Bellpine, and Steiwer soils, which make up 15 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by sedimentary bedrock at a depth of 20 to 40 inches. Available water capacity is 5 to 7.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for natural pasture and timber production. The slope makes this soil unsuitable for cultivation. A permanent plant cover should be maintained at all times. Improved varieties of grasses are desirable for cover if they can be established. Planting improved varieties of grasses early in spring insures a better cover than if the grasses are planted later and helps protect the soil from erosion the following winter.

This soil is well suited to Douglas-fir production. It is not well suited to Christmas tree production because the slope restricts management and harvesting. Mixed stands of Oregon white oak, Douglas-fir, and bigleaf maple grow on the soil. The older, even-aged stands are dominantly Douglas-fir. The site index for Douglas-fir ranges from 142 to 165, and the average site index is about 160. Based on the average site index, this soil is capable of producing about 12,850 cubic feet, or 70,000 board feet (international rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

This soil has some limitations to the use of equipment, but it is not subject to severe compaction during wet season logging. Roads and landings need protection by constructing water bars and seeding cuts, fills, and skid roads.

Seedling mortality and plant competition present some concerns.

The crops produced on this soil provide food and cover for ring-necked pheasant, California quail, and bobwhite quail. In wooded areas of Oregon white oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting Douglas-fir, using grassed waterways, planting along roadsides, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has major limitations for all community development uses because of the slope.

This soil is in capability subclass VIe.

**75A-Willamette silt loam, 0 to 3 percent slopes.** This well drained soil is on broad terraces above the flood plain. It formed in silty alluvial deposits. Slopes average about 2 percent. Elevation is 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 26 inches thick. The subsoil is dark yellowish brown and dark brown silty clay loam that extends to a depth of 69 inches or more.

Included with this soil in mapping are areas of Amity and Woodburn soils, which make up 10 percent of this map unit, and Concord, Dayton, and Holcomb soils, which make up 5 percent.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is none to slight.

This soil is one of the most productive in the county. All climatically adapted crops requiring good drainage do well. The major crops are wheat, barley, oats, field corn, orchards, grasses, and forage crops. In irrigated areas, sweet corn, strawberries, mint, hops, and pasture are the crops generally grown.

This soil may be irrigated by furrow, border, or sprinkler irrigation, but sprinklers are generally used. Leveling for irrigation or surface drainage can be done with little effort or injurious effect. Irrigation water may be available from ponds or streams.

Properly managing crop residue and using a cropping system in which grasses and legumes or grass and legume mixtures are grown help to maintain fertility and workability. The soil responds to fertilizers and amendments.

No commercial stands of timber grow on this soil. The soil is well suited to Christmas tree production.

This soil supports a wide variety of grains, grasses, legumes, orchards, and vegetable crops as well as shrubs and trees, which furnish good feed and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. If sufficient cover is available, blacktailed deer are permanent residents. Ducks and geese also feed in areas of the soil that are close to water. Grouse, band-tailed pigeon, and mountain quail are not common. Gopher, ground squirrel, mole, nutria, and opossum are common pests. Planting along roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife. This soil has numerous drainageways that are often suitable for small ponds, many of which can be managed for game fish. Water from streams is available most of the year, but most of the small ditches and streams are dry late in summer. Burning fields and fence rows will destroy both cover and food for wildlife.

Increased population growth in the county has resulted in increased homesite construction on this soil. The primary limitations for urban development are the moderate shrink-swell potential and limited ability of the soil to support a load. Dwellings and road construction can be designed to offset the last limitation. Septic tank absorption fields will not function properly in some cases during rainy periods because of the restricted movement of water through the soil.

This soil is in capability class I.

**75C-Willamette slit loam, 3 to 12 percent slopes.**

This well drained soil is on broad terraces above the flood plain. It formed in silty alluvial deposits. Slopes average about 7 percent. Elevation is 170 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 26 inches thick. The subsoil is dark yellowish brown and dark brown silty clay loam that extends to a depth of 69 inches or more.

Included with this soil in mapping are areas of Woodburn and Amity soils, which make up 10 percent of this map unit, and Concord, Dayton, and Holcomb soils, which make up 5 percent.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is one of the most productive in the county. It is used mainly for grass seed, cereal grain, orchards, and forage crops. In irrigated areas, vegetable crops, strawberries, mint, hops, and pasture are grown.

This soil may be irrigated by sprinkler or furrow irrigation. Irrigation increases the hazard of erosion and water should be applied carefully, preferably by sprinkler, at rates low enough to control runoff and erosion. Water for irrigation may be available from dams and streams.

Properly managing crop residue and using a cropping system in which grasses and legumes or grass and legume mixtures are grown help to reduce runoff and erosion and maintain fertility and workability. The soil responds to fertilizers and amendments.

No commercial stands of timber grow on this soil. The soil is moderately well suited to Christmas tree production.

This soil supports a wide variety of grains, grasses, legumes, orchard, and vegetable crops as well as shrubs and trees, which furnish good feed and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. If sufficient cover is available, black-tailed deer are permanent residents. Ducks and geese also feed in areas of the soil that are close to water. Grouse, band-tailed pigeons, and mountain quail are not common. Gopher, ground squirrel, mole, nutria, and opossum are common pests. Planting along roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife. This soil has numerous drainageways that are often suitable for small ponds, many of which can be managed for game fish. Water from streams is available most of the year, but most of the small ditches and streams are dry late in summer. Burning fields and fence rows will destroy both cover and food for wildlife.

Increased population growth in the county has resulted in increased homesite construction on this soil. The primary limitations for urban development are the moderate shrink-swell potential and limited ability of the soil to support a load. Dwellings and road construction can be designed to offset the latter limitation. Slope and the restricted movement of water through the soil may limit septic tank absorption fields.

This soil is in capability subclass IIe.

**75D-Willamette silt loam, 12 to 20 percent slopes.**

This well drained soil is on broad terraces above the flood plain. It formed in silty alluvial deposit. Slopes average about 16 percent. Elevation is 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the average frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 26 inches thick. The subsoil is dark yellowish brown and dark brown silty clay loam that extends to a depth of 69 inches or more.

Included with this soil in mapping are areas of Woodburn and Amity soils, which make up 10 percent of this unit, and Concord, Dayton, and Holcomb soils, which make up 5 percent.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate.

The soil is used for small grain, legumes for seed, alfalfa, orchards, hay, and pasture. Berries and vegetable crops are grown in some places.

Tilling and planting across the slope and winter cover crops help to control sheet and rill erosion. Grassed waterways help remove runoff water. Irrigation water should be applied by sprinkler and at a rate low enough to be absorbed by the soil. Water for irrigation may be obtained from streams and ponds. A suitable cropping system provides soil-building crops. The soil responds to fertilizer and amendments.

No commercial stands of timber grow on this soil. It is poorly suited to Christmas tree production because moderately steep slopes interfere with harvesting and proper management.

The grain, grass and legume seed, hay, pasture, and orchards that grow on this soil furnish food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Ruffed grouse, mountain quail, and band-tailed pigeons are common in wooded areas of oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses. This soil often supports black-tailed deer, which use cultivated and uncultivated areas for food and cover. Gopher, squirrel, and other burrowing animals are common pests. Planting along roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas provide cover and food for wildlife. This soil has numerous drainageways that are often suitable for small ponds, many of which can be managed for game fish. Water from streams is available most of the year, but most small ditches and streams are dry late in summer. Burning fields and fence rows will destroy both cover and food for wildlife.

Increased population growth in the county has resulted in increased homesite construction on this soil. The primary limitations for urban development are the slope, shrink-swell potential, and limited ability to support a load. Dwellings and road construction can be designed to offset the latter limitations. The slope and the restricted movement of water through the soil are limitations to septic tank absorption fields.

This soil is in capability subclass IIIe.

**76C-Witzel very stony silt loam, 3 to 12 percent slopes.** This well drained soil is on low foothills. The soil formed in colluvium weathered from basic igneous rock. Bedrock is at a depth of 12 to 20 inches. Slopes average about 8 percent. Elevation is about 325 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 52 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown very stony silt loam about 4 inches thick. The subsoil is dark reddish brown very cobbly clay loam about 13 inches thick. Fractured basalt is at a depth of 17 inches. .

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by basalt bedrock at a depth of 12 to 20 inches. Available water capacity is 1 inch to 3 inches, and the water-supplying capacity is 13 to 15 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for woodland. Shallow depth and the high percentage of coarse fragments make it unsuitable for cultivation. In cultivated areas, the soil occurs as small areas within larger areas of other soils.

This soil is moderately well suited to ponderosa pine production and poorly suited for Douglas-fir production. It is poorly suited to Christmas tree production because of droughtiness. The site index for ponderosa pine ranges from 90 to 102, and the average site index is 95 on this soil. Based on this average site index, the soil is capable of producing about 6,370 cubic feet, or 27,600 board feet (International rule, 1 /8 inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-yearold trees.

In areas intermingled with cultivated soils, ring-necked pheasant, California quail, and bobwhite quail may be present. In wooded areas of Douglas-fir, Oregon white oak, snowberry, poison-oak, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting along roadsides, using grassed waterways, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has major limitations for all community uses because of shallow depth to rock.

This soil is in capability subclass VIs.

**76E-Witzel very stony slit loam, 12 to 50 percent slopes.** This well drained soil is on low foothills. The soil formed in colluvium weathered from basic igneous rock. Bedrock is at a depth of 12 to 20 inches. Slopes average about 30 percent. Elevation is 325 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50 to 52 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is dark reddish brown very stony silt loam about 4 inches thick. The subsoil is dark reddish brown very cobbly clay loam about 13 inches thick. Fractured basalt is at a depth of 17 inches.

Included with this soil in mapping are areas of Nekia and Ritner soils, which make up 10 percent of this map unit.

Permeability is moderately slow. Effective rooting depth is restricted by basalt bedrock at 12 to 20 inches. Available water capacity is 1 inch to 3 inches, and the water supplying capacity is 13 to 15 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for woodland. Shallow depth to bedrock, a high percentage of coarse fragments, and steep slopes make the soil unsuitable for cultivation. It is moderately well suited to ponderosa pine production and poorly suited to Douglas-fir production. It is also poorly suited to Christmas tree production because of droughtiness and the slope. The site index for ponderosa pine on this soil ranges from 90 to 102, and the site index average is about 95. Based on the average site index, this soil is capable of producing about 6,370 cubic feet, or 27,600 board feet (International rule, one-eighth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Ring-necked pheasant, California quail, and bobwhite quail may be present in areas of this soil that are intermingled with

cultivated soils. In wooded areas of Douglas-fir, Oregon white oak, snowberry, poison-oak, and grass, common birds include ruffed grouse, mountain quail, and band-tailed pigeons. These birds feed on the fruit and seeds of trees and shrubs. Black-tailed deer are common. Planting along roadsides, using grassed waterways, and maintaining fence rows and brushy areas improve the cover and food supply for wildlife.

This soil has major limitations for all community uses because of the shallow depth to bedrock and the slope.

This soil is in capability subclass Vlls.

**77A-Woodburn silt loam, 0 to 3 percent slopes.**

This moderately well drained soil is on broad terraces above the flood plain in the Willamette Valley. It formed in silty alluvial deposit. Slopes average about 2 percent. Elevation is 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 17 inches thick. The upper 6 inches of the subsoil is dark brown silt loam, and the lower part is dark brown and brown silty clay loam that extends to a depth of 65 inches or more. Mottles are common in the lower part of the subsoil.

Included with this soil in mapping are areas of Willamette soils, which make up about 10 percent of this map unit, and Amity soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is greater than 60 inches. Available water capacity is 11 to 13 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is slow, and the hazard of erosion is none to slight. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is well suited to pasture, hay, small grain, grass seed, and vegetable crops. Long-lived, deep--rooted deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are adversely affected by the seasonal high water table unless the soil is drained. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 25 percent of the time help to maintain fertility and workability.

Small grains and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and, in many places, to lime. If residues are used, additional nitrogen generally is needed to prevent a decrease in yields.

The soil may be irrigated by sprinkler, furrow, or border irrigation; sprinkler irrigation is the most common and is very satisfactory. Irrigation water should be applied carefully at rates low enough to prevent runoff. Water for irrigation may be from reservoirs or streams.

The soil has moderate drainage concerns which respond to pattern drainage. Drainage is needed for maximum use and production. Seepage from higher soils can be controlled by interception and random drains. Runoff may be controlled by grassed waterways and vegetative cover.

No commercial stands of timber grow on this soil. It is well suited to Christmas tree production.

Native vegetation is grass, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Blacktailed deer are permanent residents, and ducks and geese also feed in areas that are near water. Gopher, ground squirrel, mole, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover for wildlife.

This soil has some limitations for homesites, commercial buildings, and local roads and streets because of wetness. It has major limitations for septic tank absorption fields because of slow permeability and the high seasonal water table.

This soil is in capability subclass llw.

**77C-Woodburn silt loam, 3 to 12 percent slopes.**

This moderately well drained soil is on broad terraces above the flood plain in the Willamette Valley. It formed in silty alluvial deposits. Slopes average about 7 percent. Elevation is 170 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 17 inches thick. The upper 6 inches of the subsoil is dark brown silt loam, and the lower part is dark brown silty clay loam that extends to a depth of 60 inches or more. Mottles are common in the lower part of the subsoil.

Included with this soil are areas of Willamette soils, which make up 10 percent of this map unit, and Amity soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is restricted by the seasonal high water table. Available water capacity is 11 to 13 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate (fig. 14). A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is best suited to small grain, grass seed, hay, and pasture. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, raspberries, and alfalfa may be adversely affected by the seasonal high water table unless this soil is drained. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 50 percent of the time help to reduce runoff and erosion and to maintain fertility and workability.

Small grain and grasses respond td nitrogen; row crops respond to nitrogen and phosphors; and legumes respond to phosphorus, sulfur, and, in many places, lime. If residues are used, additional nitrogen generally is needed to prevent a decrease in yields. Conservation practices are necessary to maintain fertility and check erosion. Cross-slope farming, grassed waterways, rough tillage, and winter cover or stubble mulch can help control erosion.

This soil may be irrigated by sprinklers. Irrigation increases the hazard of erosion, and water should be applied carefully at rates low enough to prevent runoff. Water for irrigation may be from reservoirs or streams.

Drainage is needed for maximum use and production. Seepage from higher soils can be controlled by interception and random drains. Runoff may be controlled by grassed waterways and vegetative cover,

No commercial stands of timber grow on this soil. It is moderately well suited to Christmas tree production because of the moderate slopes.

Native vegetation is grass, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail and mourning dove. Blacktailed deer are permanent residents, and ducks and geese also feed in areas of this soil that are near water. Gopher, ground squirrel, mole, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildllife.

This soil has some limitations for homesites, commercial buildings, and local roads and streets because of slope and wetness. Septic tank absorption fields have major limitations because of the slow permeability, slope, and seasonal high water table.

This soil is in capability subclass IIe.

**77D-Woodburn silt loam, 12 to 20 percent slopes.** This moderately well drained soil is or broad terraces above the flood plain in the Willamette Valley. It formed in silty alluvial deposit. Slopes average about 16 percent. Elevation is 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52 to 54 degrees F, and the frost-free period is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish brown and dark brown silt loam about 17 inches thick. The upper 6 inches of the subsoil is dark brown silt loam, and the lower part is dark brown silty clay loam that extends to a depth of 60 inches or more. Mottles are common in the lower part of the subsoil.

Included with this soil are areas of Willamette soils, which make up 10 percent of this map unit, and Amity soils, which make up 5 percent.

Permeability is slow. Effective rooting depth is restricted by a seasonal high water table. Available water capacity is 11 to 13 inches, and the water-supplying capacity is 20 to 26 inches. Runoff is medium, and the hazard of erosion is moderate. A seasonal high water table is at a depth of 24 to 36 inches in winter and spring.

This soil is better suited to small grain, grass seed, hay, and pasture than other crops. Long-lived, deep-rooted deciduous fruit and nut trees, strawberries, raspberries, and alfalfa may be adversely affected by the seasonal high water table unless the soil is drained. Properly managing crop residue and using a cropping system in which grasses and legumes or a grass and legume mixture are grown at least 65 percent of the time help to reduce runoff and erosion and to maintain fertility and workability.

Small grain and grasses respond to nitrogen; row crops respond to nitrogen and phosphorus; and legumes respond to phosphorus, sulfur, and, in many places, lime. If residues are used, additional nitrogen is generally needed to prevent a decrease in yields.

Erosion can be controlled by cross-slope farming, establishing permanent grass-cover along natural waterways, and protecting the soil with a winter crop or stubble mulch.

Irrigation is moderately difficult because of the strong slopes. Sprinklers are suitable for applying irrigation water. Application rates should be low enough to prevent erosion. Water for irrigation is generally available from reservoirs or streams.

The slope makes this soil unsuited to grid drainage. In most places, drainage is provided by installing interceptor ditches and random drains.

No commercial stands of timber grow on this soil. It is poorly suited to Christmas tree production because of the slope.

Native vegetation is grass, hazel, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak, which furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Blacktailed deer are permanent residents. Gopher, ground squirrel, mole, nutria, and opossum are common pests. Planting along streambanks and roadways, using grassed waterways, and preserving fence rows, woodlots, and brushy areas improve cover and food for wildlife.

This soil has some limitations to dwellings and local roads and streets because of the slope and wetness. There are major limitations to commercial buildings, septic tank absorption fields, and other community uses because of strong slopes.

This soil is in capability subclass IIIe.

**78-Xerochrepts and Haploxerolls, steep.** These soils are along streams where drainageways have incised into valley terraces and on terrace fronts above the flood plain along major streams and rivers. Xerochrepts and Haploxerolls, steep are too variable to be classified as a soil series. They are generally silty, loamy or gravelly and are stratified. They formed in

stratified silty, loamy, or gravelly alluvium and occasional outcrops of weathered bedrock. Seepage areas are common until summer. The soils range from 20 to more than 60 inches in thickness. Slopes are 20 to 60 percent and average about 35. Elevation is 125 to 400 feet. The average annual precipitation is 40 to 80 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 160 to 210 days.

Permeability, effective rooting depth, available water capacity, and the water-supplying capacity are too variable to rate. Runoff is rapid, and the hazard of erosion is high.

Most areas are in natural vegetation, but some small areas have been cleared for pasture.

No commercial stands of timber are grown. Christmas tree production is poorly suited because the slopes limit harvesting and management.

Native vegetation consists of Douglas-fir, Oregon white oak, snowberry, poison-oak and grass, which furnish good food and cover for ring-necked pheasant, California quail, bobwhite quail, and mourning dove. Black-tailed deer are numerous.

The slopes are the major limitations to homesites.

These soils are in capability subclass Vle.

**79-Xerofluvents, loamy.** These excessively drained and well drained soils are on active flood plains adjacent to streams and rivers. Xerofluvents, loamy, are too variable to be classified as a soil series. They consist of stratified loamy material over sandy loam, sand, and gravel. It formed in stratified recent alluvium. The underlying gravelly substratum is at a depth of 40 to 60 inches. Slopes are 0 to 3 percent and average about 1 percent. Areas are incised by overflow channels and are subject to frequent stream overflow. Rapidly flowing floodwaters often cause streambank erosion and redeposition of these materials elsewhere. Elevation is 125 to 700 feet. The average annual precipitation is 40 to 80 inches, the average annual air temperature is 50 to 54 degrees F, and the frost-free period is 140 to 210 days.

Permeability, available water capacity, and the water-supplying capacity are too variable to rate. Effective rooting depth is 40 to 60 inches or more. Runoff is slow, and the hazard of erosion is high.

None of these soils have been cleared for cultivation. Only a few commercial stands of timber are grown.

The native vegetation of ash, alder, cottonwood, Douglas-fir, and shrubs furnish fair cover and food for ring-necked pheasant, California quail, bobwhite quail, mourning dove, black-tailed deer, and other wildlife.

The frequent hazard of overflow is the major limitation to homesites and other community uses. Recreational use is limited.

Xerofluvents, loamy, is in capability subclass Vlw.

**80D-Yellowstone stony loam, 3 to 30 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in very gravelly and cobbly residuum and colluvium weathered from igneous rocks. Bedrock is at a depth of 12 to 20 inches. Slopes average about 20 percent. Elevation is 2,000 to 3,500 feet. The average annual precipitation ranges from 70 to 150 inches, the average annual air temperature is 42 to 44 degrees F, and the frost-free period is about 90 to 100 days.

In a representative profile, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil is dark reddish brown very gravelly loam about 14 inches thick. Fractured gabbro is at a depth of 18 inches.

Included with this soil in mapping are areas of Valsetz soils, which make up 10 percent of this map unit, and Luckiamute soils and Rock outcrop, which make up 5 percent.

Permeability is rapid. Effective rooting depth is 10 to 20 inches. Available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production. It has fair suitability for Douglas-fir and other conifers. Noble fir and western hemlock grow in mixed stands with Douglas-fir. The site index for Douglas-fir is about 80. Based on this site index, the soil is capable of producing about 4,300 cubic feet, or 5,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees.

Limitations to the use of equipment are slight. This soil is stable and trafficability is good. Stone and cobbles interfere with site preparation, planting, and roadbuilding. This soil generally is covered with snow in winter. Roads and landings should be protected with water bars and seeded to grass to prevent erosion. Plant competition is especially difficult to control in nonstocked areas. There is little seedling mortality, but the soils are droughty in summer. Natural regeneration is slow, and supplemental site preparation and planting is needed.

Blue grouse, ruffed grouse, and black-tailed deer are numerous on this soil. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope and depth to bedrock are the major limitations to homesites.

This soil is in capability subclass Vls.

**80F-Yellowstone stony loam, 30 to 90 percent slopes.** This well drained soil is in the mountains of the Coast Range. The soil formed in very gravelly and cobbly residuum and colluvium weathered from igneous rocks. Bedrock is at a depth of 12 to 20 inches. Slopes average about 60 percent. Elevation is 2,000 to 3,500 feet. The average annual precipitation ranges from 70 to 150 inches, the average annual air temperature is 42 to 44 degrees F, and the frost-free period is about 90 to 100 days.

In a representative profile, the surface layer is dark reddish brown stony loam about 4 inches thick. The subsoil is a dark reddish brown very gravelly loam about 14 inches thick. Fractured gabbro is at a depth of 18 inches.

Included with this soil in mapping are areas of Valsetz soils, which make up 10 percent of this map unit, and Luckiamute soils and Rock outcrop, which make up 5 percent.

Permeability is rapid. Effective rooting depth is 10 to 20 inches. Available water capacity is 1 inch to 2.5 inches, and the water-supplying capacity is 16 to 20 inches. Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production. It has fair suitability for Douglas-fir and other conifers. Noble fir and western hemlock are in mixed stands with Douglas-fir. The site index for Douglas-fir is about 80. Based on this site index, this soil is capable of producing about 4,300 cubic feet, or 5,200 board feet (International rule, one-fourth inch kerf), of merchantable timber from a fully stocked, even-aged stand of 80-year-old trees. Limitations to the use of equipment are major. The slope limits most operations to cable logging and aerial seeding and weeding. The slope, stones and rocks interfere with site preparation, planting, roadbuilding, and intermediate harvesting by tractor logging. Construction and maintenance of roads is difficult because of slopes. This soil is generally covered by snow in winter. Roads and landings should be protected with water bars and seeded to grass to prevent erosion.

Plant competition is especially difficult to control in poorly stocked areas. There is little hazard of seedling mortality. The soil is droughty in summer months, especially on south-facing slopes. Natural regeneration is slow.

Blue grouse, ruffed grouse, and black-tailed deer are numerous. Small herds of Roosevelt elk are in the extreme western part of the county. Areas of this soil are often closed to entry in summer and early in fall because of low humidity and high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool sea breezes and fog often add moisture during this period. There are numerous draws and drainageways where small ponds could be built.

The slope and depth to bedrock are the major limitations to homesites.

This soil is in capability subclass VIIs.

## Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area-the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

## Crops and pasture

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; 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 presented for each soil.

This section provides information about the overall agricultural potential of Polk County and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

A crop rotation system is used on most Polk County farms. These crop rotations improve fertility, increase yields, stabilize the soil, and increase the nutrient value of the crop.

Cash crops rotated in order with grasses and forage legumes are a recognized method of improving structure and tilth, protecting the soil from erosion, and maintaining organic-matter content. The steeper sloping soils require a semi-permanent vegetative cover of forage for longer periods because the hazard of erosion is greater. Including grasses and legumes in the crop rotation system works especially well where livestock are part of the farmer's economic enterprise.

Advances in farm technology and the introduction of new chemicals and machinery have helped to overcome some of the limitations of continuous cropping, providing that the crop was adequately fertilized and protected from insects and rodents by using pesticides or systems of biological control.

Modern machinery speeds up harvesting and is better able to incorporate crop residues into the surface of the soil, thereby improving tilth and providing a better seedbed for the following year's crop.

The increased use of improved chemical fertilizers and pesticides along with newly developed varieties of crops have significantly increased the yields of crops. These recently released varieties, the result of plant breeding, are also better able to resist plant diseases and insects because of their vigor.

New crops sometimes are introduced to replace crops when the market demand diminishes or when it no longer becomes profitable to produce them.

The economic conditions that affect the farmer has a direct impact on the entire farm operation. The intensity and the kind of land use is governed by the market price and the market specifications for the product. With lower prices, often the less productive cropland is no longer cropped and reverts back to weeds, grass, and shrubs or is seeded to grasses and legumes for hay or pasture. A smaller acreage that has a higher potential productivity for cash crops is farmed more intensely and in many cases yields the same production or more.

Short-term changes in weather cycles can also have a widespread effect on the kinds and intensity of cropping systems and rotations.

### 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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

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 in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils 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 included because the

acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

### Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops (28). The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, 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 landforms 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, lie. 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 too cold or too 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, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

## Woodland management and productivity

Intensive logging started in Polk County after the turn of the century. Most of the forested area at that time consisted of old stands of large Douglas-fir and hemlock. Early logging was accomplished with horses and steam engines for yarding logs. In small logging communities, logs were hauled to mills by steam railroad equipment.

Today very few stands of old-growth Douglas-fir remain in the Coast Range. The trees in these stands range from 300 to 700 years in age, and their breast height diameter is 4 to 7 feet (fig. 15). About 50 percent of the county is in woodland. The dense canopy of these trees often rises 100 feet or more above the forest surface. The forest floor has only a sparse understory. A thick mat of partly decomposed vegetative material, however, blankets the forest floor.

After World War I and during the 1930's, the demand for lumber products decreased and logging was not again fully accelerated until the beginning of World War II. Large-scale, intensive logging has continued, and the national and overseas demand for forest products is increasing.

As the old stands of Douglas-fir and hemlock rapidly diminish, the logging of stands of 35- to 50-year-old trees has intensified. Stands of second-growth trees are in the earlier logged areas. The old decomposed stumps of the massive old trees are still in evidence. The new stands are uniform in height and diameter; they range from about 90 to 150 feet in height and from 15 to 30 inches in diameter. Many of these stands are undergoing intensive management: pre-commercial and commercial thinning, cutting and removing trees from overstock stands, and spraying competing understory plants with herbicides, and the use of commercial nitrogen fertilizers. These intensive management practices reduce plant competition and accelerate faster growth for the remaining stand of trees.

Most clearcut stands are now being replanted with Douglas-fir seedlings after logging is complete. The seedlings are planted in periods of optimum weather for survival. This practice enables the fir seedling to become established and to be able to compete with brush and other noncommercial plants.

Genetically superior trees are now being selected and their progeny are used as seedlings for restocking logged areas. This practice shows much potential for producing faster growing trees and a greater volume of lumber.

The present market price of logs enables the small tree farmer and also large commercial logging companies to engage in intensive forest management practices. In past years, because of poor economic conditions in the timber industry, clear-cut areas were not managed, and brush and alder encroached into these areas making natural regeneration of Douglas-fir a long and slow process.

Federal agencies that manage public lands are also now involved in intensive management of forest lands and are successfully restocking cutover areas with Douglas-fir (fig. 16) where soils and climatic conditions are not too adverse.

Table 6 contains information useful to woodland owners or forest managers planning use of soils for wood crops. Mapping unit symbols for soils suitable for wood crops are listed, and the ordination (woodland suitability) symbol for each soil is given. All soils bearing the same ordination symbol require the same general lands of woodland 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 insignificant limitations or restrictions. If a soil has more than one limitation, priority in placing the soil into a limitation class is in the following order: x, w, t, d, c, s, f, and r.

In table 6 the soils are also rated for a number of factors to be considered in management. Slight, moderate, and severe are used to indicate the degree of major soil limitations.

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 equipment; 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 that the soil affects expected mortality of planted tree seedlings. Plant competition is not considered in the ratings. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. A rating of slight indicates that the expected mortality of the planted seedlings is less than 25 percent; moderate, 25 to 50 percent; and severe, more than 50 percent.

Considered, in the ratings of windthrow hazard are characteristics of the soil that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of slight indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; moderate, that some trees are blown down during periods of excessive soil wetness and strong winds; and severe, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of plant competition indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. 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 means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The potential productivity of merchantable or common trees on a soil is expressed as a site index (16). 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. Common 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 suitable for commercial wood production and that are suited to the soils.

## Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of

bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment (7), (23), (2), (1), (10).

*Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.*

The information is presented mainly in tables. Table 7 shows, for each kind of soil, the degree and kind of limitations for building site development; table 8, for sanitary facilities; and table 10, for water management. Table 9 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

## Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible (f0).

*Shallow excavations* are made for pipelines, sewer-lines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

*Dwellings* and small *commercial buildings* referred to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and

gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

*Local roads and streets* referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep (1), (10), (2).

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

**Sanitary facilities**

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields (7, 30) sewage lagoons, and sanitary landfills (9). The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 8 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate,* soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe,* soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good, fair,* or poor, which, respectively, mean about the same as the terms *slight*, *moderate,* and *severe.*

*Septic tank absorption fields* are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

*Sanitary landfill is* a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is

seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 8 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

*Daily cover for landfill* should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

## Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 9 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

*Roadfill is soil* material used in embankments for roads (1). Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 13 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

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

*Sand* and gravel are used in great quantities in many kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or fair has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 13.

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

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

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

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

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

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

### Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 10 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

*Embankments, dikes, and levees* require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

*Drainage* of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

*Irrigation* is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

*Grassed waterways* are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

## Recreation

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

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

The information in table 11 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 8, and interpretations for dwellings without basements and for local roads and streets, given in table 7.

*Camp areas* require such site preparation as shaping and leveling for 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 for this use 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 camping sites.

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

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of

and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

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

## Wildlife habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of fair means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of poor means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

*Grain and seed crops* are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and* legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bluegrass, bromegrass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, . and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are wild lupine, bromegrass, flat pea, velvetgrass, and teasel.

*Hardwood trees* and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are oak, poplar, cherry, and apple.

Coniferous *plants* are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the, growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants .are fir, cedar, and hemlock.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are huckleberry, Scotch-broom, snowberry, and blackberry.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface

stoniness. Examples of wetland plants are meadow foxtail, trefoil, cattails, cordgrass and rushes, sedges, and reeds.

*Shallow water areas* are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

*Openland habitat* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include doves, quail, pheasant, meadowlark, field sparrow, rabbit, and red fox.

*Woodland habitat* consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, blue grouse, woodcock, thrushes, woodpeckers, squirrels, fox, raccoon, deer, and bear.

*Wetland habitat* consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

## Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation (11, 14, 29). Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

## Engineering properties

Table 13 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 13 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 13 in the standard terms used by the U.S. Department of Agriculture (26). These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (2) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes-eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from

of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 13. Also in table 13 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

*Liquid limit* and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

## Physical and chemical properties

Table 14 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

*Permeability* is estimated on the basis of known relationships among the soil characteristics observed in the field-particularly soil structure, porosity, and gradation or texture-that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

*Available water capacity* is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

*Soil reaction* is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

*Shrink-swell potential* depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

*Erosion factors* are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

## Soil and water features

Table 15 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in

one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

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

*Flooding is* the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about' floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

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

*High water table is* the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

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

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

*Risk of corrosion* pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material (23). The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

## Soil series and morphology

In this section, each soil series in the county is described in detail. The descriptions are presented in alphabetic order by series name.

For each series, some facts about the soil and its parent material are presented first. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (26). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

## Abiqua series

The Abiqua series consists of deep, well drained, nearly level soils on broad, low, alluvial stream terraces. These soils formed in silty and clayey mixed alluvium. Slopes are 0 to 5 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Abiqua silty clay loam, 0 to 3 percent slopes, about 1 /4 mile east of Pedee School, NE1/4SE1/4 sec. 32, T. 9 S., R. 6 W.:

A11-0 to 6 inches; very dark brown (7.5YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate fine granular structure; hard, firm, sticky and plastic; many very fine roots; many very fine pores; medium acid (pH 5.9); clear wavy boundary.

A12-6 to 15 inches; very dark brown (7.5YR 3/2) silty clay loam, brown (10YR 5/3) dry; strong fine granular structure and moderate fine subangular blocky; hard, firm, sticky and plastic; many very fine roots; many fine pores; medium acid (pH 5.7); clear wavy boundary.

B1-15 to 25 inches; very dark brown (7.5YR 3/2) heavy silty clay loam, brown (7.5YR 5/2) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine pores; few thin coatings on peds; strongly acid (pH 5.3); clear wavy boundary.

B2-25 to 36 inches; brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) dry; moderate medium and fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; common medium and fine pores; common moderately dark brown (7.5YR 3/2) organic coatings on faces of peds; strongly acid (pH 5.2); clear wavy boundary.

B22-36 to 44 inches; brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) dry; weak medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; common very fine pores; dark brown (7.5YR 3/2) organic coatings on faces of peds; strongly acid (pH 5.3); clear smooth boundary.

B3-44 to 60 inches; brown (10YR 4/4) silty clay; brown (7.5YR 4/4) dry; weak fine subangular blocky structure; very hard, firm, very sticky, very plastic; common very fine and fine pores; dark stains in pores; strongly acid (pH 5.4).

The mollic epipedon is 20 to 30 inches thick. A few gray mottles are at a depth below 40 inches. The content of pebbles ranges from 0 to 5 percent throughout the soil.

The A horizon has hue of 7.5YR or 5YR and chroma of 2 or 3 moist and dry.

The B2 horizon has chroma of 3 or 4 moist or dry, value of 4 or 5 moist, and hue of 7.5YR or 5YR.

## Amity series

The Amity series consists of deep, somewhat poorly drained soils on terraces. These soils formed in mixed silty alluvium or lacustrine silt. Slopes are 0 to 3 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 52 degrees F. Typical pedon of Amity silt loam, about 3/4 mile east of Zena, SW 1/4NE1/4 sec. 36, T. 6 S., R. 4 W.:

Ap-0 to 6 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium and coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many roots; common very fine pores; medium acid (pH 5.6); clear smooth boundary.

A12-6 to 11 inches; dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; common very fine and fine tubular pores; medium acid (pH 5.8); clear smooth boundary.

A13-11 to 16 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine and fine tubular pores; medium acid (pH 5.8); clear smooth boundary.

A2-16 to 25 inches; dark grayish brown (10YR 4/2) heavy silt loam, light brownish gray (10YR 6/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common roots; many fine and medium tubular pores;. common light gray silt coatings on peds; few very fine shot; medium acid (pH 5.8); clear smooth boundary.

B21t-25 to 38 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; many fine and medium distinct yellowish brown (10YR 5/6) and reddish brown ( 5YR 4/4)

mottles; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few fine roots; many fine and medium tubular pores; common moderately thick clay films; common thin light gray silt coating on peds; few black coatings; few very fine shot; medium acid (pH 6.0); clear smooth boundary.

B22t-38 to 42 inches; dark grayish brown (10YR 4/2)heavy silty clay loam, light brownish gray (10YR 6/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few roots; many very fine pores; many moderately thick clay films; few fine black stains; slightly acid (pH 6.2); clear smooth boundary.

B3t-42 to 48 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common fine pores; common moderately thick clay films; slightly acid (pH 6.2); clear smooth boundary.

C-48 to 63 inches; olive brown (2.5Y 4/4) silty clay loam, light gray (2.5Y 7/2) dry; many distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; massive; hard, friable, slightly sticky and plastic; common fine and medium tubular pores; few thick clay films in larger pores; slightly acid (pH 6.2).

Bedrock is at a depth of more than 60 inches. A perched water table is at a depth of 6 to 18 inches in winter and spring.

The Ap and A1 horizons range from 10 to 18 inches in thickness. They have value of 2 or 3 moist and 4 or 5 dry and chroma of 2 or 3 moist or dry. The A2 horizon has value of 3 to 5 moist and 6 or 7 dry and chroma of 1 or 2. It has faint to distinct mottles.

The B2t horizon has value of 4 or 5 moist and 6 or 7 dry and chroma of 2 to 4. It is heavy silt loam or silty clay loam and averages 27 to 35 percent clay.

## Apt series

The Apt series consists of deep, well drained soils on mountainous uplands. These soils formed in colluvium weathered from sedimentary rock. Slopes are 3 to 50 percent. The mean annual precipitation is about 75 inches, and the mean annual temperature is about 50 degrees F.

Typical pedon of Apt silty clay loam, 3 to 25 percent slopes, about 1-1/2 miles south of Grande Ronde, NE1/4NW1/4 sec. 24, T. 6 S., R. 8 W.:

O1-1 inch to 0; partly decomposed leaves, needles, and brackenfern fronds.

A11-0 to 3 inches; very dark grayish brown (10YR 3/2) heavy silty clay loam, dark brown (10YR 4/3) dry; strong fine granular and fine subangular blocky structure; hard, firm, very sticky and plastic; common fine and medium roots; many fine pores; thin very dark brown (10YR 2/2) coatings; strongly acid (pH 5.2); clear smooth boundary.

A12-3 to 8 inches; dark brown (10YR 3/3) heavy silty clay loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common medium and fine roots; many fine pores; thin, very dark brown (10YR 2/2) coatings; strongly acid (pH 5.2); clear smooth boundary.

B1-8 to 17 inches; brown (10YR 4/3) silty clay, brown (10YR 5/3) dry; moderate fine subangular blocky structure; very hard, firm, very sticky and very plastic; common fine and medium roots; common fine and very fine pores; thin very dark grayish brown (10YR 3/2) coatings; very strongly acid (pH 4.7); clear smooth boundary.

B21-17 to 29 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; very hard, firm, very sticky and very plastic; common fine and very fine pores; common thin and moderately thick clay films; very strongly acid (pH 4.7); clear smooth boundary.

B22t-29 to 46 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; moderate medium and fine subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; common very fine pores; common moderately thick clay films; very strongly acid (pH 4.6); gradual smooth boundary.

B23t-46 to 55 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; common fine and very fine pores; common moderately thick clay films; very strongly acid (pH 4.6); clear smooth boundary.

B3-55 to 66 inches; yellowish brown (10YR 5/4) light silty clay, light yellowish brown (10YR 6/4) dry; common fine and medium yellowish brown (10YR 5/6) and reddish brown (5YR 4/4) variegations; moderate fine subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine pores; few fine siltstone fragments; extremely acid (pH 4.4); clear smooth boundary.

Cr-66 to 78 inches; fractured yellowish brown (10YR 5/6) siltstone that has a dark reddish brown (5YR 3/4) surface; thick illuviated clay in siltstone fractures.

The A horizon has hue of 10YR and 7.5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and dry.

The B2t horizon has hue of 10YR and 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 to 6. It is clay or is silty clay that is 45 to 60 percent clay. The B3 horizon is clay, silty clay, or silty clay loam.

## Astoria series

The Astoria series consists of deep, well drained soils on mountainous uplands. The soils formed in colluvium or residuum weathered from sedimentary rock. Slopes are 5 to 60 percent. The mean annual precipitation is about 100 inches, and mean annual air temperature is about 49 degrees F.

Typical pedon of Astoria silt loam, 5 to 30 percent slopes, about 1 mile south of Valsetz, SW1/4NE1/4 sec. 3, T. 9 S., R. 8 W.:

O1-2 inches to 0; moss, leaves, twigs and needles.

A11-0 to 4 inches; very dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular and fine subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; many fine pores; 10 percent pebbles and concretions; strongly acid (pH 5.2); clear smooth boundary.

A12-4 to 10 inches; very dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; many very fine and fine pores; few very dark brown coatings on peds; few fine concretions; very strongly acid (pH 4.8); clear smooth boundary.

B1-10 to 19 inches; dark yellowish brown (10YR 4/4) heavy silty clay loam, light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; common very fine pores; few dark brown coatings on peds; very strongly acid (pH 4.8); clear smooth boundary.

B21-19 to 24 inches; dark yellowish brown (10YR 4/4) silty clay, light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; common fine and medium roots; common thin dark brown coatings on peds; very strongly acid (pH 4.8); clear smooth boundary.

B22-24 to 49 inches; yellowish brown (10YR 5/6) silty clay, brownish yellow (10YR 6/6) dry; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; few fine roots; common very fine and fine pores; few thin coatings on peds; very strongly acid (pH 4.8); clear smooth boundary.

B3-49 to 61 inches; yellowish brown (10YR 5/6) heavy silty clay loam, brownish yellow (10YR 6/6) dry; weak medium subangular blocky structure; hard, firm, very sticky and plastic; common very fine pores; few thin coatings on peds; 10 percent fine and medium sandstone pebbles; very strongly acid (pH 4.6).

Bedrock is at a depth of more than 40 inches. Sandstone or siltstone fragments in the profile range from none to few.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist and 5 dry, and chroma of 2 or 3 moist and 3 or 4 dry. It generally contains fine concretions.

The B horizon generally has hue of 10YR but has hue of 7.5YR in places; value of 3 to 5 moist and 4 to 6 dry; and chroma of 4 to 6 moist and 4 to 8 dry. It ranges from silty clay to clay.

## Bashaw series

The Bashaw series consists of deep, poorly drained and very poorly drained soils on flood plains, terraces, and gently sloping fans. These soils formed in clayey alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is 53 degrees F.

Typical pedon of Bashaw clay, 0 to 3 percent slopes, about 3 miles northeast of Dallas, NW1/4NE1/4 sec. 23, T. 7 W., R. 5 S.:

A1-0 to 4 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong fine subangular blocky structure; very hard, very firm, very sticky and very plastic; many fine roots; many very fine pores; medium acid (pH 5.6); clear smooth boundary.

AC1g-4 to 31 inches; black (10YR 2/1) clay, dark gray (N 4/0) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, very firm, very sticky and very plastic; common fine roots; many very fine pores; many small slickensides; medium acid (pH 5.8); clear smooth boundary.

AC2g-31 to 46 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; many faint distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; many very fine pores; common medium slickensides; medium acid (pH 6.0); clear smooth boundary.

Cg-46 to 60 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; many fine and medium distinct strong brown (7.5YR 5/8) mottles;. massive; very hard, very firm, very sticky and very plastic; few roots; few very fine pores; slightly acid (pH 6.2).

The soil cracks, opens, and closes once each year and remains open for 60 consecutive days in most years. Slickensides are close enough to intersect in all or some parts at a depth of 10 to 40 inches.

The soil to a depth of 40 inches or more has chroma of 1 or less. Hue is 10YR, 2.5Y, or neutral. Value of the A horizon is commonly 2 moist in the upper 30 inches but ranges to 3 in the upper few inches. Value is 3 or 4 dry. At a depth below 30 inches, value is 2 to 4 moist and 3 to 6 dry.

The upper 10 inches of the soil material is clay, silty clay, or silty clay loam. At a depth of 10 to 40 inches or more, the soil material is clay that is more than 60 percent clay. At a depth below 40 inches, the soil material is clay or silty clay. The structure in the upper 10 inches ranges from weak to strong granular and fine subangular blocky.

## Bellpine series

The Bellpine series consists of moderately deep, well drained soils on foothills. These soils formed in colluvium weathered from sedimentary bedrock. Slopes are 3 to 75 percent. Mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F;

Typical pedon of Bellpine silty clay loam, 12 to 20 percent slopes, about 1-1/2 miles east of Falls City, NW1/4SW1/4 sec. 23, T. 8 S., R. 6 W.:

A11-0 to 4 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 5/3) dry; moderate very fine granular and moderate very fine subangular blocky structure; hard, firm, sticky and plastic; many fine roots; many fine pores; strongly acid (pH 5.2); clear smooth boundary.

A12-4 to 9 inches; dark reddish brown (5YR 3/4) heavy silty clay loam, reddish brown (5YR 5/3) dry; moderate medium and fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine pores; few thin coatings on peds; strongly acid (pH 5.2); clear smooth boundary.

B1t-9 to 13 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 5/4) dry; moderate medium and fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; many fine pores; common thin clay films; strongly acid (pH 5.2); clear smooth boundary.

B21t-13 to 20 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, very sticky and very plastic; common fine roots; many fine pores; common moderately thick clay films; strongly acid (pH 5.2); cleat smooth boundary.

B22t-20 to 32 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine and medium roots; many moderately thick clay films; few fine siltstone fragments; very strongly acid (pH 5.0); abrupt wavy boundary.

IICr-32 to 42 inches; light brown (7.5YR 6/4) weathered siltstone; yellowish red (5YR 5/6) coatings on the fragments; few fine roots in fractures of the siltstone.

The thickness of the solum and depth to paralithic contact ranges from 20 to 40 inches. Coarse fragments of weathered sedimentary rock range from few to 10 percent, and the amount increases with depth.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 to 4 moist and 3 or 4 dry.

The Bt horizon has hue of 2.5YR or 5YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 4 to 6 moist and dry. It ranges from silty clay to clay.

## Blachly series

The Blachly series consists of deep, well drained soils on the steep mountainous upland of the Coast Range. These soils formed in colluvium weathered from basalt or sedimentary rock. Slopes are 3 to 50 percent. The mean annual precipitation is about 100 inches, and mean annual air temperature is about 49 degrees F.

Typical pedon of Blachly silty clay loam, 3 to 30 percent slopes, 1 mile northwest of Blackrock; SE1/4 sec. 15, T. 8 S., R. 7 W.:

A1-0 to 5 inches; dark reddish brown (5YR 3/2) light silty clay loam, reddish brown (5YR 5/3) dry; strong fine granular structure; slightly hard, friable, slightly sticky and plastic; many fine and medium roots; many very fine and fine pores; common fine and medium shot; very strongly acid (pH 5.0); clear smooth boundary.

A3-5 to 10 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate fine and very fine subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; many very fine and fine pores; common fine and medium shot; very strongly acid (pH 4.8); clear smooth boundary.

B1-10 to 15 inches; reddish brown (5YR 4/4) heavy silty clay loam, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; common very fine and fine pores; 5 percent 2to 5-millimeter basalt fragments; very strongly acid (pH 4.8); clear smooth boundary.

B21-15 to 29 inches; reddish brown (5YR 4/4) light silty clay, reddish brown (5YR 5/4) dry; moderate medium subangular blocky structure; hard, firm, sticky and very plastic; common fine and medium roots; common very fine and fine pores; 5 percent 2- to 5-millimeter basalt frag-

ments; very strongly acid (pH 4.8); clear smooth boundary.

B22-29 to 36 inches; reddish brown (5YR 4/4) silty clay, yellowish red (5YR 5/6) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; few fine roots; common very fine pores; 5 percent 2- to 5-millimeter basalt fragments very strongly acid (pH 4.8); gradual smooth boundary.

B23-36 to 43 inches; yellowish red (5YR 4/6) silty clay yellowish red (5YR 5/6) dry; weak coarse subangular blocky structure parting to moderate medium subangular blocky; hard, firm, very sticky and very plastic; common very fine pores; 5 percent 2- to 5 millimeter basalt fragments; very strongly acid (pH 4.8); clear smooth boundary.

B3-43 to 60 inches; yellowish red (5YR 5/6) silty clay, yellowish red (5YR 5/8) dry; weak medium and coarse subangular blocky structure; hard, firm, very sticky and very plastic; few fine roots; common very fine pores; 10 percent fine to medium basalt fragments; very strongly acid (pH 4.5).

Coarse fragments in the solum range from a few to 10 percent.

The A horizon has value of 2 or 3 moist and 3 or 4 dry. The chroma is 2 or 3 moist and 3 or 4 dry.

The B horizon has value of 3 to 5 moist and 4 or 5 dry, chroma of 4 to 8 and hue of 5YR or 2.5YR.

## Bohannon series

The Bohannon series consists of moderately deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in gravelly residuum and colluvium weathered from sedimentary rock. Slopes are 3 to 75 percent. The mean annual precipitation is about 110 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Bohannon gravelly loam, 50 to 75 percent slopes, about 3-1/2 miles west of Valsetz, NW1/4NE1/4 sec. 5, T. 9 S., R. 7 W.:

A1-0 to 11 inches; very dark grayish brown (10YR 3/2) gravelly loam, brown (10YR 5/3) dry; moderate very fine granular and subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 40 percent, by volume, fine concretions and pebbles; strongly acid (pH 5.2); clear smooth boundary.

A3-11 to 16 inches; dark brown (10YR 3/3) gravelly loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 20 percent, by volume, fine concretions and pebbles; very strongly acid (pH 4.8); clear smooth boundary.

B21-16 to 22 inches; dark brown (MR 3/3) gravelly clay loam, pale brown (10YR 6/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; many fine pores; 25 percent pebbles; very strongly acid (pH 4.8); clear smooth boundary.

B22-22 to 34 inches; dark yellowish brown (10YR 4/4) gravelly clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure parting to fine subangular blocky; hard, firm, sticky and plastic; few fine and medium roots; common very fine pores; few dark brown coatings on peds; 30 percent siltstone pebbles; very strongly acid (pH 4.8); abrupt wavy boundary.

Cr-34 to 40 inches; brownish yellow partly weathered sandstone that has black and dark reddish brown coatings.

The depth to a paralithic contact is 20 to 40 inches. The umbric epipedon ranges from 14 to 20 inches in thickness. The solum is as much as 30 percent siltstone or shale fragments.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist and 5 dry, and chroma of 2 or 3 moist or dry. The B horizon has value of 3 or 4 moist and chroma of 4 moist.

## Brenner series

The Brenner series consists of deep, poorly drained soils on uplands or on bottom lands in the lowest part of the flood plain. These soils formed in mixed alluvium weathered from basic igneous and sedimentary rock. Slopes are 0 to 3 percent. The mean annual precipitation is about 80 inches and the mean annual air temperature is about 53 degrees F.

Typical pedon of Brenner silt loam, about 1.5 miles east of Valsetz, NW1/4NE1/4 sec. 1, T. 9 S., R. 8 W.:

O1-3 inches to 0; partly decomposed matted grasses and roots.

A11-0 to 6 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (MR 4/2) dry; few fine distinct yellowish brown (10YR 5/8) mottles; moderate very fine and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine and very fine pores; strongly acid (pH 5.4); clear smooth boundary.

A12-6 to 11 inches; very dark brown (10YR 2/2) heavy silt loam; dark grayish brown (10YR 4/2) dry; few fine distinct yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky and granular structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many fine and very fine pores; strongly acid (pH 5.4); clear wavy boundary.

A3-11 to 16 inches; very dark grayish brown (10YR 3/2) heavy silty clay loam, grayish brown (10YR 5/2) dry; common fine distinct yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many fine and very fine pores; few fine black stains; strongly acid (pH 5.5); clear wavy boundary.

B21g-16 to 25 inches; grayish brown (10YR 5/2) silty clay, light gray (10YR 7/2) dry; many medium prominent strong brown (7.5YR 5/8) mottles; weak coarse prismatic and weak medium and coarse subangular blocky structure; hard, firm, very sticky and very plastic; common fine roots; common fine pores; strongly acid (pH 5.5); clear wavy boundary.

B22g-25 to 36 inches; light gray (10YR 7/1) silty clay, white (10YR 8/1) dry; many medium prominent strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure parting to coarse subangular blocky; hard, firm, very sticky and very plastic; few fine roots; common fine pores; strongly acid (pH 5.5); clear wavy boundary.

B3g-36 to 60 inches; light gray (10YR 7/1) silty clay, white (10YR 8/1) dry; many coarse prominent strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure parting to coarse subangular blocky; hard, firm, very sticky and very plastic; few fine roots; few fine pores; strongly acid (pH 5.5).

These soils are saturated in winter and, unless drained, have a water table within 12 inches of the surface early in spring. The umbric epipedon ranges from 10 inches to 20 inches in thickness.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and faint to prominent mottles. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, chroma of 1 or 2 moist and dry and distinct to prominent mottles. It is silty clay or silty clay loam and is more than 35 percent clay.

## Briedwell series

The Briedwell series consists of deep, well drained soils on terraces. These soils formed in mixed gravelly alluvium. Slopes are 0 to 20 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Briedwell silt loam, 0 to 3 percent slopes, about 1/2 mile west of the Buell Community, NW1/4SW1/4 sec. 28, T. 6 S., R. 6 W.:

A11-0 to 5 inches; dark brown (7.5YR 3/2) silt loam, dark brown (7.5YR 4/3) dry; moderate very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 5 percent pebbles; medium acid (pH 6.0); clear smooth boundary.

A12-5 to 10 inches; dark brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 4/3) dry; moderate very fine and fine subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine tubular pores; 5 percent pebbles; medium acid (pH 6.0); clear wavy boundary.

B1-10 to 17 inches; dark brown (7.5YR 3/2) gravelly clay loam, brown (7.5YR 3/2) dry; moderate fine subangular blocky structure; firm, sticky and plastic; common fine roots; common very fine tubular pores; 30 percent pebbles and 10 percent cobbles; medium acid (pH 5.8); clear wavy boundary.

IIB2-17 to 31 inches; dark brown (7.5YR 3/4) very gravelly clay loam, brown (7.5YR 5/4) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; moderate fine tubular pores; 35 percent pebbles and 25 percent cobbles; medium acid (pH 5.8); clear wavy boundary. IIB3-31 to 45 inches; brown (7.5YR 4/4) very gravelly clay loam; reddish brown (7.5YR 5/4) dry; moderate very fine and fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine pores; 40 percent pebbles and 30 percent cobbles; medium acid (pH 5.8); abrupt wavy boundary.

IIC-45 to 60 inches; variegated reddish brown (7.5YR 4/4) yellowish red (7.5YR 5/6), and brown (7.5YR 4/4) very gravelly loam; massive; slightly hard, friable, slightly sticky and slightly plastic; 85 percent pebbles and 5 percent cobbles; medium acid (pH 6.0).

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry, and chroma of 2 or 3.

The B horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 or 4 moist and dry. It is heavy loam, clay loam, or silty clay loam and is 15 to 40 percent pebbles.

## Camas series

The Camas series consists of deep, excessively drained soils on flood plains. These soils formed in recent sandy and gravelly alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Camas gravelly sandy loam, 2 miles northeast of Independence, SW1/4NW1/4 sec. 14, T. 8 S., R. 9 W.:

Ap-0 to 7 inches; dark brown (10YR 3/3) gravelly sandy loam, brown (10YR 4/3) dry; moderate very fine granular structure; slightly hard, friable; many fine roots; many irregular pores; 20 percent pebbles; slightly acid (pH 6.4); clear smooth boundary.

Ap2–7 to 12 inches; dark brown (10YR 3/3) gravelly sandy loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; slightly hard, friable; many roots; many irregular pores; 30 percent pebbles; slightly acid (pH 6.4) abrupt wavy boundary.

IIC–12 to 60 inches; variegated dark yellowish brown (10YR 3/4) and dark grayish brown (10YR 4/2) very gravelly coarse sand, grayish brown (10YR 5/2) dry; single grained; loose; many roots in upper 4 inches; many irregular pores; 60 percent pebbles and 5 percent cobbles; slightly acid (pH 6.2).

The mollic epipedon is 7 to 14 inches thick. Coarse fragments are from 20 to 50 percent of the A horizon and 35 to 65 percent of the C horizon.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and dry.

The C horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 2 to 6 moist and dry. It is gravelly or very gravelly and is more than 35 percent coarse fragments.

## Chehalis series

The Chehalis series consists of deep, well drained, nearly level soils on undulating flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is 50 inches, and the mean annual air temperature is 53 degrees F.

Typical pedon of Chehalis silty clay loam, occasionally flooded, about 2–1/2 miles northeast of Independence, SE1/4 SE1/4 sec. 10, T. 8 S., R. 4 W.

Ap- 0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (10YR 4/3) dry; moderate very fine and fine granular and moderate fine subangular blocky structure; hard, friable, slightly sticky and plastic; common very fine roots; many very fine interstitial pores; very dark brown (10YR 2/2) coatings; slightly acid (pH 6.2); clear smooth boundary.

A12- 6 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (10YR 4/3) dry; moderate fine granular and fine subangular blocky structure; hard, friable, slightly sticky and plastic; common very fine roots; many very fine interstitial pores; slightly acid (pH 6.2); clear smooth boundary.

A3-12 to 22 inches; dark brown (10YR 3/3) silty clay loam, dark brown (10YR 4/3) dry; moderate fine granular and very fine and fine subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine and fine pores; slightly acid (pH 6.4); gradual smooth boundary.

B21-22 to 34 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine and fine pores; neutral (pH 6.6); clear smooth boundary.

B22-34 to 47 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine pores; neutral (pH 6.6); clear smooth boundary.

C-47 to 64 inches; dark yellowish brown (10YR 3/4) silty clay loam, yellowish brown (10YR 5/4) dry; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine pores; neutral (pH 6.8).

The A and B horizons have moist value and chroma of 2 or 3 and dry value of 4 or 5. The upper 40 inches of the profile ranges from heavy silt loam to silty clay loam. Strata of sand and gravel may occur below a depth of 5 feet.

## Chehulpum series

The Chehulpum series consists of shallow, well rained soils on low foothills. These soils formed in material weathered from sedimentary bedrock. Slopes are 3 to 40 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 53 degrees F.

The Chehulpum soils in this survey area have a cambic horizon. This characteristic is outside the range of the Chehulpum series. Therefore, these soils are considered as a taxadjunct to the Chehulpum series.

Typical pedon of Chehulpum silt loam, 3 to 12 percent lopes, about 1 mile west of Highway 99W on county road 752, SE1/4SE1/4 sec. 1, T. 7 S., R. 5 W.:

A11-0 to 6 inches; very dark grayish brown (10YR 3/4) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular and moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many irregular pores; medium acid (pH 5.8); clear smooth boundary.

A12–6 to 10 inches; very dark grayish brown (10YR 3/4) light silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and plastic; many roots; common fine tubular pores; few weathered siltstone fragments; medium acid (pH 5.8); gradual smooth boundary.

B2-10 to 16 inches; dark brown (10YR 3/3) silty clay loam, very dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; hard, firm, sticky and very plastic; common roots; common very fine tubular pores; few weathered siltstone fragments; medium acid (pH 5.6); abrupt wavy boundary.

IICr-16 to 18 inches; partly weathered fractured yellow (10YR 7/6) siltstone; dark brown (10YR 3/3) coatings.

Partly weathered bedrock is at a depth of 10 to 20 inches. Rock fragments make up from about 5 to 15 percent of the profile.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 2 or 3 moist or dry.

The B horizon has chroma of 2 or 3 moist. It is silt loam or silty clay loam.

## Cloquato series

The Cloquato series consists of very deep, well drained, nearly level to gently undulating soils on bottom lands. These soils formed in recent alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Cloquato silt loam, about 2 miles northeast of Independence, NW1/4SW1/4 sec. 14, T. 8 S., R. 4 W.:

Ap-0 to 8 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine pores; slightly acid (pH 6.2); clear smooth boundary.

A12-8 to 15 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine and very fine pores; slightly acid (pH 6.2); gradual smooth boundary.

A13-15 to 34 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard; very friable, slightly sticky and slightly plastic; common roots; common fine and very fine pores; slightly acid (pH 6.4); clear smooth boundary.

IIC1-34 to 45 inches; brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; no roots; common very fine pores; neutral (pH 6.8); abrupt wavy boundary.

IIC2-45 to 60 inches; dark yellowish brown (10YR 3/4) and dark grayish brown (10YR 4/2) variegated fine sand; single grained; loose; slightly acid (pH 6.4).

The mollic epipedon ranges from 20 to more than 40 inches in thickness. The control section is dominantly silt loam.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 2 or 3 moist and dry.

The C horizon has hue of 10YR or 2.5Y, value of 3 to 6 moist and dry, and chroma of 2 to 4 moist and dry. It is silt loam, loam, fine sandy loam, loamy sand, or sand.

## Coburg series

The Coburg series consists of deep, moderately well drained, nearly level soils on broad, low stream terraces. These soils formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Coburg silty clay loam, about 2 miles north of Buena Vista, SW1/4NW1/4 sec. 14, T. 9 S., R. 4 W.:

A11-0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine and fine subangular blocky structure; hard, friable, sticky and plastic; many fine roots; many fine pores; medium acid (pH 5.9); clear smooth boundary.

A12-9 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; common very fine and fine pores; slightly acid (pH 6.1); clear smooth boundary.

B1t-15 to 24 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; common very fine pores; few moderately thick clay films in pores and common very dark brown (10YR 2/2) coatings on surfaces of peds; slightly acid (pH 6.1); clear smooth boundary.

B21t-24 to 33 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; common fine roots; common fine pores; common moderately thick clay films and common very dark brown (10YR 2/2) coatings on surfaces of peds; slightly acid (pH 6.2); clear smooth boundary.

B22t-33 to 41 inches; dark brown (10YR 3/3j silty clay, brown (10YR 5/3) dry; common medium distinct yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; common fine pores; common medium thick very dark grayish brown (10YR 3/2) clay films on surfaces of peds; slightly acid (pH 6.2); clear smooth boundary.

B3t-41 to 60 inches; dark yellowish brown (10YR 3/4) light silty clay, yellowish brown (10YR 5/4) dry; many large distinct yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots, common fine pores; common moderately thick very dark grayish brown (10YR 3/2) clay films; neutral (pH 6.7); clear smooth boundary.

The A horizon has moist value and chroma of 2 or 3, dry value of 3 or 4, and dry chroma of 2 or 3. The B2 horizon has a moist value of 3 or 4 and chroma of 2 or 3. Distinct mottles are at a depth of about 25 to 34 inches. The depth to the fine textured B2 horizon ranges from 24 to 35 inches, and texture ranges from heavy silty clay loam to clay. The B2 horizon has a moist value and chroma of 2 to 4.

## Concord series

The Concord series consists of deep, poorly drained, level soils on terraces. These soils formed in stratified silty and clayey alluvium of mixed mineralogy. Slopes are 0 to 2 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is 52 degrees F.

Typical pedon of Concord silt loam, 1 mile west of Ralston, SE1/4NE1 /4 sec. 7, T. 6 S., R. 5 W.:

Ap-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine pores; common fine concretions; medium acid (pH 6.0); clear smooth boundary.

A2-8 to 14 inches; grayish brown (10YR 5/2) silty clay loam, light gray (10YR 7/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine and common fine pores; common fine concretions; medium acid (pH 6.0); clear smooth boundary.

B1g-14 to 19 inches; dark grayish brown (10YR 4/2) silty clay, light brownish gray (10YR 6/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky and very plastic; many very fine and fine roots; many very fine and few tine pores; few fine black stains; slightly acid (pH 6.2); clear smooth boundary.

B2tg-19 to 27 inches; dark grayish brown (10YR 4/2) silty clay, light brownish gray (10YR 6/2) dry; many fine distinct dark brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate and coarse subangular blocky; very hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; few thin clay films on ped faces and in pores; slightly acid (pH 6.4); gradual wavy boundary.

B3tg-27 to 31 inches; grayish brown (l10YR 5/2) silty clay, light gray (10YR 7/2) dry; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; very hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; few thin clay films on ped faces and in pores; few fine black concretions; medium acid (pH 6.0); gradual wavy boundary.

C-31 to 60 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; many medium distinct yellowish brown (10YR 5/6) mottles; massive; hard, friable, sticky and plastic; few roots; common very fine pores; few thick clay films in root channels; medium acid (pH 6.0).

The soils generally are moist and are saturated by water in winter. A seasonal high water table is within 6 inches of the surface in winter and spring.

The Ap horizon has value of 3 or 4 moist and chroma of 1 or 2. Structure is weak to moderate granular and subangular blocky.

The B horizon has hue of 10YR to 5Y, value of 4 or 5 moist and 6 or 7 dry, and chroma of 1 or 2 moist and dry. It is silty clay, clay, or heavy silty clay loam and averages 35 to 50 percent clay. Structure generally is weak to strong prismatic and moderate or strong very fine to medium angular or subangular blocky.

The C horizon is silt loam or silty clay loam.

## Cove series

The Cove series consists of deep, poorly drained soils on bottom lands. These soils formed in recent alluvium. Slopes are 0 to 2 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 52 degrees F.

Typical pedon of Cove silty clay loam about 1 mile north of Rickreall, SE1/4NW1/4 sec. 30, T. 7 S., R. 4 W.:

Ap-0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; hard, firm, very sticky and plastic; many very fine roots; many fine interstitial pores; medium acid (pH 6.0); clear smooth boundary.

B1g-8 to 26 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine pores; slightly acid (pH 6.2); clear smooth boundary.

B2g-26 to 37 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; many medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few roots; many very fine pores; slightly acid (pH 6.4); clear smooth boundary.

Cg-37 to 60 inches; dark gray (10YR 5/1) clay, gray (10YR 6/1) dry; many medium and large yellowish brown (10YR 5/8) mottles; massive; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; neutral (pH 6.6).

These soils are saturated 4 to 6 months of the year unless drained. They are moist nearly continuously at a depth below 20 inches. In summer, the soil generally cracks at a depth of less than 20 inches, generally between a depth of 7 and 20 inches. The solum ranges from 30 to 45 inches in thickness. Clay is at a depth of 7 to 16 inches.

The A horizon generally has hue of 10YR or, in places, 2.5Y. It has value of 2 or 3 moist and 4 or 5 dry and chroma of 3 or less. The structure in the upper few inches may range from moderate to strong granular or fine subangular blocky.

The B horizon has hue of 10YR or 2.5Y, value of 2 or 3 moist and 4 or 5 dry, and chroma of 1 or less. Structure is strong to moderate subangular blocky.

The C horizon has hue of 2.5Y or 10YR. Structure is weak or massive. The horizon ranges from silty clay to clay. Mottling is distinct or prominent within a depth of 20 inches.

## Cruiser series

The Cruiser series consists of deep, well drained soils on mountainous uplands. These soils formed in colluvium weathered from basic igneous rock and volcanic ash. Slopes are 3 to 70 percent. The mean annual precipitation is about 90 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Cruiser gravelly loam, bedrock substratum, 3 to 25 percent slopes, about 4-1/2 miles east of Valsetz, NE1/4NE1/4 sec. 29, T. 8 S., R. 7 W.:

O1-1 inch to 0; litter of leaves, needles, grass leaves, and twigs.

A1-0 to 4 inches; dark reddish brown (5YR 3/3) gravelly loam, reddish brown (5YR 5/3) dry; moderate very fine and fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 30 percent fine pebbles and concretions; very strongly acid (pH 5.0); clear smooth boundary.

A3-4 to 12 inches; dark reddish brown (5YR 3/4) loam, reddish brown (5YR 5/4) dry; moderate very fine granular and moderate very fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine plastic; common fine roots; many fine pores; 10 percent very fine pebbles and concretions; very strongly acid (pH 5.0); gradual smooth boundary.

B21-12 to 21 inches; reddish brown (5YR 4/4) loam, light reddish brown (5YR 6/4) dry; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; many fine pores; organic coatings in root channels; 15 percent fine pebbles; very strongly acid (pH 4.8); gradual smooth boundary.

B22-21 to 33 inches; reddish brown (5YR 4/4) heavy loam, light reddish brown (5YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine pores; 15 percent pebbles; very strongly acid (pH 4.8); clear smooth boundary.

B3-33 to 42 inches; yellowish red (5YR 4/6) heavy loam, reddish yellow (5YR 6/6) dry; irregular areas of variegated sandy loam saprolite (70 percent soil material and 30 percent saprolite); weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine pores; 10 percent fine pebbles; very strongly acid (pH 4.8); abrupt irregular boundary.

C-42 to 60 inches; variegated saprolite and pockets of yellowish red (5YR 4/6) loam, reddish yellow (5YR 6/6) dry; very strongly acid (pH 4.8).

Bedrock is at a depth of 40 to 60 inches. Coarse fragments make up 10 to 30 percent of the A horizon, 10 to 40 percent of the B horizon, and average less than 35 percent of the control section.

The A horizon has hue of 10YR to 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 3 or 4 moist and dry. Chroma of more than 3.5 moist is at a depth of less than 10 inches.

The B horizon has hue of 5YR to 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 4 to 6 moist or dry. It ranges from loam to clay loam throughout.

The C horizon has hue of 7.5YR or 5YR and chroma of 4 to 6 moist and dry. It generally is loam or clay loam and, in places, is sandy loam.

## Cumley series

The Cumley series consists of deep, moderately well drained soils on mountainous uplands. These soils formed in residuum and colluvium weathered from basic igneous and sedimentary rock. Slopes are 2 to 20 percent. The mean annual precipitation is about 65 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Cumley silty clay loam, 2 to 20 percent slopes, about 1 mile south of Grande Ronde, NW1/4NW1/4 sec. 19, T. 6 S., R. 7 W.:

A11-0 to 3 inches; very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; strong very fine granular and moderate fine subangular blocky structure; hard, firm, sticky and plastic; many fine roots; many fine and very fine pores; strongly acid (pH 5.2); clear smooth boundary.

A12-3 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate very fine granular and fine subangular blocky structure; hard, firm, sticky and plastic; many fine roots; many very fine pores; strongly acid (pH 5.2); clear smooth boundary.

B1-7 to 16 inches; brown (10YR 4/3) silty clay, pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; hard, firm, very sticky and plastic; common fine and medium roots; common very fine pores; common thin coatings on peds; very strongly acid (pH 5.0); clear smooth boundary.

B21t-16 to 26 inches; brown (10YR 4/3) clay, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine pores; common moderately thick clay films; few fine concretions; very strongly acid (pH 5.0); clear smooth boundary.

B22t-26 to 42 inches; brown (10YR 4/3) silty clay, pale brown (10YR 6/3) dry; many fine and medium dis-, tinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; hard, firm, very sticky and very plastic; common very fine pores; common moderately thick clay films; few fine concretions; few fine and medium sedimentary rock fragments; very strongly acid (pH 5.0); clear smooth boundary.

B3t-42 to 45 inches; dark grayish brown (10YR 4/2) silty clay, light brownish gray (10YR 6/2) dry; many fine and medium distinct yellowish brown mottles; weak medium and coarse subangular blocky structure; hard, firm, very sticky and very plastic; few very fine pores; few thin clay films; 15 percent fine sedimentary rock fragments; very strongly acid (pH 4.8); clear smooth boundary.

C-45 to 60 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; many medium distinct yellowish brown (10YR 5/8) mottles; massive; very hard, very firm, very sticky and very plastic; few fine weathered siltstone fragments; few very fine pores; very strongly acid (pH 4.8).

The A horizon has hue-of 10YR or 7.5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and dry.

The B2t horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 or 4 moist and dry. It has faint to prominent mottles. The horizon is silty clay or clay.

## Dayton series

The Dayton series consists of deep, poorly drained soils on smooth or slightly concave stream terraces and drainageways. These soils formed in clayey and silty alluvium. Slopes are 0 to 2 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is 53 degrees F.

Typical pedon of Dayton silt loam, about 3/4 mile east of Zena, NE1/4 sec. 36, T. 6 S., R. 4 W.:

Ap-0 to 5 inches; grayish brown (10YR 5/2) silt loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown mottles; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common very fine tubular pores; medium acid (pH 5.8); clear smooth boundary.

A2-5 to 12 inches; grayish brown (10YR 5/2) silty clay loam, gray (10YR 6/1) dry; many fine and medium distinct yellowish brown and reddish brown mottles; moderate fine subangular blocky structure; slightly hard, firm, sticky and plastic; common fine roots; many fine and medium tubular pores; medium acid (pH 5.8); abrupt wavy boundary.

IIB21t-12 to 24 inches; gray (10YR 5/1) clay, gray (10YR 6/1) dry; few medium distinct dark yellowish brown mottles; moderate medium and coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few fine roots; common very fine pores; common fine black stains; common thin clay films; medium acid (pH 6.0); clear smooth boundary.

IIB22t-24 to 30 inches; grayish brown (2.5Y 5/2) clay, light gray (2.5Y 7/2) dry; many medium and large distinct yellowish brown mottles; moderate coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few fine roots; common very fine tubular pores; common thin clay films; medium acid (pH 6.0); clear smooth boundary.

IIB23t-30 to 42 inches; grayish brown (2.5Y 5/2) silty clay, light gray (2.5Y 7/2) dry; many medium and large distinct yellowish brown mottles; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; common very fine pores; few moderately thick clay films; few very fine shot; medium acid (pH 6.0); clear smooth boundary.

IIC-42 to 60 inches; grayish brown (10YR 5/2) silty clay, light gray (2.5Y 7/2) dry; many medium and large distinct yellowish brown mottles; weak coarse prismatic structure; very hard, firm, very sticky and very plastic; few fine tubular pores; slightly acid (pH 6.2).

The solum ranges from 30 to 48 inches in thickness.

The A horizon has hue of 10YR or 2.5Y, value of 3 or 4 moist, and chroma of 1 or 2,

The B2t horizon has hue of 10YR, 2.5Y, or 5Y.

The IIC horizon has hue of 10YR, 2.5Y, or 5Y. It is massive or has weak coarse prismatic structure. A thick clay substratum is in some areas.

## Dixonville series

The Dixonville series consists of moderately deep, well drained soils on foothills. These soils formed in colluvium weathered from basic igneous bedrock. Slopes are 3 to 50 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Dixonville silty clay loam, 12 to 20 percent slopes, about 2 miles South of Willamina, NE1/4SW1/4 sec. 24, R. 6 S., R. 7 W.:

A11-0 to 8 inches; dark reddish brown (5YR 3/2) silty clay loam, dark brown (7.5YR 4/2) dry; strong very fine granular and strong very fine subangular blocky structure; firm, very sticky and very plastic; many fine and very fine roots; many fine pores; medium acid (pH 5.7); clear smooth boundary.

A12-8 to 16 inches; dark reddish brown (5YR 3/2) silty clay, dark brown (7.5YR 4/2) dry; moderate very fine and fine subangular blocky structure; very firm, very sticky and very plastic; common fine and medium roots; many very fine pores; medium acid (pH 5.9); clear smooth boundary.

B21t-16 to 23 inches; dark reddish brown (5YR 3/2) clay, reddish brown (5YR 4/3) dry; moderate fine and medium subangular blocky structure; very firm, very sticky and very plastic; common fine and medium roots; common very fine pores; common fine clay films; slightly acid (pH 6.2); clear smooth boundary.

B22t-23 to 29 inches; dark reddish brown (5YA 3/3) clay, reddish brown (5YR 4/3) dry; moderate medium subangular blocky structure; very firm, very sticky and very plastic; few fine and medium roots; common very fine pores; many moderately thick clay films; slightly acid (pH 6.2); clear smooth boundary.

B23t-29 to 39 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate medium and coarse subangular blocky structure; very firm, very sticky and very plastic; few fine and medium roots; common very fine pores; many moderately thick clay films; 5 percent variegated brown (10YR 5/3) and yellowish brown (10YR 5/4) saprolite fragments; slightly acid (pH 6.3); abrupt wavy boundary.

Cr-39 inches; dark yellowish brown (10YR 4/4) partly weathered basalt; dark reddish brown (5YR 3/4) clay coatings on fractures; few tongues of clay from B2t horizon on fractures.

The A horizon has hue of 7.5YR, 10YR, or 5YR and value and chroma of 2 or 3 moist. Pebbles and cobbles make up 0 to 15 percent of the horizon. The horizon ranges from silty clay loam to silty clay.

The B horizon has hue of 7.5YR or 5YR and value and chroma of 2 to 4 moist. Coarse fragments make up 0 to 35 percent of the horizon. The horizon ranges from silty clay to clay.

The underlying weathered basalt substratum or saprolite is at a depth of 20 to 40 inches.

## Dupee series

The Dupee series consists of deep, somewhat poorly drained soils in depressions and drainageways and on foothills. These soils formed in moderately fine textured and fine textured colluvium overlying weathered sedimentary bedrock. Slopes are 3 to 20 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 52 degrees F.

Typical pedon of Dupee silt loam, 3 to 12 percent slopes, about 2 miles north of Dallas, SE1/4NW1/4 sec. 21, T. 7 S., R. 5 W.:

A11-0 to 4 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; strong fine granular and subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; many fine pores; medium acid (pH 5.8); clear wavy boundary.

A12-4 to 9 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine and medium pores; medium acid (pH 5.8); clear wavy boundary.

A3-9 to 17 inches; dark yellowish brown (10YR 3/4) heavy silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine roots; many very fine pores; very strongly acid (pH 5.0); clear wavy boundary.

B1-17 to 24 inches; dark yellowish brown (10YR 3/4) heavy silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/8) mottles; weak medium prismatic structure; hard, firm, sticky and plastic; common very fine and fine roots; many fine pores; few light gray (10YR 7/2) coatings on peds; very strongly acid (pH 5.0); clear wavy boundary.

B21t-24 to 34 inches; brown (10YR 4/3) silty clay, pale brown (10YR 5/6) dry; few fine distinct dark grayish brown (10YR 5/6) motttes; weak medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; common very fine

roots; common very fine pores; common moderately thick dark yellowish brown (10YR 3/4) clay films; common gray silt coatings on peds; very strongly acid (pH 4.8); clear wavy boundary.

B22t-34 to 42 inches; dark yellowish brown (10YR 4/4) silty clay, pale brown (10YR 6/3) dry; common fine distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; common moderately thick dark yellowish brown (10YR 3/4) clay films; common fine black stains; common light gray silt coatings; very strongly acid (pH 4.8); clear wavy boundary.

B3tg-42 to 51 inches; dark grayish brown (10YR 4/2) silty clay, pale brown (10YR 6/3) dry; many medium distinct yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; few very fine pores; common moderately thick clay films; few fine black stains; common light gray silt coatings on peds; common fine strong brown (7.5YR 5.8) soft masses; very strongly acid (pH 4.8); clear wavy boundary.

Cg-51 to 62 inches; mottled grayish brown (10YR 5/2), gray (10YR 5/1) and yellowish brown (10YR 5/6) clay; massive; very firm, very sticky and very plastic; few very fine pores; few fine strongly weathered siltstone fragments; very strongly acid (pH 4.8).

The solum ranges from 35 to more than 60 inches in thickness. Mottles of chroma 2 or less are within 30 inches of the surface.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist and 5 or 6 dry, and chroma of 2 to 4 moist and dry.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 moist and 5 or 6 dry, and chroma of 2 to 4 moist and dry. It is heavy silty clay loam, silty clay, or clay and is 35 to 45 percent clay.

The C horizon is similar in color to the B horizon. It ranges from silty clay to clay.

## Grande Ronde series

The Grande Ronde series consists of deep, somewhat poorly drained, nearly level soils on stream terraces. These soils formed in mixed old clayey alluvial deposits. Slopes are 0 to 2 percent. The mean annual precipitation is about 65 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Grande Ronde silty clay loam, about 1-1/2 miles north of Valley Junction, 100 feet south of the Yamhill County line, SW1/4SW1/4 sec. 5, T. 6 S., R. 7 W.:

Ap-0 to 7 inches; dark brown (10YR 3/3) silty clay loam, pale brown (10YR 6/3) dry; moderate fine and very fine subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine roots; many very fine pores; strongly acid (pH 5.2); clear smooth boundary.

B1-7 to 18 inches; dark brown (10YR 4/3) silty clay, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; strongly acid (pH 5.2); clear smooth boundary.

B21-18 to 26 inches; dark brown (10YR 4/3) silty clay, pale brown (10YR 6/3) dry; many fine and medium distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; hard, very firm, very sticky and very plastic, few very fine roots; common very fine pores; few fine black stains; common light gray very fine sand coatings on faces of peds; very strongly acid (pH 4.8); clear smooth boundary.

IIB22-26 to 35 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; many fine and medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; common light gray very fine sand grains on faces of pads; very strongly acid (pH 4.8); clear smooth boundary.

IIC1-35 to 47 inches; mottled yellowish brown (10YR 5/8) light gray (10YR 5/2) and dark brown (7.5YR 4/4) clay; weak coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; few very fine pores; few, fine and medium black stains; very strongly acid (pH 4.8); clear wavy boundary.

IIC2-47 to 62 inches; yellowish brown (10YR 5/8) clay; brownish yellow (10YR 6/8) dry; common fine and medium fine and medium distinct light brownish gray (10YR 6/2) mottles; massive; very hard, very firm, very sticky and very plastic; few very fine pores; very strongly acid (pH 4.8).

The soil is saturated by water in winter unless artificially drained. It is more than 60 inches thick, but rooting depth is restricted in some areas by a temporary, perched water table at depth of 18 to 24 inches.

The A horizon has chroma of 2 or 3 moist and dry. The B horizon has value of 4 or 5 moist and 6 or 7 dry and chroma of 2 or 3 moist and dry.

The C horizon has hue of 10YR or 2.5Y. It is silty clay or clay.

## Haploxerolls

These deep soils are along streams where drainageways have incised into valley terraces. They are on terrace fronts above the flood plain along major streams and rivers. These soils formed in stratified silty, loamy, or gravelly alluvium in areas where weathered bedrock occasionally crops out. Slopes are 20 to 60 percent. The average annual precipitation is 40 to 80 inches, and the average annual air temperature is 50 to 54 degrees F. A reference profile representing a Haploxeroll from an area of Xerochrepts and Haploxerolls, steep, about 1-1 /2 miles south of Buena Vista, NW1 /4N1 /4 sec. 34, T. 9 S., R. 5 W.:

Ap-0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid (pH 5.8); abrupt smooth boundary.

A3-7 to 15 inches; dark brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; medium acid (pH 5.8); clear wavy boundary.

B1-15 to 26 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; common very fine roots; many very fine tubular pores; thin clean sand and silt grains on ped surfaces; medium acid (pH 5.6); clear smooth boundary.

B21-26 to 33 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common medium distinct dark brown (7.5YR 4/4) and grayish brown (10YR 5/2) mottles; weak medium prismatic and moderate medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine and fine tubular pores; common clean fine sand and silt coatings on ped surfaces; few fine concretions and few black stains; medium acid (pH 5.6); clear smooth boundary.

B22-33 to 46 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common medium distinct dark brown (7.5YR 4/4) and grayish brown (10YR 5/2) mottles and few dark reddish brown (5YR 3/3) and black (N 2/0) mottles; weak medium prismatic structure parting to moderate coarse subangular blocky; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; slightly acid (pH 6.2); clear smooth boundary.

B3-46 to 60 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; common fine distinct dark brown (7.5YR 4/4) and dark reddish brown (5YR 3/2) mottles; weak coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine tubular pores; slightly acid (pH 6.2).

The A horizon has value of 4 or 5 dry and chroma of 2 or 3 dry.

The B horizon has chroma of 2 or 3 moist and hue of 10YR or 7.5YR. Distinct mottles are at a depth of 20 to 30 inches.

## Hazelair series

The Hazelair series consists of moderately deep, moderately well drained to somewhat poorly drained soils on low, rolling foothills. These soils formed in mixed clayey colluvium weathered from sedimentary rock. Slopes are 3 to 30 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 52 degrees F.

Typical pedon of Hazelair silt loam, 3 to 12 percent slopes, about 4-1 /2 miles northeast of Dallas in the Basket Slough area, NE1/4NE1/4 sec. 10, T. 7 S., R. 5W.:

A11-0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium and fine subangular blocky and moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; medium acid (pH 5.8); clear smooth boundary.

A12-6 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; medium acid (pH 5.8); clear smooth boundary.

B2-10 to 17 inches; very dark grayish brown (10YR 3/2) heavy silty clay loam, grayish brown (10YR 5/2) dry; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine roots; many very fine tubular pores; strongly acid (pH 5.4); abrupt smooth boundary.

IIC1-17 to 33 inches; grayish brown (2.5Y 5/2) clay, light brownish gray (2.5Y 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; vertical 5- to 10-millimeter cracks about 18 centimeters apart; few pressure faces; strongly acid (pH 5.2); abrupt smooth boundary.

IIIC2-33 to 38 inches; light olive brown (2.5Y 5/3) clay, light brownish gray (2.5Y 6/2) dry; massive; very hard, very firm, very sticky and very plastic; very few and very fine

roots; very few tubular pores; few pressure faces; 10 percent fine and very fine siltstone fragments; strongly acid (pH 5.2); clear smooth boundary.

Cr-38 inches; highly weathered yellowish brown (10YR 5/4) siltstone; dark brown (10YR 4/3) moderately thick coatings.

Sedimentary bedrock is at a depth of 20 to 40 inches. The solum above nonconforming clay IIC horizon ranges from 12 to 24 inches in thickness.

The A horizon has hue of 10YR and 7.5YR, value of 2 or 3 moist, and chroma of 2 or 3 moist or dry.

The B horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 or 4 moist and 5 or 6 dry; and chroma of 2 to 4 moist and dry. It is silty clay loam or silty clay.

The IIC horizon has hue of 2.5Y or 10YR, moist value of 4 to 6, and moist chroma of 2 to 4. It is 60 to 70 percent clay. The lower part of the horizon is 5 to 25 percent siltstone fragments that are easily crushed.

## Helmick series

The Helmick series consists of deep, somewhat poorly drained soils on low, rolling foothills that merge into the main valley terraces. These soils formed in stratified alluvium, colluvium, and residuum weathered from sedimentary rock. Slopes are 3 to 50 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 52 degrees F.

Typical pedon of Helmick silt loam, 3 to 12 percent slopes, about 2-1 /2 miles south of Independence, NW1/4SE1/4 sec. 5, T. 9 S., R. 4 W.:

A11-0 to 5 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; strong fine and medium granular and strong fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine pores; medium acid (pH 5.8); clear wavy boundary.

A12-5 to 10 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine and fine pores; medium acid (pH 5.6); clear wavy boundary.

B2-10 to 16 inches; dark brown (10YR 4/3) heavy silty clay loam, pale brown (10YR 6/3) dry; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine pores; strongly acid (pH 5.4); abrupt wavy boundary.

IICl-16 to 22 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; extremely hard, very firm, very sticky and very plastic; many very fine and fine roots; common very fine pores; few small pressure faces; strongly acid (pH 5.2); clear wavy boundary.

IIC2-22 to 28 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common medium faint very dark gray (10YR 3/1) and common fine distinct yellowish brown (10YR 5/6) mottles; massive; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine pores; few small pressure faces; strongly acid (pH 5.2); clear wavy boundary.

IIC3-28 to 36 inches; grayish brown (10YR 5/2) clay, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) and common medium faint gray (10YR 5/1) mottles; massive; extremely hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; few small pressure faces; strongly acid (pH 5.2); clear wavy boundary. IIC4-36 to 50 inches; light brownish gray (10YR 6/2) clay, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/6) and few medium faint gray (10YR 5/1) mottles; massive; extremely hard, very firm, very sticky and very plastic; few very fine roots; few very fine pores; few small pressure faces; strongly acid (pH 5.2); clear wavy boundary.

IIC5-50 to 62 inches; mottled light brownish gray (2.5Y 6/2) and strong brown (7.5YR 5/6) clay; massive; extremely hard, very firm, very sticky and very plastic; few very fine pores; very strongly acid (pH 5.0).

The solum above the nonconforming clay IIC horizon ranges from 12 to 20 inches in thickness. The average clay content in the control section ranges from 60 to 65 percent. Mottles that have chroma of 2 or less are within 30 inches of the surface. The soils generally are moist but are dry between depths of 4 and 12 inches for 45 to 70 consecutive days in summer.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist and 6 dry, and chroma of 2 or 3 moist and dry.

The B horizon has value of 4 or 5 moist and 6 dry. It is heavy silty clay loam or silty clay, and the weighted average of clay is 35 to 45 percent.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 6 or 7 dry, and chroma of 1 or 2 moist and dry. It is 60 to 70 percent clay. The lower part of the C horizon is 0 to 35 percent weathered siltstone fragments that are easily crushed.

## Helvetia series

The Helvetia series consists of deep, moderately well drained soils on high terraces. These soils formed in old alluvium weathered from mixed sources. Slopes are 0 to 20 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Helvetia silt loam, 0 to 12 percent slopes, about 1/2 mile south of Bethel Church, NE1/4SW1/4 sec. 21, T. 6 S., R. 4 W.:

A11-0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine and fine subangular blocky and very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine interstitial pores; medium acid (pH 5.8); clear smooth boundary.

A12-8 to 15 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine tubular pores; few, gray silt coatings on peds; medium acid (pH 6.0); clear smooth boundary.

B1-15 to 20 inches; dark yellowish brown (10YR 3/4) silty clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, sticky and plastic; many very fine tubular pores; few dark reddish brown (5YR 3/4) and black coatings on peds; common gray silt coatings on peds; medium acid (pH 6.0); clear smooth boundary.

B21t-20 to 32 inches; brown (10YR 4/3) heavy silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to subangular blocky; brittle, firm, sticky and plastic; few very fine tubular pores; many moderately thick clay films; common fine reddish brown and black coatings on peds; many gray silt coatings on peds; medium acid (pH 5.8); clear smooth boundary.

B22t-32 to 40 inches; dark brown (10YR 4/3) heavy silty clay loam, pale brown (10YR 6/3) dry; few medium distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate medium and coarse prismatic structure parting to subangular blocky; brittle, very firm, sticky and plastic; few very fine pores; many moderately thick reddish brown clay films; many medium black coatings; many gray silt coatings; medium acid (pH 5.8); clear smooth boundary.

B23t-40 to 54 inches; dark brown (10YR 4/3) heavy silty clay loam, pale brown (10YR 6/3) dry; common fine distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; common very fine pores; few gray silt coatings; many moderately thick dark brown clay films; common medium black coatings; medium acid (pH 6.0); clear smooth boundary.

B3t-54 to 62 inches; dark grayish brown (10YR 4/2) silty clay loam, brown (10YR 5/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; common gray silt coatings; few fine clay films; slightly acid (pH 6.2).

Mottles of chroma 2 or less are at a depth of 30inches or more in some places.

The A horizon has value of 3 moist and 5 dry and chrqma of 2 or 3 moist and dry.

The Bt horizon has value of 3 or 4 moist and 5 or 6 dry and chroma of 2 to 4 moist and dry. It is heavy silty clay loam or light silty clay and is 35 to 45 percent clay.

## Hembre series

The Hembre series consists of deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in residuum and colluvium weathered from basalt rock, Slopes are 3 to 75 percent. The mean annual precipitation is about 100 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Hembre gravelly silt loam, 3 to 25 percent slopes, about 4 miles south of Valley Junction, SE1/4SE1/4 sec. 32, T. 6 S., R. 7 W.:

A1-0 to 5 inches; dark reddish brown (5YR 3/2) gravelly silt loam, reddish brown (5YR 5/3) dry; moderate very fine granular structure; slightly hard, firm, sticky and plastic; many fine roots; many fine pores; 30 percent, by volume, very fine pebbles and concretions; strongly acid (pH 5.2); gradual smooth boundary.

A3-5 to 10 inches; dark reddish brown (5YR 3/2) gravelly silt loam, reddish brown (5YR 5/3) dry; moderate very fine and fine granular structure; slightly hard, firm, sticky and plastic; many fine roots; many fine pores; 35 percent by volume very fine pebbles and concretions; very strongly acid (pH 5.0); clear smooth boundary.

B21-10 to 18 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; weak fine subangular blocky structure; slightly hard, firm, slighly sticky and slightly plastic; common fine roots; common very fine and fine pores; few fine coatings on peds; 15 percent, by volume, very fine and fine pebbles and concretions; very strongly acid (pH 4.8); clear smooth boundary.

B22-18 to 32 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, slightly sticky and plastic; common fine and medium roots; common very fine and fine pores; few thin coatings on peds and pores; 15 percent, by volume, very fine and fine gravel and concretions; very strongly acid (pH 4.8); gradual smooth boundary.

B3-32 to 54 inches; reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; weak coarse subangular blocky structure; hard, firm, sticky and

roots; common very fine pores; few thin coatings on peds and pores; 10 percent, by volume, very fine gravel and concretions; very strongly acid (pH 4.8). .

R-54 inches; basalt; fractures more than 4 inches apart.

The depth to bedrock and thickness of the solum is 40 to 50 inches. The A and B2 horizons are 5 to 35 percent pebbles and cobbles.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and 3 or 4 dry.

The B horizon has value of 3 or 4 moist and chroma of 4 to 6 moist or dry.

## Holcomb series

The Holcomb series consists of deep, somewhat poorly drained, nearly level soils on smooth terraces. These soils formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Holcomb silt loam, about 1-1/2 miles southeast of Monmouth, SE1/4SW1/4 sec. 31, T. 8 S., R. 4 W.:

Ap-0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky and moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine interstitial pores; medium acid (pH 5.8); clear smooth boundary.

A12-4 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few faint yellowish brown mottles; moderate medium fine subangular blocky structure parting to moderate fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine and very fine tubular pores; medium acid (pH 5.8); clear smooth boundary.

A2-12 to 18 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; many fine and medium distinct yellowish brown mottles; moderate coarse and medium subangular blocky structure; few fine roots; many very fine and fine pores; medium acid (pH 6.0); clear smooth boundary.

B1-18 to 24 inches; grayish brown (10YR 5/2) silty clay loam, light gray (10YR 7/2) dry; many medium distinct yellowish brown mottles; weak coarse and medium subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine tubular pores; medium acid (pH 6.0); abrupt wavy boundary.

IIB21t-24 to 43 inches; dark grayish brown (10YR 6/2) clay, light brownish gray (10YR 6/2) dry; many medium distinct reddish brown and yellowish brown mottles; weak coarse and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few fine roots; common very fine pores; common thin clay films; few fine black stains, slightly acid (pH 6.4); gradual wavy boundary.

IIB22t-43 to 60 inches; dark grayish brown (10YR 4/2) clay, light brownish gray (10YR 6/2) dry; many medium distinct dark yellowish brown mottles; weak medium and coarse subangular blocky structure; very hard, very firm, very sticky and plastic; common very fine pores; common thin clay films; neutral (pH 6.6).

The solum ranges from 36 to 60 inches in thickness. The A1 or Ap horizons have a value of 2 or 3 moist and 5 dry and chroma of 2 or 3 moist and dry. The A2 horizon has value of 3 or 4 moist and 5 or 6 dry and chroma of 2 or 3 moist and 2 dry. It is silt loam or light silty clay loam.

The B1 horizon may not be present in some pedons. The IIB2t horizon has value of 4 or 5 moist and 5 or 6 dry and chroma of 2 in hue 10YR to 5Y. It is silty clay or clay.

## Honeygrove series

The Honeygrove series consists of deep, well drained soils on mountainous uplands of the Coast Range. These soils formed in residuum and colluvium weathered from sedimentary and igneous rock. Slopes are 2 to 75 percent. The mean annual precipitation is about 75 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Honeygrove silty clay loam, 3 to 25 percent slopes, about 4 miles west of Falls City, SW1/4NW1/4 sec. 11, T. 8 S., R. 7 W.:

O1-1 inch to 0; duff and litter.

A11-0 to 5 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) dry; strong fine granular and subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many fine pores; common fine and medium shot; very strongly acid (pH 5.0); clear smooth boundary.

A12-5 to 10 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate fine granular and subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common medium and fine shot; very strongly acid (pH 4.8); clear smooth boundary.

A3-10 to 15 inches; dark reddish brown (5YR 3/4) heavy silty clay loam, reddish brown (5YR 4/4) dry; moderate very fine granular and fine subangular blocky structure; hard, firm, sticky and plastic; many fine pores; few fine shot; very strongly acid (pH 4.8); clear smooth boundary.

B1t-15 to 25 inches; reddish brown (5YR 4/4) silty clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very, plastic; many roots; many very fine pores; few thin clay films; 5 percent, by volume, fine siltstone fragments; very strongly acid (pH 4.8); clear wavy boundary.

B21t-25 to 30 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common roots; many very fine pores; common moderately thick clay films; 5 percent, by volume, fine siltstone fragments; very strongly acid (pH 4.8); clear smooth boundary. B22t-30 to 49 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; moderate fine and medium subangular blocky structure; few roots; common very fine pores; many moderately thick clay films; 10 percent, by volume, fine siltstone fragments; very strongly acid (pH 4.8); clear smooth boundary.

B3t-49 to 62 inches; yellowish red (5YR 4/6) silty clay, yellowish red (5YR 5/6) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and very plastic; common moderately thick clay films; 20 percent, by volume, fine siltstone fragments; very strongly acid (pH 4.8).

The solum is commonly as thick as 5 feet or more but it is as thin as 40 inches in some places.

The A horizon has hue of 7.5YR to 5YR, value of 2 or 3 moist and 3 or 4 dry, and a chroma of 2 to 4 moist and dry.

The Bt horizon has hue of 5YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 4 to 6 moist and dry. The B2t horizon is clay or silty clay and is 50 to 60 percent clay. It has few to continuous, moderately thick clay films.

## Jory series

The Jory series consists of deep, well drained, strongly sloping soils on low, rolling foothills that have abrupt, steep north exposures. These soils formed in fine textured colluvium weathered mainly from basic igneous material and secondarily from tuffaceous and sedimentary material. Slopes are 2 to 60 percent. The mean annual precipitation is about 50 inches, and the mean annual temperature is about 52 degrees F.

Typical pedon of Jory silty clay loam, .2 to 12 percent, about 3/4 mile southwest of Popcorn School in the Eola Hills, SW1/4SW1/4 sec. 13, T. 7 S., R. 4 W.:

Ap-0 to 6 inches; dark reddish brown (5YR 3/3) silty clay loam, dark brown (7.5YR 4/4) dry; moderate fine and very fine granular and subangular blocky structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many very fine tubular and interstitial pores; medium acid (pH 5.6); clear smooth boundary.

A12-6 to 11 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many medium fine and very fine tubular pores; common very fine concretions; medium. acid (pH 5.6); clear smooth boundary.

B1-11 to 20 inches; dark reddish brown (5YR 3/4) heavy silty clay loam, reddish brown (5YR 4/4) dry; moderate medium and fine subangular blocky structure; hard, firm, sticky and plastic; common medium and fine roots; many medium, fine and very fine tubular pores; common fine and very fine concretions; medium acid (pH 5.6); gradual smooth boundary.

B21t-20 to 30 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, very sticky and very plastic; few medium roots; many large medium and fine pores; few thin clay films; common medium and fine concretions; strongly acid (pH 5.4); gradual smooth boundary.

B22t-30 to 35 inches; reddish brown (5YR 4/4) clay, yellowish red (5YR 4/6) dry; moderate medium subangular blocky structure parting to fine subangular blocky; very hard, very firm, very sticky and very plastic; few medium roots; large medium and fine tubular pores; common moderately thick clay films; many black coatings; common fine concretions less than 2 millimeters thick; strongly acid (pH 5.3); clear smooth boundary.

B23t-35 to 60 inches; reddish brown (5YR 4/4) clay, yellowish red (5YR 4/6) dry; moderate and fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few medium roots; common medium and fine tubular pores; few moderately thick black coatings; many fine concretions less than 2 millimeters thick; strongly acid (pH 5.4); clear smooth boundary.

B3t-60 to 70 inches; reddish brown (5YR 4/4) clay, yellowish red (5YR 4/6) dry; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine tubular pores; few moderately thick clay films; common very fine concretions; strongly acid (pH 5.3).

The A horizon has value of 2 or 3 moist and 4 dry and chroma of 3 or. 4 moist and 3 to 6 dry. It is silt loam or silty clay loam.

The B2t horizon has hue of 2.5YR and 5YR,, value of 3 moist and 4 dry, and chroma of 4 to 6 moist and dry. It is clay, silty clay, or silty clay loam. It averages about 50 to

60 percent clay. Structure ranges from moderate to strong.

## Kilchis series

The Kilchis series consists of shallow, well drained soils in mountainous topography in the Coast Range. These soils formed in gravelly residuum and colluvium weathered from igneous rock. Slopes are 3 to 90 percent. The mean annual precipitation is about 90 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Kilchis stony loam, 60 to 90 percent slopes, about 3 miles west of Falls City, NE1/4NE1/4 sec. 36, T. 8 S., R. 7 W.:

A11-0 to 4 inches; dark reddish brown (5YR 3/3) stony loam, reddish brown (5YR 5/3) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine interstitial pores; 40 percent pebbles and 5 percent stones and cobbles; strongly acid (pH 5.2); clear wavy boundary.

A12-4 to 8 inches; dark reddish brown (5YR 3/3) very gravelly loam, reddish brown (5YR 4/3) dry; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine pores; 55 percent pebbles and 5 percent stones and cobbles; very strongly acid (pH 4.8); clear wavy boundary.

B2-8 to 15 inches; dark reddish brown (5YR 3/4) very gravelly heavy loam, reddish brown (5YR 4/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine pores; 65 percent pebbles and 10 percent cobbles; strongly acid (pH 5.0); abrupt wavy boundary.

R-15 inches; fractured diorite that has a few thin tongues of B2 horizon material.

Bedrock is at a depth of 12 to 20 inches. The profile is 18 to 27 percent clay, and the weighted average of rock fragments is more than 35 percent in the control section. The umbric epipedon is 7 to 20 inches thick.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and dry.

The B horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist and 3 to 5 dry, and chroma of 3 or 4 moist and dry. It is more than 35 percent pebbles, cobbles, and stones.

## Kilowan series

The Kilowan series consists of moderately deep, well drained, gently sloping to very steep soils on broad ridges and uplands in the Coast Range. These soils formed in fine textured colluvium and residuum weathered from sedimentary bedrock. Slopes are 3 to 75 percent. The mean annual precipitation is about 100 inches, and the mean annual air temperature is about 48 degrees F.

Typical pedon of Kilowan gravelly silty clay loam, 3 to 25 percent slopes, about 2 miles west of Blackrock, SE1/4SW1/4 sec. 15, T. 8 S., R. 7 W.:

O1-1 inch to 0; undecomposed layer of needles, cones, small branches, and leaves; abrupt smooth boundary.

A11-0 to 7 inches; dark reddish brown (5YR 3/3) gravelly silty clay loam, reddish brown (5YR 5/3) dry; strong fine and very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 30 percent 2- to 5-millimeter shot and coarse fragments; strongly acid (pH 5.2); clear wavy boundary.

A12-7 to 13 inches; dark reddish brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; strong fine and medium granular structure; hard, friable, sticky and slightly plastic; many fine and medium roots; many fine pores; 10 percent 2- to 5-millimeter shot and coarse fragments; strongly acid (pH 5.2); clear wavy boundary.

B21-13 to 17 inches; yellowish red (5YR 4/6) silty clay, yellowish red (5YR 5/6) dry; moderate fine subangular blocky structure; very hard, firm, very sticky, and very plastic; common fine and medium roots; common very fine pores; common thin coatings on peds; few siltstone fragments; very strongly acid (pH 5.0); clear wavy boundary.

B22-17 to 24 inches; yellowish red (5YR 4/6) silty clay, yellowish red (5YR 5/6) dry; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; common fine and medium roots; common very fine pores; common thin coatings on peds; very strongly acid (pH 4.8); clear wavy boundary.

Cr-24 to 30 inches; partly weathered very pale brown (10YR 7/4) siltstone; yellowish red (5YR 4/6) moderately thick clay coatings on fractured siltstone fragments; few fines from B22 horizon in fractures of upper few inches.

Bedrock is at a depth of 20 to 40 inches. The A horizon is 15 to 35 percent weathered sedimentary rock fragments. The soil has an umbric epipedon that is less than 10 inches thick. It generally is moist, but it is dry in the control section for less than 45 consecutive days in summer.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 to 4 moist and 3 to 6 dry. Structure is strong to moderate granular and fine or very fine subangular blocky.

The B horizon has hue of 5YR or 2.5YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 4 to 6 moist and 4 to 8 dry. The upper part of the horizon is silty clay loam or silty clay, and the lower part is silty clay loam, silty clay, or clay. The lower part of the B horizon is 35 to 50 percent clay. Structure is moderate to weak very fine to medium subangular blocky.

The underlying bedrock dominantly is siltstone that is partly weathered.

## Klickitat series

The Klickitat series consists of deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in gravelly and cobbly residuum and colluvium weathered from basic igneous rock. Slopes are 3 to 90 percent. The average annual precipitation is about 90 inches, and the average annual air temperature is about 50 degrees F.

Typical pedon of Klickitat gravelly clay loam, 3 to 30 percent slopes, about 5 miles south of Valley Junction, SE1/4NE1/4 sec. 5, T. 7 S., R. 7 W.:

O1-2 inches to 0; leaves, twigs, and roots.

A1-0 to 7 inches; dark reddish brown (5YR 3/2) gravelly clay loam, reddish brown (5YR 4/3) dry; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 30 percent fine and medium basalt pebbles; strongly acid (pH 5.2); clear wavy boundary.

B1-7 to 15 inches; dark reddish brown (5YR 3/3) gravelly clay loam, reddish brown (5YR 4/3) dry; moderate very fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine pores; 30 percent fine and medium basalt pebbles; very strongly acid (pH 5.0); clear wavy boundary.

B21-15 to 26 inches; reddish brown (5YR 4/4) very gravelly clay loam, reddish brown (5YR 5/4) dry; moderate very fine and fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many fine pores; 50 percent basalt coarse fragments (35 percent pebbles and 15 percent cobbles); very strongly acid (pH 4.8); clear wavy boundary.

B22-26 to 42 inches; reddish brown (5YR 4/4) very gravelly clay loam, reddish brown (5YR 5/4) dry; moderate fine subangular blocky structure; hard; firm, sticky and plastic; few fine roots; common fine pores; 60 percent basalt coarse fragments (40 percent pebbles and 20 percent cobbles); very strongly acid (pH 4.8); abrupt wavy boundary.

R-4.2 inches; fractured basalt; fractures more than 4 inches apart.

Bedrock or highly fractured bedrock is at a depth of 40 to 50 inches. The umbric epipedon ranges from 10 to 20 inches in thickness. Coarse fragments make up from 15 to 35 percent of the A horizon and from 35 to 70 percent of the B horizon. The amount of coarse fragments increases with depth.

The A horizon has hue of 7.5YR and 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and dry.

The B2 horizon has value of 3 or 4 moist and 4 to 6 dry and chroma of 4 to 6 moist and dry. It is dominantly clay loam but ranges to heavy loam in some places.

## Knappa series

The Knappa series consists of deep, well drained soils on terraces in the Coast Range. These soils formed in silty alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 110 inches, and the mean annual air temperature is about 58 degrees F.

Typical pedon of Knappa silt loam, 0 to 7 percent slopes, about 2-1/2 miles southeast of Valsetz, SW1/4SE1/4 sec. 35, T. 8 S., R. 8 W.:

O1-1 inch to 0; partly decomposed conifer needles, twigs, and stems.

A11-0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular and subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine medium roots; many fine pores; 15 percent fine concretions; very strongly acid (pH 4.8); clear wavy boundary.

A12-4 to 12 inches; very dark grayish brown (10YR 3/2) heavy 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 fine roots; many very fine pores; very strongly acid (pH 4.8); clear wavy boundary.

B1-12 to 18 inches; dark brown (10YR 3/3) light silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; common very fine pores; very strongly acid (pH 4.8); clear wavy boundary.

B2-18 to 26 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; few fine pores; very strongly acid (pH 4.8); clear irregular boundary.

B31-26 to 35 inches; yellowish brown (10YR 5/6) silty clay loam, brownish yellow (10YR 6/6) dry; weak medium and coarse subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few very fine pores; few thin dark brown coatings on peds; few fine yellowish red (5YR 5/6) and pale brown (10YR 6/3) weathered siltstone fragments; very strongly acid (pH 4.6); abrupt wavy boundary.

B32-35 to 42 inches; yellowish brown (10YR 5/6) silty clay loam, brownish yellow (10YR 6/6) dry; weak medium and coarse subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few very fine pores; few thin dark brown coatings on peds; many fine grayish brown (10YR 5/2), yellowish red (5YR 5/6), and pale brown (10YR 6/3) weathered siltstone fragments and variegations; very strongly acid (pH 4.6); clear wavy boundary.

IIC-42 to 60 inches; variegated light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and pale brown (10YR 6/3) silty clay loam; weak coarse subangular blocky structure; very firm, very sticky and very plastic; few fine roots; few fine pores; very strongly acid (pH 4.6).

The solum is 40 to 60 inches thick. The umbric epipe don is more than 20 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist or dry. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5 moist and 5 or 6 dry, and chroma of 3 to 6 moist and dry.

## Luckiamute series

The Luckiamute series consists of shallow, welldrained soils in mountainous topography. These soils formed in moderately fine textured colluvium weathered from shale or siltstone. Slopes are 3 to 75 percent. The mean annual precipitation is about 130 inches, and mean annual temperature is about 43 degrees F.

Typical pedon of Luckiamute very shaly loam, 3 to 30 percent slopes, 1/2 mile south of Riley Peak, NW1/4NE1/4 sec. 13,T. 8 S., R. 8 W.:

O1-1 inch to 0; organic litter of leaves and needles.

A1-0 to 3 inches; brown (7.5YR 5/4) very shaly loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; 45 percent shale fragments; very strongly acid (pH 5.0); clear wavy boundary.

B21-3 to 7 inches; brown (7.5YR 5/3) very shaly clay loam, light brown (7.5YR 6/4) dry; weak fine subangular blocky structure; hard, firm, sticky and plastic; many fine roots; 55 percent shale fragments, very strongly acid (pH 5.0); clear wavy boundary.

B22-7 to 16 inches; brown (7.5YR 5/4) very shaly clay loam, light brown (7.5YR 6/4) dry; weak fine subangular blocky structure; hard, firm, sticky and plastic; many fine roots; 70. percent shale fragments; very strongly acid (pH 4.8); abrupt wavy boundary.

R1-16 to 35 inches; light gray extremely hard fractured shale; many large black coatings on surfaces; fragments range from 1 /2 inch to 4 inches in thickness and from 2 to 6inches in length; little or no fines in interstices.

R2-35 inches; consolidated shale.

Fractured shale is at a depth of 14 to 20 inches, and consolidated bedrock is at a depth of 24 to 40 inches. The control section above the fractured bedrock is 50 to 80 percent shale rock fragments.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 moist and 5 or 6 dry, and chroma of 3 or 4 moist and dry. It is 35 to 55 percent shale rock fragments.

The B horizon has hue of 10YR or 7.5YR, value of 6 or 7 dry, and chroma of 3 or 4 moist and dry. It is clay loam to silty clay loam and is 27 to 35 percent clay and 50 to 80 percent shale fragments.

## Lurnick series

The Lurnick series consists of moderately deep, well drained, steep soils on mountainous topography. These soils formed in fine textured residuum and colluvium weathered from shale or siltstone. Slopes are 3 to 75 percent. The mean annual precipitation is about 130 inches, and mean annual temperature is about 43 degrees F.

Typical pedon of Lurnick gravelly loam, 3 to 30 percent slopes, about 2 miles northwest of Blackrock, SW1/4NE1/4 sec. 16, T. 8 S., R. 7 W.:

A11-0 to 4 inches; very dark grayish brown (10YR 3/2) gravelly loam, grayish brown (10YR 5/2) dry; moderate fine and very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 35 percent 3- to 5-millimeter shot and siltstone fragments; strongly acid; (pH 5.2); clear smooth boundary.

A12-4 to 9 inches; very dark grayish brown (10YR 3/2) gravelly loam, grayish brown (10YR 5/2) dry; moderate fine and very fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 30 percent 2- to 5-millimeter shot and siltstone fragments; very strongly acid (pH 4.8); clear wavy boundary.

B1-9 to 15 inches; dark brown (10YR 4/3) gravelly heavy silty clay loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; many very fine pores; 30 percent fine siltstone fragments; very strongly acid (pH 4.8); clear wavy boundary.

B21-15 to 21 inches; dark yellowish brown (10YR 4/4) very gravelly silty clay, light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; hard, firm, very sticky and very plastic; common medium and fine roots; common very fine pores; 45 percent fine and medium sized siltstone fragments: very strongly acid

(pH 4.8); clear wavy boundary.

B22-21 to 30 inches; dark yellowish brown (10YR 4/4) very gravelly silty clay, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; hard, firm, very sticky and very plastic; few fine and medium roots; common fine pores; 60 percent fine and medium sized siltstone fragments; very strongly acid (pH 4.8); abrupt wavy boundary.

Cr-30 to 38 inches; yellowish brown (10YR 5/4) partly weathered siltstone; few thin tongues of soil material from the B2 horizon.

Siltstone is at a depth of 20 to 40 inches. Coarse fragments make up from 15 to 35 percent of the A horizon and 30 to 70 percent of the B horizon, increasing with depth.

The A horizon has hue of 10YR or 7.5YR and chroma of 2 or 3. Structure ranges from strong to moderate. The B horizon has hue of 10YR or 7.5YR and has chroma of 3 or 4. The B1 horizon is clay loam or silty clay loam, but it ranges to heavy loam in some places.

## Malabon series

The Malabon series consists of deep, well drained soils on broad, low stream terraces. These soils formed in silty and clayey mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Malabon silty clay loam, about 2 miles east of Dallas, SW1/4NE1/4 sec. 35, T. 7 S., R. 5 W.:

A11-0 to 7 inches; very dark grayish brown (10YR 3/2) light silty clay loam, grayish brown (10YR 5/2) dry; moderate very fine granular and moderate fine subangular blocky structure; hard, friable, slightly sticky and plastic; many roots; many fine interstitial pores; medium acid (pH 5.8); clear smooth boundary.

A12-7 to 15 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many roots; many fine and very fine tubular pores; slightly acid (pH 6.0); clear smooth boundary.

B1-15 to 25 inches; dark brown (10YR 3/3) light silty clay, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and very plastic; many roots; many very fine pores; common thin very dark grayish brown coatings on peds; slightly acid (pH 6.2); clear smooth boundary.

B21t-25 to 36 inches; dark yellowish brown (10YR 3/4) silty clay, yellowish brown (10YR 5/4) dry; moderate fine and medium subangular blocky structure; very hard, very firm, sticky and very plastic; few roots; many fine and very fine tubular pores; few thin clay films; few thin very dark grayish brown coatings on peds; slightly acid (pH 6.4); gradual smooth boundary.

B22t-36 to 44 inches; dark yellowish brown (10YR 3/4) silty clay, yellowish brown (10YR 5/4) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common roots; many fine and very fine tubular pores; common thin clay films; common thin dark brown and very dark brown coatings on peds; slightly acid (pH 6.4); clear smooth boundary.

B23t-44 to 60 inches; dark yellowish brown (10YR 4/4) silty clay, yellowish brown (10YR 5/4) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few roots; common thin clay films; common thin dark brown coatings on peds; neutral (pH 6.6).

The mollic epipedon is 20 to 30 inches thick.

The A and B horizons have hue of 10YR and 7.5YR. The A horizon has a value of 2 or 3 moist and 4 or 5 dry and chroma of 2 or 3 moist and dry.

The B horizon to a depth of 20 inches or more has a value of 3 moist and at a depth below 20 inches, a value of 3 or 4. Value is 4 or 5 dry. This horizon has chroma of 2 or 3 moist and 3 or 4 dry. It ranges from silty clay loam to silty clay and is more than 35 percent clay.

## Marty series

The Marty series consists of deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in residuum and colluvium weathered from igneous rock. Slopes are 3 to 60 percent. The mean annual precipitation is about 100 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Marty gravelly loam, 3 to 25 percent slopes, about 4 miles east of Valsetz, SW1/4SE1/4 sec. 32, T. 8 S., R. 7 W.:

A11-0 to 6 inches; dark reddish brown (5YR 3/2) gravelly loam, reddish brown (5YR 4/3) dry; strong very fine granular structure; soft, very friable, slightly sticky, and slightly plastic; many fine roots; many very fine pores; 20 percent very fine 2- to 4-millimeter pebbles; very strongly acid (pH 4.8); clear smooth boundary.

A12--6 to 13 inches; dark reddish brown (5YR 3/4) gravelly loam, reddish brown (5YR 4/4) dry; strong very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; 25 percent fine 2- to 20millimeter pebbles; very strongly acid (pH 4.8); clear smooth boundary.

B1-13 to 21 inches; reddish brown (5YR 4/3) gravelly loam, reddish brown (5YR 5/3) dry; moderate very fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; many fine pores; 25 percent fine 2- to 20-millimeter pebbles; very strongly acid (pH 4.8); clear smooth boundary.

B21-21 to 34 inches; reddish brown (5YR 4/4) gravelly heavy loam, reddish brown (5YR 5/4) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and medium roots; many fine pores; 25 percent fine 2- to 20-millimeter pebbles; very strongly acid (pH 4.8); clear wavy boundary.

B22-34 to 46 inches; reddish brown (5YR 4/4) gravelly clay loam, reddish brown (5YR 5/4) dry; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many very fine and fine pores; 25 percent fine 5- to 25-millimeter pebbles; very strongly acid (pH 4.6); abrupt wavy boundary.

IIC-46 to 60 inches; strong brown (7.5YR 4/6) clay loam, strong brown (7.5YR 5/6) dry; massive; hard, firm, sticky and plastic; 15 percent partly weathered rock fragments; very strongly acid (pH 4.6).

Coarse fragments are from a few to 25 percent of the upper part of the solum and from a few to 30 percent of the lower part.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist, and chroma of 3 or 4 moist. The B horizon has hue of 5YR, value of 4 and 5 dry and 3 or 4 moist, and chroma of 4 to 6 moist and dry. It ranges from heavy loam to clay loam and is 22 to 35 percent clay.

## McAlpin series

The McAlpin series consists of deep, moderately well drained soils on fans and flood plains. These soils formed in stratified silty alluvium of mixed mineralogy. Slopes are 0 to 6 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is 52 degrees F.

Typical pedon of McAlpin silty clay loam, 0 to 3 per cent slopes, about 1 mile south of Buell, SE1/4NE1 /4 sec. 32, T. 6 S., R. 6 W.:

Ap-0 to 9 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/3) dry; moderate fine and medium angular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine pores; strongly acid (pH 5.5); clear wavy boundary.

A3-9 to 18 inches; dark brown (7.5YR 3/2) heavy silty clay loam, brown (7.5YR 4/3) dry; medium and coarse subangular blocky structure; hard, firm, very sticky and very plastic; many very fine roots; common very fine pores; strongly acid (pH 5.5); clear wavy boundary.

B1-18 to 25 inches; dark brown (7.5YR 3/2) heavy silty clay loam, brown (7.5YR 4/3) dry; moderately fine and medium subangular blocky structure; hard, very firm, very sticky and very plastic; common very fine roots; many fine and very fine pores; medium acid (pH 5.6); clear wavy boundary.

B21-25 to 36 inches; brown (7.5YR 4/4) heavy silty clay loam, brown (7.5YR 5/4) dry; few fine yellowish red (5YR 5/6) and dark brown (7.5YR 3/2) mottles; moderate fine and medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; many very fine pores; medium acid (pH 5.6); clear wavy boundary.

B22-36 to 51 inches; dark brown (7.5YR 4/2) light silty clay; common medium distinct yellowish red (5YR 4/6) and gray (N 5/0) mottles; weak medium subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; many fine pores; medium acid (pH 5.8); clear wavy boundary.

B3-51 to 62 inches; mottled dark brown (7.5YR 4/2), gray (N 5/0), and yellowish red (5YR 4/6) silty clay; moderate fine subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; common weathered light brownish gray (10YR 6/2) sand grains; medium acid (pH 5.7).

The mollic epipedon is 20 to 25 inches thick. Distinct mottles are at a depth of 30 to 35 inches.

The A horizon has hue 7.5YR or 5YR and moist chroma and value of 2 or 3 . The B horizon has hue of 7.5YR or 5YR and moist and dry chroma of 3 or 4. These horizons are silty clay or silty clay loam and are more than 35 percent clay.

## McBee series

The McBee series consists of deep, moderately well drained soils on alluvial bottoms. These soils formed in alluvium weathered from mixed sedimentary and igneous rocks. Slopes are 0 to 3 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is 53 degrees F.

Typical pedon of McBee silty clay loam, about 2 miles northeast of Independence, NW1/4NW1/4 sec. 14, T. 8 S., R. 4 W.:

Ap1-0 to 4 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky and fine granular structure; hard, firm, sticky and plastic; many fine roots; many very fine tubular pores; slightly acid (pH 6.2); clear smooth boundary.

Ap2-4 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate coarce

subangular blocky structure parting to moderate fine and medium subangular blocky; hard, firm, sticky and plastic; many fine roots; common very fine pores; slightly acid (pH 6.2); clear smooth boundary.

IIB1-12 to 21 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many tubular pores; slightly acid (pH 6.2); clear smooth boundary.

IIB21-21 to 27 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; few fine yellowish brown (10YR5/6) mottles; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; slightly acid (pH 6.4); clear smooth boundary.

IIB22-27 to 35 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; common fine and medium yellowish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common very fine and fine tubular pores; neutral (pH 6.6); clear smooth boundary.

IIB3-5 to 57 inches; brow n (10YR 4/3) silt loam, brown (10YR 5/3) dry; many medium yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; common fine pores; slightly acid (pH 6.4); clear wavy boundary.

IIC-57 to 64 inches; dark grayish brown (10YR4/2) very fine sandy loam, brown (10YR 5/3) dry; many medium yellowish brown (10YR 5/6) and reddish brown (5YR 4/4) mottles; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine pores; slightly acid (pH 6.2).

The mollic epipedon is 20 to 40 inches thick. Layers or lenses of gravel or sand are in the lower part of the B horizon and C horizon in some places.

The A horizon has hue of 10YR or 7.5 YR, value of 2 or 3 moist, and chroma of 2 or 3 moist and dry.

The B horizon has hue of 10YR or 7.5YR, value of 2 to 4 moist and 4 to 6 dry, an chrome of 2 to 4 moist or dry. Distinct mottles are at a depth of 20 to 36 inches.

## McDuff series

The McDuff series consist of moderately deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in residuum and colluvium weathered from sedimentary rock. Slopes are 3 to 75 percent. The mean annual precipitation is about 80 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of McDuff silty clay loam, 25 to 50 percent slopes, about 5 miles west of Grande Ronde, SW1 /4SE1 /4 sec. 6, T. 6 S., R. 8 W.:

O1-1 inch to 0; duff, litter, salal, fern leaves, and twigs.

A11-0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong fine granular structure; hard, firm, sticky and plastic; many fine and medium roots; many fine pores; strongly acid (pH 5.2); clear smooth boundary.

A12--6 to 11 inches; very dark grayish brown (10YR 3/2) heavy silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky and granular structure; hard, firm, very sticky and plastic; many fine and medium roots; many fine pores; strongly acid (pH 5.2); clear smooth boundary.

B1-11 to 19 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; moderate medium and fine subangular blocky structure; very hard, very firm, very sticky and very plastic; many fine and medium roots; few fine pores; very strongly acid (pH 4.7); clear wavy boundary.

B21t-19 to 26 inches; dark brown (10YR 3/3) silty clay, brown (10YR 4/3) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine and medium roots; common very fine pores; few moderately thick clay films; very strongly acid (pH 4.7); clear wavy boundary.

B22t-26 to 32 inches; dark yellowish brown (10YR 4/4) silty clay, strong brown (7.5YR 5/6) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine and medium roots; few very fine pores; common moderately thick clay films; few fine weathered siltstone fragments; very strongly acid (pH 4.6); clear wavy boundary.

B3t-32 to 38 inches; variegated strong brown (7.5YR 5/6) and pale brown (10YR 6/3) silty clay; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; very few very fine pores; common moderately thick clay films; 30 percent fine and very fine weathered siltstone fragments; very strongly acid (pH 4.6); clear wavy boundary.

Cr-38 to 45 inches; partly weathered pale brown (10YR 6/3) siltstone; reddish brown (5YR 4/3) coatings on siltstone fragments.

Siltstone is at a depth of 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3 moist arid 4 or 5 dry, and chrome of 2 or 3 moist and dry. Structure ranges from moderate to strong.

The B horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 to 6. It is silty clay or clay and is 45 to 60 percent clay.

## Mulkey series

The Mulkey series consists of moderately deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in residuum and colluvium weathered from basic igneous rock. Slopes are 5 to 25 percent. The mean annual precipitation is about 100 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of Mulkey loam, 5 to 25 percent slopes, on Monmouth Peak, NE1/4NE1/4 sec. 16, T. 9 S., R. 7 W.:

A11-0 to 11 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; strong very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 5 percent fine pebbles and concretions; very strongly acid (pH 5.0); gradual wavy boundary.

A12-11 to 23 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 15 percent fine pebbles and concretions; very strongly acid (pH 4.8); clear smooth boundary.

B2-23 to 30 inches; dark brown (10YR 3/3) gravelly loam, brown (10YR 5/3) dry; moderate very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine pores; 25 percent fine and medium pebbles; very strongly acid (pH 4.8); abrupt wavy boundary.

IIC-30 to 35 inches; dark yellowish brown (10YR 4/4) very gravelly loam, light yellowish brown (10YR 6/4) dry; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine pores; 55 percent pebbles; very strongly acid (pH 4.8); clear wavy boundary.

IIR-35 to 40 inches; fractured gabbro.

Bedrock is at a depth of 20 to 40 inches. Coarse fragments make up from 0 to 15 percent of the A horizon and as much as 35 percent of the B2 horizon.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 moist, and chroma of 2 or 3 moist and dry.

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

## Nekia series

The Nekia series consists of moderately deep, well drained soils on foothills and higher, rolling uplands. These soils formed in colluvium and residuum weathered from basic rock. Slopes are 2 to 50 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Nekia silty clay loam, 12 to 20 percent slopes, along Eagle Crest road about 3/4 mile northwest of Popcorn School, NW1/4SW1/4 sec. 12, T. 7 S., R. 4 W.:

A1-0 to 5 inches; dark reddish brown (5YR 3/3) silty clay loam, dark brown (7.5YR 4/4) dry; moderate fine granular and very fine subangular blocky structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many very fine interstitial and tubular pores; very strongly acid (pH 5.8); clear smooth boundary.

A3-5 to 9 inches; dark reddish brown (5YR 3/3) heavy silty clay loam, dark reddish brown (5YR 3/4) dry; moderate fine and very fine subangular blocky structure; slightly hard, friable, sticky and plastic; many fine and very fine roots; many very fine tubular pores; few fine concretions; very strongly acid (pH 5.8); clear smooth boundary.

B1-9 to 14 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 4/4) dry; moderate coarse and medium subangular blocky structure parting to fine subangular blocky; hard, firm, sticky and very plastic; many fine and very fine tubular pores; few fine concretions; very strongly acid (pH 5.6); clear smooth boundary.

B21-14 to 19 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate coarse and medium subangular blocky structure; very hard, firm, very sticky and very plastic; common medium and fine roots; many fine and very fine pores; many fine and very fine concretions; very strongly acid (pH 5.4); clear smooth boundary.

B22t-19 to 25 inches; dark reddish brown (5YR 3/4) clay, reddish brown (5YR 4/4) dry; moderate medium and fine subangular blocky structure; very hard, firm, very sticky and very plastic; common medium and fine roots; many fine pores; few thin clay films; 5 percent weathered basalt pebbles; very strongly acid (pH 5.4); abrupt wavy boundary.

R-25 to 28 inches; partly weathered fractured basalt on surface; tongues of soil material from B2 horizon in fractures; common thin red (5YR 4/6) clay films on rock fragments; many thick black coatings on rock fragments.

The depth to bedrock and thickness of the solum ranges from 20 to 40 inches. Hard basalt rock fragments make up from 0 to 15 percent of the upper part of the profile and as much as 50 percent of the lower part of the B horizon.

The A horizon has hue of 7.5YR and 5YR, value of 2 or 3 moist, and chroma of 2 or 3 moist and 2 to 4 dry.

The B horizon has hue of 5YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 3 or 4 moist and 4 to 6 dry. It is silty clay or clay and is 40 to 50 percent clay.

## Newberg series

The Newberg series consists of deep, somewhat excessively drained soils on alluvial bottoms. These soils formed in recent alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Newberg fine sandy loam, about 2 1/2 miles northeast of Independence, NE1/4SW1/4 sec. 14, T. 8 S., R. 4 W.:

Ap-0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; common fine pores; slightly acid (pH 6.2); clear smooth boundary.

A12-6 to 15 inches; dark brown (10YR 3/3) fine sandy loam and intermittent thin bands of silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common roots; common fine pores; slightly acid (pH 6.2); clear smooth boundary.

AC-15 to 26 inches; dark yellowish brown (10YR 3/4) fine sandy loam and intermittent bands of fine sand, brown (10YR 5/3) dry; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common roots; many very fine and fine pores; medium acid (pH 6.0); clear smooth boundary.

C1-26 to 37 inches; dark yellowish brown (10YR 3/4) loamy fine sand, dark brown (10YR 4/3) dry; single grained; loose; common roots; many fine interstitial pores; medium acid (pH 6.0); abrupt wavy boundary.

IIC2-37 to 60 inches; variegated dark yellowish brown (10YR 3/4) and dark grayish brown (10YR 4/2) fine sand, brown (10YR 4/3) and grayish brown (10YR 5/2) dry; single grained; loose; common roots; many interstitial pores; medium acid (pH 5.8).

The mollic epipedon is 7 to 20 inches thick. Loamy fine sand that is less than 50 percent fine or coarser sand is at a depth of 25 to 40 inches.

The upper 10 inches of the soil has hue of 10YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3. It is fine sandy loam or loam. Below the A1 or Ap horizons, the soil has hue of 10YR or 7.5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of mainly 3 or 4. At a depth below 2 or 3 feet, chroma ranges from 2 to 4.

## Peavine series

The Peavine series consists of moderately deep, well drained, gently rolling to very steep soils on hills, at an elevation of 700 to 1,400 feet. These soils formed in fine textured colluvium and residuum weathered from siltstone and shale. Slopes are 3 to 75 percent. The mean annual precipitation is about 70 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Peavine silty clay loam, 3 to 30 percent, about 2-1 /2 miles south of Valley Junction, SE1/4NE1/4 sec. 28, T. 6 S., R. 7 W.:

A1-0 to 5 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 5/3) dry; moderate fine subangular blocky and moderate fine granular structure; hard, friable, sticky and plastic; many fine roots; many fine pores; 10 percent fine siltstone fragments; medium acid (pH 5.6); clear smooth boundary.

A3-5 to 10 inches; dark reddish brown (5YR 3/4) silty clay loam, reddish brown (5YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky, and plastic; many fine and moderate roots; many fine tubular pores; 10 percent fine siltstone fragments; medium acid (pH 5.5); clear smooth boundary.

B1-10 to 18 inches; reddish brown (5YR 4/4) heavy silty clay loam, yellowish red (5YR 5/6) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common medium and fine roots; many very fine pores; few fine siltstone fragments; very strongly acid (pH 4.8); clear smooth boundary.

B2t-18 to 30 inches; yellowish red (5YR 4/6) clay, reddish yellow (5YR 6/6) dry; moderate medium subangular blocky structure parting to fine subangular blocky; hard, very firm, very sticky and very plastic; few fine roots; few thin clay films; very strongly acid (pH 4.6); abrupt wavy boundary.

Cr-30 inches; yellow (10YR 7/6) partly weathered siltstone; red (2.5YR 4/6) moderately thick clay coatings.

The solum ranges from 20 to 40 inches in thickness and is over firm, fractured, partly consolidated siltstone and shale that commonly is consolidated at a depth below 60 inches.

The A horizon has hue of 10YR to 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 to 4 moist and dry. The structure is moderate or strong subangular blocky or granular.

The B2t horizon has hue of 5YR or 2.5YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 4 to 8 moist and dry. It is silty clay or clay. The structure is moderate fine, medium, and in some places coarse subangular blocky. Clay films range from few thin to moderately thick and are continuous on surfaces of

peds. A few weathered fine siltstone and shale fragments are scattered throughout the solum in some places.

The C horizon is partly weathered fractured shale or siltstone, and the fractures are filled with clayey material.

## Philomath series

The Philomath series consists of shallow, well drained soils on foothills. These soils formed in colluvium and residuum weathered from basic igneous rock. Slopes are 3 to 50 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 52 degrees F.

Typical pedon of Philomath silty clay, 3 to 12 percent slopes, about 2 miles south of Willamina, NW1/4NW1/4 sec. 13, T. 6 S., R. 7 W.:

A11-0 to 4 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; strong very fine granular and strong very fine subangular blocky structure; hard, friable, very sticky and very plastic; many very fine roots; many very fine pores; 5 percent coarse fragments; slightly acid (pH 6.2); clear wavy boundary.

A12-4 to 7 inches; very dark brown (10YR 2/2) clay, very dark grayish brown (10YR 3/2) dry; moderate fine and very fine subangular blocky structure; very hard, friable, very sticky and very plastic; many very fine roots; common very fine pores; 5 percent coarse fragments; slightly acid (pH 6.2); clear wavy boundary.

A13-7 to 14 inches; very dark brown (10YR 2/2) clay, very dark grayish brown (10YR 3/2) dry; moderate medium and fine subangular blocky structure; very hard, friable, very sticky and very plastic; few very fine roots; common fine and fine pores; neutral (pH 6.7); abrupt wavy boundary.

Cr-14 inches; partly weathered basalt; very dark brown organic stains in cracks and fractures.

The soil ranges from 12 to 20 inches in thickness. It is over partly weathered basalt. Coarse fragments make up from 5 percent to 25 percent of the profile.

The A horizon has chroma of 1 or 2 moist or dry. It is silty clay or clay. The structure in the lower part of the A horizon ranges from fine moderate subangular blocky to fine moderate prismatic.

## Pilchuck series

The Pilchuck series consists of deep, excessively drained and somewhat excessively drained soils on alluvial bottoms subject to overflow. These soils formed in mixed recent alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F.

The Pilchuck soils in this county have a chroma of 3 in the C horizon. This characteristic is outside the range of the Pilchuck series. Therefore, these soils are considered as a taxadjunct to the series.

Typical pedon of Pilchuck fine sandy loam, about 5 miles southwest of Monmouth and 200 feet west of the Willamette River, SE1/4SE1/4 sec. 6, T. 9 S., R. 3 W.:

A1-0 to 7 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; loose; few fine roots; few fine pores; slightly acid (pH 6.4); clear wavy boundary.

IIC1-7 to 45 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; massive; loose; few fine roots; few fine pores; pockets and lenses of fine sand; slightly acid (pH 6.4); abrupt wavy boundary.

IIC2-45 to 62 inches; very dark grayish brown (10YR 3/2) fine sand, grayish brown (10YR 5/2) dry; single grained; loose; few fine pores; neutral (pH 6.6).

Coarse fragments make up from 0 to 15 percent of the profile.

The A horizon has value of 3 or 4 moist and chroma of 2 or 3 moist.

The C horizon has value of 3 or 4 moist and chroma of 2 or 3 moist: It is loamy fine sand or sand.

## Rickreall series

The Rickreall series consists of shallow, well drained soils on foothills. These soils formed in colluvium and residuum weathered from sedimentary bedrock. Slopes are 3 to 75 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Rickreall silty clay loam, 3 to 12 percent slopes, about 4-1/2 miles northeast of Dallas, NE1/4N1/4 sec. 11, T. 7 S., R. 5 W.:

Ap-0 to 5 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (7.5YR 5/4) dry; weak medium and coarse subangular blocky structure; slightly hard, firm, sticky and slightly plastic; many fine and very fine roots; many very fine interstitial pores; strongly acid (pH 5.4); clear smooth boundary.

B21t-5 to 8 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 4/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine tubular pores; few thin clay films; strongly acid (pH 5.2); clear smooth boundary. B22t-8 to 12 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; many very fine and fine tubular pores;

common moderately thick clay films pores; strongly acid (pH 5.2); clear smooth boundary.

B23t-12 to 17 inches; yellowish red yellowish red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; many very fine tubular pores; common moderately thick clay films; 15 percent, by volume, yellowish brown weathered pebbles; very strongly acid (pH 5.0); abrupt wavy boundary.

Cr-17 to 19 inches; partly weathered siltstone; a few tongues of soil material from the B23t extend into fractures; many thick yellowish red (5YR 4/6) clay films on fragments.

The thickness of the solum and depth to the paralithic contact ranges from 12 to 20 inches.

The A horizon has hue of 7.5YR and 5 YR, value of 2 to 4 moist and 3 to 5 dry, and chroma of 2 to 4 moist and 3 or 4 dry.

The Bt horizon has hue of 7.5YR and 5YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 4 to 6 moist and dry. It ranges from silty clay to clay and is 40 to 50 percent clay.

## Ritner series

The Ritner series consists of moderately deep, well drained soils on hilly and step foothillsof mountainous areas. These soils formed in cobbly colluvium weathered from basic igneous rock. Slopes are 3 to 60 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Ritner gravelly silty clay loam, 12 to 30 percent slopes, about 2. 3 miles southwest of West Salem, SW1/4NE1/4 sec. 30, T. 7 S., R. 4 W.:

A1-0 to 6 inches; dark reddish brown (5YR 3/3) gravelly silty clay loam, reddish brown (5YR 4/3) dry; strong fine and very fine subangular blocky structure; hard, friable, sticky and plastic; many medium and fine roots; many very fine tubular pores; 20 percent medium to large pebbles; medium acid (pH 5.8); clear smooth boundary.

B1-6 to 14 inches; dark reddish brown (5YR 3/4) gravelly silty clay loam, reddish brown (5YR 4/3) dry; strong fine and very fine subangular blocky structure; hard, friable, sticky and plastic; common medium roots; many very fine tubular pores; 20 percent pebbles; and 10 percent cobbles; medium acid (pH 5.8); clear smooth boundary.

B21-14 to 26 inches; dark reddish brown (5YR 3/4) gravelly silty clay, reddish brown (5YR 4/4) dry; moderate fine and very fine subangular blocky structure; hard, firm, very sticky and plastic; few medium and fine roots; common very fine tubular pores; 25 percent

B22-26 to 38 inches; dark reddish brown (5YR 3/4) very cobbly silty clay, reddish brown (5YR 4/4) dry; moderate fine and very fine subangular blocky structure; hard, firm, very sticky and very plastic; few medium and fine roots; few very fine tubular pores; 40 percent cobbles and 20 percent stones; dark reddish brown (5YR 3/3) coatings on pees; strongly acid (pH 5.2); abrupt wavy boundary.

R-38 inches; fractured basalt; few thin tongues of soil material from the B22 horizon in fractures; about 20 to 30 percent of the bedrock fragments have partly weathered surfaces.

The underlying fractured bedrock is at a depth of 20 to 40 inches. Coarse fragments make up from 10 to 30 percent of the A and B1 horizons and 35 to 75 percent of the B2 horizon. The amount increases with depth. Coarse fragments range from pebbles to stones in size. An ochric epipedon that has a moist chroma of 4 is at a depth of less than 10 inches.

The A horizon has hue of 10YR, 7.5YR, or 5YR; value of 2 or 3 moist; and chroma of 2 to 4 moist and 3 or 4 dry. Structure is strong very fine subangular blocky or strong fine granular.

The B2 horizon has hue of 5YR or 2.5YR, value of 3 or 4 moist, and chroma of 4 to 6 moist and dry. It is clay, silty clay, or heavy silty clay loam and is 35 to 50 percent clay. Structure is weak or moderate fine to medium subangular blocky.

## Salkum series

The Salkum series consists of deep, well drained soils on high gravelly terraces. These soils formed in fine textured alluvium. Slopes are 2 to 12 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 52 degrees F.

Typical pedon of Salkum silty clay loam, 6 to 12 percent slopes, about 2 miles south of the Pleasant Hill Cemetery, SW1/4SE1/4 sec. 14, T. 7 S., R. 6 W.:

A11-0 to 7 inches; dark reddish brown (5YR 3/3) silty clay loam, reddish brown (5YR 5/4) dry; moderate fine granular structure; hard, friable, slightly sticky and plastic; many very fine roots; many very fine pores; medium acid (pH 5.9); clear smooth boundary.

A12-7 to 12 inches; reddish brown (5YR 3/3) heavy silty clay loam, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many fine and very fine pores; medium acid (pH 5.8); clear smooth boundary.

B1-12 to 17 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 5/4) dry; moderate fine and medium

subangular blocky structure; hard, friable, very sticky and very plastic; many roots; many fine and very fine pores; medium acid (pH 5.7); clear wavy boundary.

B21t-17 to 26 inches; dark reddish brown (5YR 3/4) silty clay, reddish brown (5YR 5/4) dry; moderate fine and medium subangular blocky structure; very hard, friable, very sticky and very plastic; common roots; common fine and very fine pores; few thin clay films on faces of peds and in pores; medium acid (pH 5.6); clear smooth boundary.

B22t-26 to 37 inches; reddish brown (5YR 4/4) clay, light reddish brown (5YR 6/4) dry; moderate fine and medium subangular blocky structure; very hard, very friable, very sticky and very plastic; few very fine roots; common fine and very fine pores; few fine and medium yellowish red (5YR 5/8) variegations; common moderately thick clay films on faces of peds and in pores; strongly acid (pH 5.3); clear wavy boundary.

C-37 to 49 inches; variegated strong brown (7.5YR 5/8) dark brown (7.5YR 4/2) red (2.5YR 4/6), pinkish gray (7.5YR 6/2) silty clay; massive; hard, friable, very sticky and very plastic; many very fine pores; few moderately thick red (2.5YR 5/6) clay films in pores; common medium and fine black stains; very strongly acid (pH 5.0); clear wavy boundary.

IIC-49 to 60 inches; yellowish red (5YR 4/6), weathered and partly weathered gravel yellowish red (5YR 5/8) dry; massive; very firm; common medium black stains; common medium accumulations of yellowish red (5YR 4/6) alluvial clay.

Weathered gravel is at a depth of 40 to 60 inches.

The A horizon has hue of 7.5YR or 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 and 3 moist or dry.

The B2t horizon has value of 3 to 5 moist and 5 or 6 dry. The weathered gravel in the C horizon can be cut with a knife. On terraces at lower elevations, the B horizon is 10 to 30 percent hard, partly weathered gravel. The underlying gravel in the substratum is partly weathered and hard.

## Santiam series

The Santiam series consists of deep, moderately well drained soils on terraces above the main Willamette Valley floor. These soils formed in silty alluvium over older clayey alluvium. Slopes are 0 to 20 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F. Typical pedon of Santiam silt loam, 6 to 15 percent slopes, about 1 mile southeast of Monmouth, on County Road No. 848, NE1 /4SW1 /4 sec. 31, T. 8 S., R. 4 W.:

A11-0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky and moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine interstitial pores; medium acid (pH 5.6); clear smooth boundary.

A12-4 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine and fine interstitial pores; medium acid (pH 5.6); clear smooth boundary.

A13-8 to 17 inches; dark brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) dry; moderate medium and coarse subangular blocky structure parting to fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common very fine tubular pores; few light gray silt coatings on peds; medium acid (pH 5.6); clear smooth boundary.

B1-17 to 24 inches; dark brown (10YR 3/3) silty clay loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common very fine tubular pores; few light gray silt coatings on peds; strongly acid (pH 5.4); clear smooth boundary.

B21t-24 to 29 inches; dark brown (10YR 4/3) heavy silty clay loam, pale brown (10YR 6/3) dry; few fine dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common very fine tubular pores; common thin clay films; common light gray coatings on peds; strongly acid (pH 5.2); clear smooth boundary.

B22t-29 to 34 inches; dark brown (10YR 4/3) heavy silty clay loam, light gray (10YR 7/2) dry; many fine and medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common very fine tubular pores; many light gray coatings on peds; many moderately thick clay films; few very fine shot; strongly acid (pH 5.2); abrupt smooth boundary.

IIC1-34 to 40 inches; grayish brown (10YR 5/2) clay, very pale brown (10YR 7/3) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; very hard, very firm, very sticky and very plastic; few very fine pores; few slickensides; few very fine shot; strongly acid (pH 5.2); clear smooth boundary.

IIC2-40 to 60 inches; dark brown (10YR 4/3) clay, light yellowish brown (10YR 6/4) dry; massive; very hard, very firm, very sticky and very plastic; few slickensides; few fine shot; strongly acid (pH 5.2).

Mottles that have chroma of 2 or less are at a depth of less than 30 inches.

The A horizon has hue of 10YR, value of 3 or 4 moist, and chroma of 2 or 3 moist and dry.

The B2t horizon has hue of 10YR, value of 3 or 4 moist, and chroma of 2 to 4 moist and dry. It is silty clay loam, silty clay, or clay, and the weighted average of clay is 35 to 42 percent. Structure ranges from weak to moderate prismatic to moderate subangular blocky. Peds are commonly coated with clean silt and very fine sand.

## Slickrock series

The Slickrock series consists of deep, well drained soils on mountainous uplands. These soils formed in colluvium or residuum weathered from sedimentary rock. Slopes are 3 to 50 percent. The mean annual precipitation is about 100 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Slickrock gravelly loam, 3 to 25 percent slopes, about 5 miles southeast of Valsetz, SE1/4SE1/4 sec. 32, T. 9 S., R. 7 W.:

O1-1 inch to 0; litter of needles, leaves, and twigs; abrupt smooth boundary.

A11-0 to 7 inches; very dark grayish brown (10YR 3/2) gravelly loam, brown (10YR 5/3) dry; strong very fine and fine subangular blocky structure; friable, slightly sticky and slightly plastic; many fine and medium roots; many fine and very fine pores; 25 percent fine pebbles and/or concretions; very strongly acid (pH 4.8); clear smooth boundary.

A12-7 to 15 inches; very dark grayish brown (10YR 3/2) gravelly loam, brown (10YR 5/3) dry; moderate fine granular and moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; many fine and medium roots; common very fine pores; 25 percent fine pebbles and/or concretions; very strongly acid (pH 4.8); clear smooth boundary.

B21-15 to 27 inches; dark brown (10YR 3/3) gravelly loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common very fine pores; 20 percent fine pebbles; very strongly acid (pH 4.7); clear smooth boundary.

B22-27 to 37 inches; brown (10YR 4/3) gravelly heavy loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; common very fine pores; 15 percent pebbles; very strongly acid (pH 4.6); clear smooth boundary.

B23-37 to 49 inches; dark yellowish brown (10YR 4/6) gravelly clay loam, yellowish brown (10YR 5/6) dry; moderate medium subangular blocky structure; hard, firm, slightly sticky, and slightly plastic; few roots; common very fine pores; 15 percent fine sandstone pebbles; very strongly acid (pH 4.7); clear smooth boundary.

B3-49 to 65 inches; dark yellowish brown (10YR 4/6) gravelly clay loam, yellowish brown (10YR 5/6) dry; hard, firm, sticky and plastic; few roots; common very fine pores; 30 percent fine sandstone pebbles; very strongly acid (pH 4.6).

The A horizon has a chroma of 2 or 3 moist and a value of 4 or 5 dry. It ranges from gravelly loam to gravelly silty clay loam. It is 15 to 35 percent coarse fragments.

The B horizon ranges from 10YR to 7.5YR in hue. It is gravelly loam, gravelly clay loam, or gravelly silty clay loam. It is 10 to 35 percent coarse fragments.

## Steiwer series

The Steiwer series consists of moderately deep, well drained soils on low foothills. These soils formed in material weathered from sedimentary bedrock. Slopes are 3 to 50 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Steiwer silt loam, 3 to 12 percent slopes, in the Baskett Slough wildlife refuge on county road No. 752, NW1/4NE1/4 sec. 11, T. 7 S., R. 5 W.:

A11-0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular and subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine interstitial pores; medium acid (pH 5.6); clear smooth boundary.

A12-7 to 15 inches; very dark grayish brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; strongly acid (pH 5.4); gradual smooth boundary.

B21-15 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine and very fine pores; strongly acid (pH 5.4); clear smooth boundary.

B22-19 to 26 inches; dark brown (10YR 4/3) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common very fine tubular pores; few thin coatings on peds; few siltstone fragments; strongly acid (pH 5.2); abrupt wavy boundary.

Cr-26 to 30 inches; very pale brown (10YR 7/3) partly weathered siltstone; reddish brown coatings on surfaces of siltstone.

Thickness of the solum and depth to partly consolidated bedrock ranges from 20 to 40 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chrome of 2 or 3 moist and dry. It is silt loam or silty clay loam.

The B horizon has value of 3 or 4 moist and 5 or 6 dry and chrome of 2 to 4 moist and dry. It is silty clay loam and is 27 to 35 percent clay.

## Suver series

The Suver series consists of deep, somewhat poorly drained, gently sloping to steep soils on uplands. These soils formed in fine textured colluvium and residuum weathered from sedimentary bedrock. Slopes are 3 to 30 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Suver silty clay loam, 3 to 12 percent slopes, 1 /2 mile south of Dallas on county road No. 8519, NE1/4SE1/4 sec. 5, T. 8 S., R. 5 W.:

Ap-0 to 6 inches; dark brown (7.5YR 3/2) silty clay loam, brown (7.5YR 5/2) dry; moderate very fine and fine granular and subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial pores; medium acid (pH 5.6);clear smooth boundary.

A12-6 to 11 inches; dark brown (7 .5YR 3/2) silty clay loam, brown (7.5YR 5/2) dry; moderate medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; common very fine tubular pores; medium acid (pH 5.6); clear smooth boundary.

B21t-11 to 15 inches; brown (7.5YR 4/4) heavy silty clay, light brown (7.5YR 5/4) dry; few fine distinct red (2.5YR 4/6) and gray (5YR 5/1) mottles; moderate very fine and fine subangular blocky structure; hard, firm, very sticky, and very plastic; many fine roots; common very fine tubular pores; few thin clay films; strongly acid (pH 5.4); clear smooth boundary.

B22t-15 to 20 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 5/3) dry; many medium distinct dark red (2.5YR 3/6) and reddish gray (5YR 5/2) mottles; moderate very fine and fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine tubular pores; many moderately thick clay films; strongly acid (pH 5.4); clear smooth boundary.

B3t-20 to 28 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; many medium and large distinct red (2.5YR 4/6 and 4/8) mottles; moderate medium and coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine tubular pores; many intersecting slickensides; strongly acid (pH 5.2); abrupt wavy boundary.

C1-28 to 34 inches; light olive gray (5YR 6/2) clay, light gray (10YR 7/2) dry; many fine and medium prominent red (2.5YR 4/6 and 4/8) mottles; massive; very hard, very firm, very sticky and very plastic; few nonintersecting slickensides; 15 percent strong brown (7.5YR 5/6) weathered 2- to 5-millimeter siltstone fragments; strongly acid (pH 5.2); clear smooth boundary.

C2-34 to 42 inches; pale brown (10YR 6/3) clay, light gray (10YR 7/2) dry; few fine prominent red (2.5YR 4/6) mottles; massive; very hard, very firm, very sticky, and very plastic; 40 percent strong brown (7.5YR 5/6) weathered 2- to 20-millimeter siltstone fragments; very

Cr-42 inches; partly weathered sedimentary bedrock.

Depth to bedrock and paralithic contact is 40 to 60 inches.

The A horizon has hue of 10YR to 5YR, value of 2 or 3 moist and 4 or 5 dry, and chrome of 2 or 3 moist and 2 to 4 dry. It is silt loam or silty clay loam.

The B2t horizon has hue of 7.5YR to 2.5YR, value of 4 or 5 moist and 5 to 7 dry, and chrome of 3 or 4 moist and dry. The gray and red mottles range from few fine to many large and are distinct or prominent. This horizon is silty clay or clay. Structure is moderate or strong subangular blocky or prismatic. Mottles that have chrome of 2 or less are in the upper 10 inches of the Bt horizon.

The C horizon ranges from 60 to 70 percent clay. Weathered sedimentary rock fragments that are easily crushed range from few to 20 percent in the upper part of the C horizon and from 20 to 40 percent in the lower part.

## Trask series

The Trask series consists of moderately deep, well drained soils on steep and mountainous uplands. These soils formed in shaly residuum and colluvium weathered from sedimentary rock. Slopes are 3 to 90 percent. The mean annual precipitation is about 105 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Trask shaly loam, 3 to 30 percent slopes, about 1-1/4 miles south of Blackrock, NW1/4NE1/4 sec. 26, T. 8 S., R. 7 W.:

A11-0 to 7 inches; very dark grayish brown (10YR 3/2) shaly loam, brown (10YR 5/3) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; many interstitial pores; 20 percent fine shale fragments and concretions; very strongly acid

(pH 5.0); clear smooth boundary.

A12-7 to 12 inches; very dark brown (10YR 3/4) very shaly loam, brown (10YR 5/3) dry; very fine and fine granular and moderate very fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 45 percent fine shale fragments; very strongly acid (pH 4.8); clear smooth boundary.

B21-12 to 20 inches; dark yellowish brown (10YR 4/4) very shaly heavy loam, pale brown (10YR 7/3) dry; moderate very fine subangular blocky and moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine and very fine pores; 55 percent fine shale fragments; very strongly acid (pH 4.6); clear smooth boundary.

C1-20 to 31 inches; yellowish brown (10YR 5/4) very shaly heavy loam, light yellowish brown (10YR 7/3) dry; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common roots; many fine pores; 65 percent shale fragments (mostly 2 inches by 4 inches and 3 inches by 4 inches); very strongly acid (pH 4.6); abrupt wavy boundary.

C2r-31 to 40 inches; very pale brown (10YR 7/3) partly weathered shale; yellowish brown (10YR 5/6) coatings; fractures are less than 4 inches apart on horizontal plane.

Bedrock is at a depth of 20 to 40 inches. The umbric epipedon is less than 10 inches thick. The soil generally is moist, but it is dry between depths of 4 and 12 inches for less than 45 consecutive days.

The A horizon has hue of 10YR or 7.5YR and value of 2 or 3 moist and dry. The structure is moderate or strong granular or subangular blocky. This horizon is 35 to 75 percent shale rock fragments.

The B2 horizon has hue of 7.5YR and 10YR, value of 3 to 5 moist and 5 to 7 dry, and chroma of 3 to 6. It is silt loam, loam, or silty clay loam and is 20 to 30 percent clay. It is 50 to 75 percent rock fragments.

The C1 horizon is 65 to 85 percent shale and siltstone rock fragments intermingled with shale material that is similar to that of the B2 horizon. The underlying shale or siltstone is partly consolidated and fractured to a depth of 40 inches or more.

## Valsetz series

The Valsetz series consists of moderately deep, well drained soils on mountainous uplands in the Coast Range. These soils formed in gravelly and cobbly residuum and colluvium weathered from igneous rocks. Slopes are 3 to 90 percent. The mean annual precipitation is about 120 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of Valsetz stony loam, 50 to 75 percent slopes, about 2 miles southwest of Laurel Mountain, SW1/4SW1/4 sec. 6, T. 8 S., R. 7 W.:

O1-1 inch to 0; duff and litter.

A1-0 to 4 inches; dark reddish brown (5YR 3/4) stony loam, reddish brown (5YR 5/4) dry; moderate fine and very fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many medium roots; many very fine pores; 30 percent rock fragments (15 percent pebbles, 10 percent cobbles, and 5 percent stones); very strongly acid (pH 5.0); clear wavy boundary.

B21-4 to 14 inches; reddish brown (5YR 4/4) very gravelly loam, reddish brown (5YR 5/4) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many medium roots; common very fine pores; 55 percent rock fragments (35 percent pebbles, 10 percent cobbles, and 10 percent stones); very strongly acid (pH 4.8); clear wavy boundary.

B22-14 to 24 inches; strong brown (7.5YR 5/6) very gravelly heavy loam, reddish yellow (5YR 6/6) dry; hard, friable, sticky and plastic; weak fine subangular blocky structure; common medium roots; many fine pores; 70 percent rock fragments (40 percent pebbles, 20 percent cobbles, 10 percent stones); very strongly acid (pH 4.8); abrupt wavy boundary.

R-24 inches; fractured gabbro; a few thin intrusions of fines in the interstices.

Depth to bedrock and lithic contact ranges from 20 to 40 inches. These soils are from 30 to 80 percent rock fragments; from 15 to 30 percent cobbles and stones; and from 15 to 60 percent pebbles. The amount of stones on the surface layer ranges from 1 to 10 percent. The A horizon has hue of 7.5YR or 5YR, value of 3 moist and 5 or 6 dry, and chroma of 3 or 4 moist and 4 dry.

The B horizon has hue of 7.5YR or 5YR, value of 4 or 5 moist and 5 or 6 dry, and chroma of 4 to 6 moist and dry. It is loam to clay loam and is 20 to 30 percent clay.

Bedrock is gabbro, andesite, and diorite.

## Waldo series

The Waldo series consists of deep, poorly drained soils on narrow flood plains and low terraces. These soils formed in silty and clayey alluvium from mixed, but dominantly basic igneous material. Slopes are 0 to 3 percent. The mean annual precipitation is about 50 53 degrees F.

Typical pedon of Waldo silty clay loam, about 1 mile east of Airlie, NW1/4NW1/4 sec. 33, T. 9 S., R. 5 W.:

Ap-0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; many fine prominent strong brown (7.5YR 5/8) mottles; hard, firm, slightly sticky and slightly plastic; many very fine interstitial pores; slightly acid (pH 5.2); abrupt smooth boundary.

A12g-8 to 13 inches; very dark gray (10YR 3/1) heavy silty clay loam, gray (10YR 5/1) dry; many medium prominent yellowish red (5YR 5/8) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many fine and medium tubular pores; few fine black concretions; strongly acid (pH 5.2); clear smooth boundary.

B1g-13 to 19 inches; dark gray (10YR 4/1) silty clay, gray (10YR 6/1) dry; many medium prominent yellowish red (5YR 5/6) and strong brown (7.5YR 5/6) mottles; weak medium prismatic and moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; common very fine roots; many fine and medium tubular pores; many medium black concretions; strongly acid (pH 5.4); gradual smooth boundary.

B22g-19 to 40 inches; dark gray (10YR 4/1) silty clay, gray (10YR 6/1) dry; many coarse prominent yellowish red (5YR 5/6) mottles; moderate medium prismatic structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; common light gray (10YR 7/2) sand coatings on pads; strongly acid (pH 5.4); clear smooth boundary.

B3g-40 to 50 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; common medium and coarse prominent yellowish red (5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; few fine black concretions; strongly acid (pH 5.4); clear smooth boundary.

Cg-50 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; common coarse prominent yellowish brown (10YR 5/6) mottles; massive; hard, firm, very sticky and very plastic; medium acid (pH 5.6).

The solum ranges from 30 to 50 inches in thickness. The horizon has hue of 10YR or 7.5YR and chroma of 1 or 2 moist. Structure is strong to weak granular and very fine subangular blocky.

The B horizon has hue of N, 2.5Y, 5Y or 10YR, and moist value of 3 or 4 in the upper part and 4 or 5 in the lower part. It is clay or silty clay. Structure is moderate to weak prismatic and weak to moderate subangular and angular blocky.

## Wapato series

The Wapato series consists of poorly drained, nearly level soils on flood plains. These soils formed in mixed alluvium. Slopes are 0 to 3 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Wapato silty clay loam, about 2 miles north of Independence, SE1/4SE1/4 sec. 10, T. 8 S., R. 4 W.:

Ap-0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct dark brown (7.5YR 4/4) mottles; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and plastic; few very fine roots; common very fine interstitial pores; slightly acid (pH 6.2); abrupt smooth boundary.

A12-8 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; many fine distinct strong brown (7.5YR 5/6) and dark gray (10YR 4/1) mottles; moderate fine and medium subangular blocky and fine granular structure; hard, friable, sticky and plastic; few very fine roots; many very fine and fine tubular pores; slightly acid (pH 6.2); clear wavy boundary.

B21 g-15 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; many fine and medium distinct reddish brown (5YR 4/4) and strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; slightly acid (pH 6.4); gradual wavy boundary.

B22g-24 to 31 inches; dark gray (N 4/ ) silty clay loam, gray (N 6/ ) dry; many medium and coarse distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; hard, firm, sticky and plastic; many very fine tubular pores; medium acid (pH 6.0); gradual wavy boundary.

B23g-31 to 39 inches; dark gray (10YR 4/1) silty clay loam, light grayish brown (10YR 6/2) dry; many fine and medium distinct yellowish brown (7.5YR 5/6) mottles; moderate fine and very fine subangular blocky structure; hard, firm, sticky and plastic; many very fine and few fine and medium tubular pores; medium acid (pH 6.0); gradual wavy boundary.

B3g-39 to 60 inches; gray (10YR 5/1) silty clay loam, light grayish brown (10YR 6/2) dry; many medium and coarse distinct strong brown (7.5YR 5/6) and yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; hard, friable, sticky and plastic; no roots; many very fine and fine pores; medium acid (pH 6.0).

The A horizon has value of 2 or 3 moist and 4 or 5 dry. Mottles are throughout the A horizon or are only in the lower part.

The B horizon has value mainly of 4 or 5 moist, chroma of 1 or 2, and hue of 10YR or 2.5Y. The upper part of the B horizon has value of 3 in some places. The lower part of the B horizon is stratified thin layers of silt loam or loam in some places.

## Willakenzie series

The Willakenzie series consists of moderately deep, well drained soils on low foothills. These soils formed in colluvium and residuum weathered from sedimentary rock. Slopes are 2 to 45 percent. The mean annual precipitation is about 45 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Willakenzie silty clay loam, 2 to 12 percent slopes, 3 miles southwest of Dallas on County Road No. 848, NE1/4NE1/4 sec. 18, T. 8 S., R. 5 W.:

Ap-0 to 8 inches; dark reddish brown (5YR 3/3) silty clay loam, brown (7.5YR 5/4) dry; moderate fine and medium subangular blocky and moderate fine granular structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid (pH 5.6); clear smooth boundary.

B1-8 to 13 inches; dark reddish brown (5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate coarse and medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine and very fine tubular pores; few thin coatings on peds; medium acid (pH 5.6); clear smooth boundary.

B21t-13 to 19 inches; dark reddish brown (5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few roots; many very fine tubular pores; few thin clay films; medium acid (pH 5.4); clear smooth boundary.

B22t-19 to 26 inches; dark reddish brown (5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few roots; many very fine tubular pores; few thin clay films; medium acid (pH 5.4); clear smooth boundary.

B23t-26 to 33 inches; dark reddish brown (5YR 3/4) silty clay loam, strong brown (7.5YR 5/6) dry; weak medium and coarse subangular blocky structure; hard, firm, very sticky and very plastic; few fine roots; many very fine tubular pores; common thin clay films; few fine weathered siltstone fragments; medium acid (pH 5.4); abrupt wavy boundary.

Cr-33 inches; very pale brown (10YR 8/3) partly weathered siltstone; thick dark red (10YR 3/6) clay films on siltstone fragments.

The paralithic contact of siltstone and sandstone bedrock is at a depth of 20 to 40 inches, and 30 to 40 inches is the most common depth. Hue in the solum generally is 7.5YR, but it ranges to 5YR in the lower part of the B horizon and 10YR in the A horizon.

The A horizon has value of 2 or 3 moist and chroma of 2 or 3 moist and dry.

The Bt horizon has value of 5 or 6 dry and chroma of 4 to 6 dry throughout. Chroma is 4 moist in the upper part and 4 to 6 moist in the lower part. It is clay loam or silty clay loam and is 27 to 35 percent clay. The upper 20 inches of the argillic horizon is less than 15 percent coarser than very fine sand. Clay films range from few to many and thin in the B2t horizon, and commonly become thick and continuous in the fractures of the bedrock.

## Willamette series

The Willamette series consists of deep, well drained soils on broad terraces above the flood plain. These soils formed in silty alluvium. Slopes are 0 to 20 percent. Elevations are 170 to 300 feet. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Willamette silt loam, 0 to 3 percent slopes, about 2 miles northeast of Suver, NW1 /4 sec. 28, T. 9 S., R. 4 W.:

Ap-0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many very fine interstitial pores; medium acid (pH 6.0); abrupt smooth boundary.

A12-10 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine and medium interstitial pores; medium acid (pH 6.0); clear smooth boundary.

A3-18 to 26 inches; dark brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; hard, friable, sticky and slightly plastic; common very fine roots; many medium pores; medium acid (pH 5.8); clear smooth boundary.

B21t-26 to 39 inches; dark yellowish brown (10YR 3/4) silty clay loam, brown (10YR 5/3) dry; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and medium pores; common thin clay films; medium acid (pH 5.8); clear smooth boundary.

B22t-39 to 52 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; few faint dark brown mottles; weak coarse prismatic and moderate medium and coarse

subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many fine and medium pores; common moderately thick clay films on ped surfaces and in pores; common fine black stains on peds; slightly acid (pH 6.4); gradual smooth boundary.

B3t-52 to 69 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many fine pores; few thin clay films on peds and few moderately thick clay films in pores; slightly acid (pH 6.4).

The A horizon has chroma of 2 or 3 moist or dry and value of 4 or 5 dry.

The Bt horizon has value of 3 or 4 moist and 5 or 6 dry and chroma of 3 or 4 moist or dry. The Bt horizon is silty clay loam or heavy silt loam and is 25 to 35 percent clay. Faint mottles that have chroma of more than 2 are at a depth of 30 to 40 inches in some places, and distinct mottles are at a depth below 40 inches in other places.

## Witzel series

The Witzel series consists of shallow, well drained soils on low foothills. These soils formed in colluvium weathered from basic igneous rock and mixed with some loess. Slopes are 3 to 50 percent. The mean annual precipitation is about 50 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Witzel very stony silt loam, 12 to 50 percent slopes, 2 miles southwest of Salem, NW1/4NE1/4 sec. 30, T. 7 S., R. 3 W.:

A1-0 to 4 inches; dark reddish brown (5YR 3/3) very stony silt loam, dark reddish brown (5YR 4/3) dry; strong fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine interstitial pores; 30 percent gravel sized basalt fragments; medium acid (pH 6.0); clear smooth boundary.

B21-4 to 8 inches; dark reddish brown (5YR 3/3) very cobbly clay loam, reddish brown (5YR 4/4) dry; moderate very fine and fine subangular blocky structure; slightly hard, friable, sticky and plastic; common fine and medium pores; 60 percent cobbles and gravel sized basalt fragments that are partly weathered on surface; medium acid (pH 6.0); clear wavy boundary.

B22-8 to 17 inches; dark reddish brown (5YR 3/4) very cobbly clay loam, reddish brown (5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; few medium roots; common very fine and fine tubular pores; 50 percent cobbles and 30 percent pebbles that are partly weathered on surfaces; medium acid (pH 6.0); abrupt wavy boundary.

IIR-17 inches; hard basalt; partly weathered surfaces on fractures of basalt; a few thin tongues of soil material from the B22 horizon.

The thickness of the soil and depth to bedrock ranges from 12 to 20 inches. The control section generally is more than 50 percent coarse fragments, but coarse fragments range from 35 to 70 percent.

The A horizon has a hue of 7.5YR to 5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and 2 to 4 dry. Structure is moderate or strong granular or very fine subangular blocky.

The B horizon has hue of 7.5YR or 5YR, value of 4 or 5 dry, and chroma of 2 to 4 moist and 3 or 4 dry. It is silty clay loam or clay loam and is 50 to 75 percent gravel, stones, and cobbles. Structure is weak to moderate subangular blocky or granular.

## Woodburn series

The Woodburn series consists of deep, moderately well drained soils on broad terraces. These soils formed in silty alluvial deposit. Slopes are 0 to 20 percent. The mean annual precipitation is about 42 inches, and the mean annual air temperature is about 53 degrees F.

Typical pedon of Woodburn silt loam, 0 to 3 percent slopes, about 1-1/2 miles east of Suver, NE1/4SE1/4 sec. 33, T. 9 S., R. 4 W.:

Ap-0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; strong fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid (pH 5.8); abrupt smooth boundary.

A12-9 to 17 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; medium acid (pH 5.8); clear wavy boundary.

B1-17 to 23 inches; dark brown (10YR 3/3) heavy silt loam, pale brown (10YR 6/3) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; common clean fine sand and silt coatings on ped surfaces; medium acid (pH 6.0); clear smooth boundary.

B21t-23 to 29 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common medium distinct yellowish brown (10YR 5/6) and dark grayish brown (10YR 4/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few very fine roots; many fine and medium

tubular pores; common clean fine sand and silt coatings on ped surfaces; common thin dark brown clay films on ped surfaces and in pores; few fine concretions and few medium black stains; medium acid (pH 6.0); clear smooth boundary.

B22t-29 to 42 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common medium distinct yellowish brown (10YR 4/6) and grayish brown (10YR 4/2) mottles and few distinct dark reddish brown and black mottles; weak medium prismatic structure parting to strong coarse subangular blocky; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; common thin and moderately thick clay films on ped surfaces and in pores; common medium black stains; slightly acid (pH 6.2); clear smooth boundary.

B23t-42 to 52 inches; dark brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common fine distinct dark brown (10YR 3/3) and dark reddish brown (5YR 3/4) mottles; weak coarse subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine tubular pores; few moderately thick clay films on ped surfaces and in pores; common fine sand coatings on ped surfaces; slightly acid (pH 6.2); clear smooth boundary.

B3t-52 to 65 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; common fine distinct dark brown (10YR 3/3) and dark reddish brown (5YR 3/4) mottles; weak coarse prismatic structure; hard, firm, sticky and plastic; common fine pores; few moderately thick clay films in pores; common medium black stains; common fine sand coatings on ped faces; slightly acid (pH 6.2).

The A horizon to a depth of 10 inches or more has value of 2 or 3 moist and 4 or 5 dry and chroma of 2 or 3 moist and dry.

The B2t horizon has chroma of 2 or 3 moist and hue of 10YR or 7.5YR. It is heavy silt loam or silty clay loam and is 20 to 30 percent clay. Distinct mottles that have chroma of 2 or less are at a depth of 20 to 30 inches.

## Xerochrepts

These deep soils are along streams where drainageways have incised into valley terraces. They formed in loamy material. Slopes are 20 to 60 percent. The mean annual precipitation is 40 to 80 inches, and the mean annual air temperature is 52 degrees F.

A reference profile representing a Xerochrept from an area of Xerochrepts and Haploxerolls, steep, is about 2 1/2 miles east of Suver, NW1/4NW1/4 sec. 34, T. 9 8., R. 4 W.:

A11-0 to 5 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium granular structure; slightly hard, slightly sticky and slightly plastic; many very fine roots; many very fine pores; medium acid (pH 5.8); clear smooth boundary.

A12-5 to 12 inches; dark yellowish brown (10YR 3/4) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; slightly hard, slightly sticky and slightly plastic; many very fine roots; many very fine pores; medium acid (pH 5.8); clear smooth boundary.

B1-12 to 21 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine and medium subangular blocky structure; slightly hard, slightly sticky and slightly plastic; common very fine roots; common very fine pores; meidum acid (pH 5.6); clear smooth boundary.

B21-21 to 34 inches; dark yellowish brown (10YR 4/4) heavy silt loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, sticky and plastic; common very fine roots; common very fine pores; medium acid (pH 5.6); clear smooth boundary.

B22-34 to 45 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; slightly hard, slightly sticky and slightly plastic; few very fine roots; few very fine pores; medium acid (pH 5.6); clear smooth boundary.

IIC-45 to 61 inches; dark yellowish brown (10YR 4/4) loam, light yellowish brown (10YR 6/4) dry; common fine distinct dark grayish brown (10YR 3/2) mottles; weak coarse subangular blocky structure; slightly hard, slightly sticky and slightly plastic; few very fine pores; medium acid (pH 5.6).

## Xerofluvents, loamy

These alluvial soils are well drained to excessively drained. They formed in stratified alluvial material. Slopes are 0 to 3 percent. The mean annual precipitation is about 60 inches, and the mean annual air temperature is about 50 degrees F.

A reference profile representing Xerofluvents, loamy, is about 4 miles south of Buell, SW1/4 sec. 18, T. 7 S., R.6 W.:

A11-0 to 6 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine pores; slightly acid (pH 6.3); clear wavy boundary.

A12-6 to 17 inches; dark yellowish brown (10YR 3/4) loam, brown (10YR 5/3) dry; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine pores; slightly acid (pH 6.3); clear wavy boundary.

AC1-17 to 28 inches; yellowish brown (10YR 3/4) fine sandy loam, brown (10YR 5/3) dry; single grained; soft, very friable, nonsticky and nonplastic; common medium roots; many very fine pores; slightly acid (pH 6.3); clear wavy boundary.

AC2-24 to 42 inches; dark yellowish brown (10YR 3/4) loamy fine sand, yellowish brown (10YR 5/4) dry; single grained; loose; few fine roots; many fine pores; 10 percent pebbles; slightly acid (pH 6.4); abrupt wavy boundary.

IIC2-42 to 62 inches; variegated dark yellowish brown (10YR 3/4), brown (10YR 4/3), and dark grayish brown gravelly sand; single grained; loose; common fine pores; 30 percent pebbles; medium acid (pH 5.8).

## Yellowstone series

The Yellowstone series consists of shallow, well drained soils on mountainous uplands of the Coast Range. These soils formed in gravelly and cobbly residuum and colluvium weathered from igneous rock. Slopes are 3 to 90 percent. The mean annual precipitation is about 135 inches, and the mean annual air temperature is about 43 degrees F.

Typical pedon of Yellowstone stony loam, 3 to 30 percent slopes, about 1/2 mile northwest of Riley Peak, SE1/4NE1/4 sec. 12, T. 8 S., R. 8 W.:

A1-0 to 4 inches; dark ;reddish brown (5YR 3/3) stony loam, reddish brown (5YR 5/3) dry; strong very fine granular structure; nightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 20 percent pebbles and stones; strongly acid (pH 5.2); clear smooth boundary.

B2-4 to 13 inches; dark reddish brown (5YR 3/3) very gravelly loam, reddish brown (5YR 5/4) dry; moderate fine granular arid subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 55 percent pebbles Viand cobbles; very strongly acid (pH 4.8); clear wavy boundary.

C-13 to 18 inches; dark reddish brown (5YR 3/4) very gravelly loam, reddish brown (5YR 5/4) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; 70 percent pebbles and cobbles; very strongly acid (pH 4.8); abrupt wavy boundary.

R-18 inches; fractured diorite.

Bedrock is at a depth of 10 to 20 inches. The weighted average of rock fragments. is 35 to 60 percent in the control section.

The A horizon has hue of 7.5YR or 5YR, value of 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and dry. It is 20 to 50 percent rock fragments.

The B2 horizon has hue of 7.5YR or 5YR, value of 3 or 4 moist and 4 or 5 dry, and chrome of 3 or 4 moist and dry. It is 35 to 70 percent rock fragments.

The C horizon has hue of 7.5YR or 5YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 or 4 moist and dry. It is 50 to 75 percent rock fragments.

## Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*27*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 16, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol.* An example is Inceptisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Umbrept (*Umbr*, meaning a dark colored surface horizon, plus *ept*, from Inceptisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplumbrepts (*Hapl*, meaning simple horizons, plus *umbrept*, the suborder of Inceptisols that have an umbric epipedon).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some

properties that are representative of the great groups 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 is thought to typify the great group. An example is Typic Haplumbrepts.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic, Typic Haplumbrepts.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

## Formation of the soils

Soil is formed and horizons are developed when the environmental factors of climate, biological forces, relief, and time interact with the parent material. The formation of each soil and its characteristics are affected by these factors (*5, 20, 21*), which are individual, but interdependent agents. The influence of these factors on the kind and degree of soil formation varies from place to place. These factors react in different intensities and combinations from one area to another. In some places, one or two factors may be dominant; for example, the influence of climate affects the type of plants and the amount of water available for the weathering of the parent rock material. In other areas, relief will be the dominant factor in soil formation, and its influence on erosion, runoff, and internal drainage is reflected in soil formation. Time is a measure of the amount of change produced by the combination and intensity of the other soil-forming factors. These factors and their effect on the soils in Polk County are discussed in the paragraphs that follow.

### Climate

Climate has a strong influence on soil formation. Temperature and precipitation affect the rate rocks are weathered into parent material and organic matter is decomposed.

Polk County has a modified marine climate that varies considerably within the county. There are three climate zones: Willamette valley floor and the lower foothills and steep uplands of the Coast Range.

Polk County has a Pacific coastal climate characterized by winter precipitation (13). About 70 percent of the annual precipitation occurs from November through March, and less than 5 percent falls from June through August. In the agricultural areas, nearly all the winter precipitation is rain. Only on the highest peaks of the steep uplands of the Coast Range can any significant amount of snow regularly be expected each year. Summers are moderately warm and moderately dry, and winters are cool and wet. Annual precipitation is adequate to saturate the soils and recharge the deep water table.

On the Willamette Valley floor, plant growth is rapid on deep soils late in spring; it continues at a reduced rate throughout the summer and increases with the rains in September. The shallow soils are generally dry, however, by the middle of July, and the moderately deep soils, by August. Decomposition of organic matter is hastened by adequate moisture, mild winters, and warm springs. The oxidation, or loss, of organic matter is offset by the long growing season, lush vegetative growth, lack of moisture, and cool nights in summer and fall. As a result, the accumulation of organic matter in Polk County is moderate.

Precipitation gradually increases from the valley floor west into the low foothills. On the valley floor, it is 40 to 45 inches. It ranges from 40 inches along the foot slopes of the foothills to 60 inches on the upper slopes. On the steep uplands, precipitation ranges from 60 to 120 inches. The soils in these two areas seldom freeze to a depth of more than a fraction of an inch.

The soils that formed under the mild sub-humid climate of the valley are less leached and have a higher base saturation than soils on the low foothills and mountainous uplands, which are strongly acid to very strongly acid. Climatic variation from the valley to the low foothill areas is not sufficient to account for all the differences between the soils because the differences also are related to other soil-forming factors.

In the foothills and steep uplands of the Coast Range in the western part of Polk County, the elevation increases from east to west. It ranges about 250 feet on the mainly valley terrace to an average of 1,500 feet in the foothills. Some mountain peaks have an elevation of 2,500 to 3,400 feet. As the elevation increases, the annual precipitation increases steadily from 40 to about 180 inches, and the average annual air temperature decreases from about 54 degrees to 42 degrees F at the highest elevations.

Vegetation and climate are closely related to the soils. The effects of the higher precipitation and lower temperatures are reflected in the kind of vegetation, which influences the kinds of soils that are formed. Vegetation changes from grasslands in the valley to coniferous forests in the uplands. The organic-

matter content in the upper part of the A1 horizon is higher in soils at the higher elevations because lower temperatures and higher precipitation combine to produce dense stands of vegetation.

The soils on the steep uplands have little textural differentiation (*4*) within the soil because the higher precipitation probably has removed much of the fine silt and clay from the soil. These soils are seldom dry. The structural formation of the subsoil is weaker in these soils than in soils that are subject to periodic drying, which promotes stronger development. These soils have been leached of many of the soluble bases (*15*) and, therefore, they are strongly acid to very strongly acid.

## Biological forces

Man, plants, animals, and organisms have materially affected the kind of soils that have formed in Polk County. The soil-forming factors of parent material, relief, time, and climate have influenced the kinds of plants and animals that occupy a soil.

The soils of Polk County formed under several distinct types of vegetative cover. Soils on the main valley floor and the adjacent flood plain formed under a cover of grass and sedges. These soils have a thick, dark-colored surface layer that is high in organic-matter content, and they have high base saturation. The influence of this grassy cover is reflected, for example, in Willamette, Woodburn, Malabon, and Chehalis soils.

The native vegetation in the foothills was mixed stands of Douglas-fir, grand fir, and oak interspersed with openings of brush and grass. Soils that formed in these areas are thinner, and have a lighter colored surface layer and a lower base saturation. They are more strongly acid than soils that formed under grass. Some of these are Jory, Nekia, and Bellpine soils.

On the steep uplands, the native vegetation was dense stands of Douglas-fir, alder, and bigleaf maple (*12*). Soils formed under this cover have a thin surface layer, a low base saturation (*15*), and they are strongly acid to very strongly acid. Blachly, Marty, and Klickitat soils are representative.

Stems, leaves, roots, and twigs from many different kinds of plants are decomposed by such soil organisms as bacteria and fungi. This decomposed organic residue is mixed into the surface layer by worms, insects, and small animals.

Organic matter improves soil structure and increases the water intake and water-holding capacity of a soil. It is an important source of plant nutrients. The biochemical action of organic soil solutions that contain organic acids is important in the weathering of rocks and minerals into the parent material.

The native vegetation in Polk County originally provided a protective cover. After the soils were cleared and tilled by man, however, soil formation under this natural cover was disrupted and man's influence was reflected. In many instances, this influence resulted in improvement by drainage, fertilization, and cultivation; in other cases, the changes resulted in decreased organic-matter content and severe erosion.

## Relief

Relief is described as the difference in elevation within an area. It has a strong influence on soil formation (*24*). Relief may modify the forces of climate because of slope gradient, the shape of slopes, and the exposure or aspect of slopes. These features affect the rate of runoff, evaporation, and internal drainage of the soil. In nearly level or depressional areas, the soil is ponded or water runs off very slowly, which allows more moisture to enter and percolate through the soil. On steeper slopes of the same parent material (*6*), water runs off more rapidly and less enters the soil. This relationship directly affects the kinds of soils that are formed and the type and amount of vegetation that will grow on them.

The recent flood plains in Polk County have low relief and are subject to frequent flooding. This results in removal and redeposition of materials, the abandonment of old channels, and cutting of new channels (5). The topography on the flood plain is undulating, and the maximum relief is about 10 feet. It is produced by water's channeling during overflow.

The main valley floor typically is nearly level and has little appreciable local relief. Differences in elevation generally do not exceed 2 or 3 feet. The surface drainage pattern is not well developed, and surface runoff is often very slow or the soil is ponded. The soils, therefore, are mainly moderately well drained to poorly drained (*5, 19* ).

On the low foothills and old high terraces adjacent to the valley floor, broad tops are gently sloping to moderately sloping, and ridges break into steep side slopes. Runoff varies with the slope gradient. Alluvial fans, foot slopes, and pediments from these hills gradually merge with the valley floor. These soils are shallow to deep.

The steep, dissected uplands rise abruptly above the low foothills. They are characterized by pronounced local relief; side slopes are very steep and ridges are narrow to broad and moderately sloping. The uplands have been incised by narrow tributary valleys. Many slopes are unstable, and active erosion and mass movement occur in the steeper areas (*6*). Soils on uplands range from shallow to deep.

## Time

Time is measured by the rate and degree of soil formation caused by the interaction of the other soil-forming factors on the raw geologic or parent material. Absolute ages for soils may be obtained by radiocarbon dating of buried wood. The number,

arrangement, and kind of soil horizons indicate the degree of formation of a soil and its relative age or maturity.

In general, the soils of Polk County show increasing development with the increasing age of the geomorphic surface and related parent material (*21, 19*). The youngest soils formed in recent stratified alluvium along rivers and streams. These soils have very weakly expressed horizon development. The accumulation of organic matter and weak structural development are the only evidences of soil formation (*5*). Newberg, Camas, and Cloquato are soils that formed in those materials. The more mature soils have formed in sediment on somewhat higher terraces and in older parent material. These soils have well developed horizons of clay accumulation (*18, 5*) and have an argillic horizon. Willamette, Woodburn, Coburg, and Amity are soils that formed in terrace sediment.

The foothills that have broad rounded ridges and tops are stable surfaces (*17*). Soils. that have moderate to strong textural and structural development formed in these old, intensively weathered residual and alluvialcolluvial material. Jory, Belipine, and Hazelair are soils that formed in these areas.

On steep, dissected uplands, the land surfaces are unstable and are subject to active erosion. Soils that formed in this alluvial-colluvial material exhibit weak to moderate textural development (*6, 17*). Klickitat, Valsetz, and Luckiamute soils are examples.

## Parent material

Parent material is a product of the weathering of rock fragments that have been altered to various degrees. It is the unconsolidated material that underlies the soil at various depths. Parent material is identified and described by its geologic origin and mineral composition (*24*). Soils in Polk County formed in a wide range of parent material: recent alluvium, terrace sediment, old gravelly alluvium, sandstone and siltstone formations, basalt flows, and intrusive rocks (fig. 17).

Recent alluvium is the main kind of parent material along river and stream bottoms. This sediment was derived from material of mixed mineralogy. Some materials are from local alluvium that has been transported only short distances. The alluvium along major streams and rivers, however, has been moved considerable distances. This alluvium ranges from gravel to clay. Some soils that formed in recent alluvium are Chehalis, Newberg, Camas, Brenner, and Bashaw soils.

Terrace sediment on the main valley floor consists of thick deposits of stratified sediment that ranges from silt to clay (*5, 18*). This material was deposited by water late in the Pleistocene Age. The initial textural and mineralogical differences in these materials (*22, 5*) resulted in soils that reflect these differences in their chemical and physical characteristics. Amity, Dayton, Willamette, and Woodburn are examples of soils that formed in these deposits. Malabon and Coburg soils formed in the more recent sediment on younger terraces.

Old gravelly alluvium composed of well weathered gravel of mixed sedimentary and volcanic rocks occur as terrace remnants along the lower slopes of foothills. These materials have been covered with a more recent deposit of silt 2 to 3 feet deep. Salkum soils formed in these materials.

The sandstone and siltstone formation consists of a thick sequence of rhythmically bedded sandstone and sandy siltstone. It is present throughout the county (*3, 4*). This formation extends from the valley foothills into the deeply dissected Coast Range. The sandstone and siltstone are composed of micaceous, arkosic and basaltic debris and occasional beds of lime that have a matrix of clay mineral. The rock is about 20 to 30 percent quartz minerals, 30 to 40 percent plagioclase, and 10 percent mica and fragments of volcanic rocks (*3, 4, 25*). This soft sedimentary rock weathers rapidly, and the effect of the parent material is reflected in the soil characteristics. The morphology of the soils indicates that many of their parent materials were colluvial. Astoria, Apt, Bellpine, and Suver soils formed in this material.

The basalt flows are the oldest rock exposed in the county. They consist of a thick sequence of basalt flows composed of pillow lavas, flow breccias, and pyroclastic material (*3*). The tuffaceous siltstone is a member of this formation although the predominant rock is basalt. The basalt ranges from hard unweathered rock to almost completely weathered soft saprolite *(4, 17*). The partly weathered basalt saprolite is brownish to yellowish gray. These materials are on the low foothills and extend into the steep dissected mountainous area of the Coast Range. Many of the soils associated with this formation formed in alluvial and colluvial material as a result of the active erosion on steeper slopes (*6, 17*). Blachly, Jory, Kilchis, Klickitat, and Ritner soils are some that formed in basaltic material. Dikes and sills composed of gabbro and diorite intrusives cut the sedimentary rock formation. Nearly all of the higher peaks are capped by sills of these rocks (*3*). Many dikes and intrusive rocks are throughout the center of the county. The sedimentary rocks adjacent to the larger intrusive masses have been indurated by extreme heat as a result of volcanic activity. Plagioclase feldspar is the most common mineral and makes up to 40 to 60 percent of most of the rocks. Marty, Cruiser, and Valsetz soils formed in these materials.

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## Glossary

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

**Area reclaim.** An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping 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 | More than 9 |

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

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

**Bottom land.** The normal flood plain of a stream, subject to frequent flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Capillary water.** Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

**Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

**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 coat, clay skin.

**Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Coarse fragments.** Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

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

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

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

**Complex slope.** Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

**Complex, soil.** A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

**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 (or contour farming).** 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 40 or 80 inches (1 or 2 meters).

**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.** Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

**Depth to rock.** Bedrock at a depth that adversely affects the specified use.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation 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. Dome are so steep that much of the water they receive are lost as runoff. All are free of 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 the roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*- Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly perivious 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 periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*-Water *is* removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

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

**Erosion.** The wearing away of the land surface by running 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 a bare surface.

**Excess fines.** Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

**Fast Intake.** The rapid movement of water into the soil.

**Favorable.** Favorable soil features for the specified use.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

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

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Flooding.** The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May,* for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and

marches is not considered flooding.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forage.** Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

**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.

**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.

**Gravelly soil material.** Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Green manure** (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Habitat.** The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or graphical distribution.

**Hardpan.** A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

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

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

*A horizon.*-The mineral horizon, formed at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon moist of which was originally part of a B horizon.

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

*B horizon.*-The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

*C horizon.*-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

*R layer.*-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**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 stow 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.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**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.

*Furrow.*-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*-Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*-Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Landslide.** The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones.** Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Light textured soil.** Sand and loamy sand.

**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.** Inadequate strength for supporting loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous areas.** Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

**Moderately coarse textured (moderately light textured) soil.** Sandy loam and fine sandy loam.

**Moderately fine textured (moderately heavy textured) soil.** Clay loam, sandy clay loam, and silty clay loam.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance-*few, common, and many,* size-*fine, medium, and coarse;* and contrast-*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of the three single variables-hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3.

**Nutrient, plant.** Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

**Parent material.** The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**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.** The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the 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 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and *very rapid* (more than 20 inches).

**Phase, soil.** A subdivision of a soil series or other unit in the soil classification system based on differences in

the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

**pH value.** (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

**Piping.** Moving water of subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**Poorly graded.** Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Poor outlets.** Surface or subsurface drainage outlets difficult or expensive to install.

**Productivity** (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

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

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as-

| | pH |
|---|---|
| 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 accumulates over disintegrating rock.

**Rill.** A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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

**Rooting depth.** Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Runoff.** The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Saprolite** (geology). Soft, earthy, clay-rich, thoroughly decomposed rock formed in place by chemical weathering of igneous and metamorphic rock. In soil survey, the term saprolite is applied to any unconsolidated residual material underlying the soil and grading to hard bedrock below.

**Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

**Seepage.** The rapid movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silica.** A combination of silicon and oxygen. The mineral form is called quartz.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Siltstone.** Sedimentary rock made up of dominantly siltsized particles.

**Site Index**. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

**Slickensides**. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**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**. The slow movement of water into the soil.

**Slow refill**. The slow filling of ponds, resulting from restricted permeability in the soil.

**Small stones**. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

**Soil.** A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates**. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very *coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand (1.0* to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); very *fine sand (0.10* to 0.05 millimeter); silt (0.05 to 0.002 millimeter); and clay (less than 0.002 millimeter).

**Solum**. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

**Stone line**. A concentration of coarse fragments in soils that generally marks an old weathering surface. In a cross section, the line may be one fragment or more thick. The line generally overlies material that weathered in place and marks the top of a paleosol. It is ordinarily overlain by recent sediment of variable thickness.

**Stones**. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Stratified.** Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

**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 that are separated from adjoining aggregates. The principal forms of soil structure are-platy (laminated), pris*matic* (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, to provide protection from soil blowing 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.

**Surface soil**. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**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 or management.

**Terrace (geologic).** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

**Texture, soil**. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand,

may be further divided by specifying "coarse," "fine," or " very fine."

**Thin layer.** Otherwise suitable soil material too thin for the specified use.

**Tilth, soil.** The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Water-supplying capacity.** Water stored in the soil at the beginning of plant growth in the spring, plus rainfall not in excess of evapotranspiration during the growing season, less runoff.